2.3. Social learning for deliberative policy-making

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This chapter continues to explore the problems of knowledge generation and use in the context of environmental policy process. It discusses social learning as the central components of the learning process in social-ecological systems, and uses a case study of climate change adaptation in the Broads ecosystem in order to illustrate how social knowledge contributes to address policy-making and – implementation challenges, such as issues of mismatches, ignorance and plurality of scales and levels.

2.3.1. Social learning — the policy context

To successfully address the complexity of global environmental change and societal responses to it and diversity of perspectives, pluralism in ideas and approaches is required (cf. (Functowicz & Ravetz, 1993; Kates et al., 2001; Turner II et al., 2003). Through participation of various collective and individual actors, different types of knowledge and information can be integrated and the plurality addressed (Arnstein, 1969; Blackstock et al., 2007; Dryzek, 2000; Fischer, 2000; O'Neill, 2001; Rauschmayer & Wittmer, 2006; Renn et al., 1995; Stirling, 2004).

The concept of *social learning* arguably has large potential for analytical understanding the processes and driving forces behind the changes of policies and practices in society. At the operational level, social learning concepts is applied to advise upon the initiation and facilitation of collaborative processes for climate change adaptation amid complexity and uncertainty (cf. King & Jiggins, 2002; NRC, 1999; Pahl-Wostl et al., 2008). In general terms, social learning aimed to address the challenges of changing climate can be described as "processes of agent and institutional reconfiguration derived from a conscious awareness and willingness to act and deal with the common problem [of climate change]" (Tàbara et al., 2009). Over time, participants can develop and change mechanisms and procedures for overcoming the past, present and forthcoming challenges of climate governance e. g. effectively bridging scales and levels for climate change adaptation.

There is an increasing number of studies exploring social learning from both theoretical perspective (e. g. Ison et al., 2004; Pahl-Wostl et al., 2007a; Pahl-Wostl & Hare, 2004) or from operational point of view analyzing empirical evidences of learning in environmental decision-making (Pahl-Wostl, 2006; Pahl-Wostl et al., 2007b). A number of studies recently emerged that addressed the entangled issues of scales, information, and knowledge (e. g. Cash et al., 2006), and highlighted the need for social learning to span scales and levels.

2.3.2. Social learning for climate change adaptation

Numerous definitions exist of the meaning of learning. Here we draw on the work of Siebenhüner (2002a) who proposes to understand learning as "*a process of long-lasting change in the behavior or the general ability to behave in a certain way that is founded on changes of knowledge*". The knowledge gained in this process, according to Siebenhüner, can then be of either substantive or procedural nature. *Substantive knowledge* involves the actual problems considered, and the details and level of integration of the analysis. *Procedural knowledge* refers to how the process is designed, including which actors are involved, which methods of collaborative problem solving are employed, and how complexity and uncertainty is dealt with.

CAs long as adaptation requires processes of co-production and application of knowledge between various actors, learning must therefore not only occur at the level of individuals, but rather at the level of the collective body of individuals involved. The idea of collective, organizational, or social learning has being developed and explored in the social sciences since about three decades to describe changes at the level of collectives (e.g. organizations) and society at whole. Major advances in inquiry into social learning have been made in the fields of psychology (Bandura, 1977), organization theory (Argyris & Schön, 1978, 1996), and policy and development studies (Dunn, 1971; Hall, 1993; Heclo, 1974). In this literature, social learning is understood as going beyond the composition of individual learning processes in that it also includes alterations of processes and shared knowledge, based on the contributions of members of the collective body i. e. “society”(cf. Siebenhüner, 2002a).

Various scholars have pointed to the different kinds of social learning processes that can occur. Drawing upon earlier research on organization learning by Argyris and Schön (1978), recent studies (ADAM, 2007; Hall, 1993; Pahl-Wostl & Hare, 2004; Siebenhüner, 2002a, b) differentiate *single-loop*, *double-loop*, and, in several cases *deutero* (Argyris & Schön, 1978) or *triple-loop* (King & Jiggins, 2002) learning. Single loop learning refers to the simple adaptation of new knowledge to the existing knowledge base. Double-loop learning takes place when learning also leads to alterations of the underlying theory of action, including the objectives, values, norms, and belief structures. Deutero learning happens on a meta-level and considers the ability to learn itself. The upper levels of learning are believed to be most substantive but also most difficult to achieve that also explains relatively little evidences of double- and especially triple-loop learning (Hall, 1993; Siebenhüner, 2002a).

Recent studies by Mostert et al. (2007) and Pahl-Wostl and Hare (2004) conceptualized social learning as an open-ended, iterative process that may involve several cycles and stages. At its core is a *process* (1) of interaction and collaboration between multiple actors that is influenced by the specific *context* (2), and results in *outcomes* (3) in a form of practical action, policy responses or behavioral changes. The context may include internal (structural and cultural) and contextual or external factors (Siebenhüner, 2002a).

Assessing the outcomes of social learning is not easy. Some commentators consider changes in practices (i.e. actions, policies) and behaviors of the actors as indicators of social learning (Hall, 1993; Siebenhüner, 2002a). For example, Siebenhüner (2002a, b) proposes to look for “crucial learning events” in which past experiences are reflected and incorporated into changes of the design of collaborative assessment, planning, and implementation efforts. According to this view, successful social leaning means that a specific policy or management goal was achieved (Heclo, 1974; Siebenhüner, 2002a). Others stress the spontaneous character of learning processes (ADAM, 2007) and suggest the rather abstract notion of “enhanced capacity of the social-ecologic system to cope with sustainability challenges” should be seen as ultimate goal of a learning process

(Folke et al., 2003; Tompkins & Adger, 2004). Both positions, however, are complementing each other. For example, social learning can be successful if the actors achieved a specific goal of considering new information they possess. At the same time it also matters if this new knowledge was taken into account and had been used to enhance capacity of the actors to address sustainability challenges.

In this light, the concept of social learning is increasingly applied in the study of and consultancy for processes and dynamics of collaborative knowledge production and decision making of multiple actors on natural resources' management and sustainable development issues (cf. NRC, 1999; Pahl-Wostl, 2006; Pahl-Wostl et al., 2007a; Pahl-Wostl & Hare, 2004; Social Learning Group, 2001a, b). Extending the focus of learning processes from specific organizations or policy issues towards the evolution of complex social-environmental systems brings new challenges and opportunities to "learning societies". In this broader understanding, social learning cannot be reduced to mere transfer of information between the actors but should be seen as taking place in a wider environmental and social context (Folke et al., 2003; Mostert et al., 2007; Pahl-Wostl et al., 2007a; Tompkins & Adger, 2004).

Therefore, the focus of learning processes for sustainability should be on "developing adaptive cross-sectoral capacities and new types of knowledge" to address the problems which are persist rather due to our poor understanding of the structure of socio-environmental systems than in the mere lack of knowledge about ecosystems and their reaction to human intervention (Pahl-Wostl et al., 2008).

2.3.3. Conceptualizing Social Learning for Bridging Scales and Levels

The different but complimentary perspectives on sustainability decision-making reflected by the concept of scales and levels and the concept of social learning may supplement each other in grounding the efforts by society on climate adaptation. Looking at the history of action and decision-making through the prism of "social learning" helps to understand and, possibly, to facilitate dynamics of social processes towards more adaptive planning and actions. At the same time, reflecting on the problems, capacities and interests associated with different scales/levels sheds light on the structures of socio-environmental systems and related problems, therefore, helps to set up specific targets for social learning processes.

It can be argued that processes of social learning are needed to improve the cross-scalar and multi-level climate adaptation assessment and. First, bridging scales and levels is most often an unprecedented effort related to new challenges of complex decision-making in the field of environment and sustainable development. Society needs to accumulate knowledge on complexity of issues related to multi-level structures of social-environmental systems and experience on how to address this complexity. Through social learning, appropriate strategies can be identified, tested, and further developed over time. Second, our understanding of the complex cross-scalar and multi-level dynamics of many environmental issues is constantly evolving. Only continuous learning processes of all affected actors will allow to identify and to respond to changing conditions.

For the sake of simplicity in explanations, social learning can be considered as successful when the participants of the climate change adaptation process increase their joint capacities or general ability to integrate cross-scalar and multi-level interactions in their research and implementation activities. Along these lines, substantive knowledge involves information about the dynamics and interactions of phenomena at and across different levels and scale. Procedural knowledge deals with the way the process of integrating information is designed and the approach used to facilitate cross-scale and multilevel co-production of knowledge. Single loop learning occurs if information from another level or scale is integrated that has not been considered before. Double loop learning happens if the learning process has led to significant alterations of the processes and structures of integration.

To analyze in detail how social learning could help in bridging scales and levels in climate change adaptation, we can draw on Cash et al.'s (2006) three main challenges for bridging mentioned above. Table 2.1 describes how social learning could contribute to addressing each of the challenges. The table summarizes, first, how social learning may help to identify the problems and the gaps related to the particular challenge, and, second, how learning process may lead toward solutions to address these problems and gaps.

Table 2.1

Social learning for addressing challenges for cross-level and cross-scale interaction

Challenges	Potential contributions of Social Learning (SL) for addressing the challenges
Ignorance	– SL can help to identify levels and scales that was previously not considered (either because of lack of knowledge that they exist or reluctance to take them into account); – SL can help to identify the links between levels and scales that actors were not aware or might have ignored if they had acted individually; – during the process of SL actors may find out or develop ways to take into account levels and scales that have been previously ignored
Mismatch	– SL can help to identify mismatches in the way how the problem is addressed (e. g. lack of fit between biogeophysical system and social institutions, between long-term objectives and short terms of policy objectives, etc.) and possible risks associated with them for decision-making; – SL may help to identify mismatches between knowledge production (e. g. content and form it is presented) and type of knowledge needed for credible and legitimate decision-making; – SL can enhance developing the knowledge and know-how necessary to fit institutions to levels of problems (if we learn from previous failures or predicted problems)
Plurality	– SL can help identify the actors associated with different levels and scales, their interests and visions on the problem (e. g. identifying and transferring local visions into scenarios based on global environmental models and vice versa); – SL is explicitly attuned to facilitate discussion among various actors that may support informational exchange and communicate plurality of visions and interests and contribute to possible solutions

Following the argumentation of Cash and colleagues (2006), it can be suggested that social learning has great importance for developing responses to the problem of levels and scales i. e.: *institu-*

tional interplay, co-management and operation of *boundary organizations*. Remarkably, all three "responses" also play an important role in establishing and facilitation of the learning process in a society. Institutional interplay is necessarily for transfer of information, establishing communications and building trust between the actors (Pahl-Wostl et al., 2008); co-management supports the processes of learning by doing by "communities of practice" and also helps to avoid management overlaps (HarmoniCOP Team, 2005; Pahl-Wostl et al., 2008); and boundary organizations provide an independent platforms for actors' interaction, accumulation and transfer of knowledge and facilitation of the learning processes (Olsson et al., unpublished manuscript, cited by Borowski et al., 2008; Cash et al., 2006; Tàbara et al., 2009). Therefore, social learning processes may use institutional interplay, co-management and boundary organization as a platform for information transfer and communication. At the same time, it is a part of the social learning process to learn how these three responses can be employed more effectively e.g. to enhance cross-scale and cross-level interaction. Therefore we can suggest that institutional interplay, co-management and boundary organizations as such represent rather *potentials* than ready-to-use responses. These potentials may not be necessarily realized and used by society. It is a social leaning process in which society finds how to create, use and improve social responses (e.g. institutional interplay, co-management and boundary organization) for bridging levels and scales.

Evidence from empirical case studies suggests that social learning for cross-scale and multilevel integration is most feasible if it is place based (AAG GCLP Research Team, 2003; Kates et al., 2001; NRC, 1999; Wilbanks, 2003). Developing an understanding of the complex relationships among environmental, economic, and social dynamics seems to be only possible when conducting relatively focused and place-based assessments, integrating various types of knowledge from the global to local scale (NRC, 1999). For example, potentials for adapting to climate change most often strongly depend on locally specific contexts, options, and avenues for action while decisions are often taken at the upper levels of administrative and scientific hierarchy (Burch & Robinson, 2007; Wilbanks, 2007).

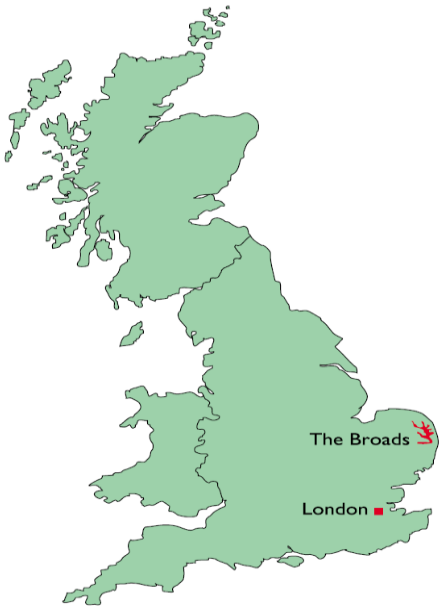
2.3.4. Case study: Climate Change Adaptation in The Broads Ecosystem

The Broads ecosystem is situated in the East Anglia, south-eastern United Kingdom, at the border of the Norfolk and Suffolk regions (Fig. 2.6). It includes the Broads National Park (about 301 km²) as well as adjacent river catchments and coastal zones (Broads Authority, 2004).

The Broads area features of fens, marshes, and shallow lakes (broads) drained by rivers and man-made canals. Due to the great diversity of landscapes and floristic and faunistic species, the ecosystem has been identified as a unique wetland and lowland complex of national and international importance (Natural England, 2008). The ecosystem further includes a mosaic of agricultural lands, industrial and housing areas (water-side villages and peripheral urban lands), and zones of recreational use (boatyards, holiday accommodations, etc.) (Broads Authority, 2004).

The region has a long history of economic development in water related sectors. Traditional economic and recreational activities include agriculture, fishing, tourism, and navigation. Intensive recreational activities and agricultural exploitation of The Broads' landscapes resulted in a notable decrease of environmental quality from the 1950s to the 1970s that threatened nature conservation and wild-life preservation as well as economic activities relying on healthy ecosystems (e. g. tourism). The subsequent implementation of policy measures and significant investments in nature conservation in the area helped to maintain and restore the ecosystem conditions and strengthened its status as one of the most popular recreational sites in UK.

The potential impacts of climate change are among the main current threats for the future of the Broads sensitive ecosystems. Temperature rises of about two to five degrees Celsius are predicted for the next 100 years (Broads Authority, 2004) that, in combination to the natural sinking of the coastline, are expected to cause sea level rise and derogate fresh-water ecosystems through salt-water intrusions.



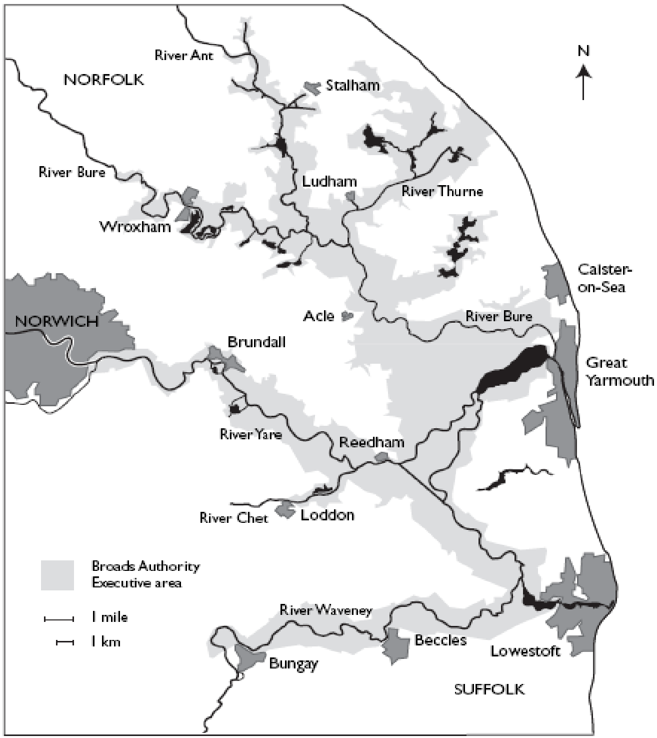


Fig. 2.6. The Broads area: A. The Broads in UK; B. The Broads National Park (Broads Authority, 2004)

Increased magnitude and lowered predictability of river and tidal floods and changing climate patterns will impact land-use and economic activities, including greater demand and lower quality of water for agriculture and tourism. At the same time, new climate conditions may bring opportunities for the area including lengthening of the growing season and wetland creation for biodiversity and recreation (Broads Authority, 2004).

The Broads' history of adaptation to natural disasters is almost as long as the history of human activity in the area (George, 1992). Public and policy awareness of risks of devastating floods was already raised after severe storms in the North Sea in 1937 and 1950. Today, climate change and its possible resulting impact on flood risks is recognized as one of the most important factors influencing economic development from the national to local levels.

The Broads Authority holds management and planning duties in the national park. Besides, management system in the area involves multiple interests and supporting institutions at different levels: EU policies; national legislation on planning and development, sectoral and climate policies and responsible governmental agencies; regional development plans; administrations of the bordering areas and multiple interest groups (wildlife conservation, navigation, business, tourism, land-owners and others) (Fig. 2.6).

In the remainder of this section, we employ the concept for social learning for climate change adaptation as described above to reflect on two decades of actions (e.g. knowledge generation, assessments, planning and implementations) towards more climate-proof development in The Broads. Local climate adaptation cannot be seen as a separate "domain" but only in the context of other planning and development decisions in the area. Therefore, "learning for adaptation" in The Broads can be hardly separated from broader "learning for better management". Fig. 2.7 represents a "road-map" of this process including factors and events at different levels that have had (or still have) an influence on decision-making on climate adaptation in the Broads. Based on official documents (Broads Authority, 2004, 2007, 2008; Communities and Local Government, 2007; DEFRA, 2005, 2007; EERA, 2004; EU, 2007) and interviews, we represent 20 years of "climate learning" in the Broads as two cycles including context, process and outcomes (Pahl-Wostl et al., 2007a; Tàbara et al., 2009) with several "key learning events" (Siebenhüner, 2002a) also reflecting on first- and second-order learning in the case study. Overview of these broader learning processes at different levels over time represents an important part of the case study description. It provides a clear view on a larger system of reference within which the local agents need to operate i.e. to build their responses and to establish learning activities. Detailed description of the cycles of multi-level social learning process grounds the analysis of social learning for bridging scales and levels at the local level represented in the next section.

Fist cycle: from The Broads Act (1998) to The Broads Plan (2004)

Context: In 1988, the UK Government Norfolk and Suffolk Broads Act established The Broads National Park and introduced the Broads Authority (BA) as the main management body responsible for navigation, tourism and nature conservation at both terrestrial and water spaces (Broads Authority, 2004). Important step had been made towards spatial and administrative integrity of management that was previously shared between Norfolk and Suffolk County Councils.

In the beginning of 1990s, increasing evidences of climate change and information campaigns at global and national levels stressed the importance of integrating adaptation measures in local development planning. The adaptation focus in The Broads started to shift from the traditional reliance on technical approaches to flood protection towards a long-term perspective that, among other factors, also considered the potentially emerging issues like salinization and loss of fresh-water ecosystems. Growing industrial and agricultural development pressures in close-by areas increased water pollution and eutrophication, resulting in negative effects not only for biodiversity but also for navigation.

Fig. 2.7. A road-map of the decision-making process on climate adaptation in The Broads: decisions, actions, institutions and factors of influence

At the same time, environmental policies at the national and EU level provided new, and often stricter, standards for environmental quality and safety. The EU Birds and Habitat directive applied within the boundaries of the national park and the new EU Water Framework Directive (WFD) established higher standards for water quality. River Basin Management Schemes (RBMS) introduced by the WFD expanded planning schemes beyond the borders of the national park, thereby increasing the complexity of management and, to some extent, limiting the capacity of the BA to plan adaptation responses within its borders. At the national level, the Flood Alleviation Program reduced possibilities for economic activity in the zones qualified as "flood-prone" — which form only part of the area — that further increased management fragmentation. Although significant financial support existed in the national park, the majority of funds are appropriated for ecosystem preservation while funding for adaptation measures is still limited.

Scientific research on The Broads ecosystem has been immense (cf. George, 1992). Starting form 1990s, new series of research in the area increasingly stressed social and economic aspects including considerations of risks of flooding and possible adaptation measures (Turner et al., 2003, 2004), climate change scenarios (Lorenzoni et al., 2000a, b) and schemes for complex environmental management (Turner et al., 2003, 2004). Several studies, supported by initiatives at national and EU levels, argued for more participatory approaches (Lorenzoni et al., 2000a, b; Turner et al., 2003).

Process: New conditions of management and increasing effects of climate change forced the Broads Authority to look for alternative management solutions. The development of a new management strategy spread over two years and included several phases: initial planning and design; identification of stakeholders; public consultations to identify key issues; preparation of a draft Plan and following consultations; and finalization of the new Broads Plan (Broads Authority, 2004). The process was organized by the BA and independent consultants were involved in the process to assess the design and facilitation of dialogues (Broads Authority, 2004).

Outcomes and key learning events: In 2004, the Authority adopted the new Broads Plan (BP), a guiding document providing management objectives for the four themes of 'living landscapes', 'water, habitat and wildlife', 'tourism and recreation', and 'understanding the Broads' (Broads Authority, 2004). Climate change was increasingly considered as one of the factors with most potential influence on The Broads development. The BP developed a five-year Actions Plan, considered visions of future developments within the next 20 years, and uses a one hundred year interval as reference line for evaluating possible consequences of global climate change (Broads Authority, 2004). The administrative structure of the BA was revised to implement a more pragmatic and problem-oriented approach which enhanced its position as a coordinating body. The Broads Authority further initiated the Broads Forum (BF) as a consultative stakeholder body, aiming at involving stakeholders' knowledge and to share awareness of and responsibility for complex decisions. The Broadland Flood Alleviation Project, focused on flood protection in river section (e. g. constructing of banks) and based on 20-years public and private partnership funding scheme, started to operate.

Second cycle: from the Broads Plan to the modern challenges

Context: From 2004 to 2008 several changes happened at the national and regional levels. To support a strategic move toward sustainable development at the local level (Turnpenny & O'Riordan, 2007) the UK government significantly revised planning standards. The Local Development Framework (LDF) supported an integral system of planning and management at the local level by combining different development objectives. Later on, Regional Spatial Strategies (RSS) had been introduced to set up development frameworks at the regional level. By introducing LDF and RSS, the UK government attempted to enhance the role of regions in planning and management (EERA, 2004).

Advances in climate policy development (UK Climate Impact Program, Adaptation Framework Program and Climate Bill (DEFRA, 2005, 2007) brought climate issues to a fore. Climate change became an important factor for strategic planning and was integrated into development policies and guidelines (Communities and Local Government, 2007; EERA, 2004). Nevertheless, the main policy focus remained on mitigation. The EU Green Paper on Adaptation (EU, 2007) aimed to balance adaptation objectives with the mitigation agenda at the EU level. At the local level, increasing evidences of disastrous events (e. g. storms of 2006 and 2007) raised public awareness and emphasized necessity to protect population from climate-related risks. However, alongside with the local development and adaptation, the BA needed to support the standards for water management and biodiversity conservation (EU WFD and Habitat Directives) controlled by, respectively, the Environmental Agency (EA) and Natural England (NE). Fragmentation of management was recognized as an important barrier: BA did not have control over flood protection at the coast (responsibility of the EA) and nearby areas.

Process: According to new planning regulations, the BA got full planning and management functions including responsibility for development and implantation of the LDF. To overcome fragmentation and meet the demands at upper levels, the BA revised its management structure and initiates institutional cooperation with the EA and NE. The BA also expects possible changes in planning structure according the new RSS — The East England Plan (EERA, 2004). In 2008, Natural England (NE) prepared a draft version of the Adaptation Strategy for the key natural character areas in UK, including the Broads (Natural England, 2008). The strategy suggested several scenarios of adaptation depending on the way the society will face climate change (i. e. from complete reluctance to accepting climate-related changes in ecosystems); the document had strong focus on ecosystem protection and less on other aspects of development in The Broads.

Several public consultations were organized in the area. River Management Basin Schemes (RBMS) were presented for public discussion according to the WFD requirements. Climate impact models developed by the EA were discussed at the BF; stakeholder consultations were organized on the adaptation strategy by the NE. At present, the Broads Forum looks for new ways to enhance capacity for stakeholder participation, e.g. to contribute to and to communicate possible climate change strategies.

Outcomes and key learning events: BA, EA and NE established the Committee for Coordinated Action for Adaptation, which subsequently became an important step towards more effective and less fragmented management. To address the complexity of addressing adaptation challenges and to support the standards of RBMS/WFD, the BA introduced new "whole valley" management schemes based on river catchments. A new Green Plan suggests climate action for the area, combining mitigation targets by the BA with adaptation strategies based on the objectives defined by the Broads Plan 2004.

At present, the balance of development objectives at the regional level and trade-off between long- and short-term priorities at the local level are among the most important challenges for climate policy and climate learning in the area. New planning regulations (RSS) shift responsibility for planning to Regional Development Agency (EERDA) that may give more priority to the economic development and less to environmental issues, that may "*make it a lot more a challenge to get climate change at the regional level"* (Interview 2). Continuing reliance on traditional technical measures for flood protection may preserve the areas from flooding and reduce the risk for the population in a short and medium perspective while accepting unavoidable natural changes in land-use structure may deliver effective solutions in a longer run.

2.3.5. Social Learning Processes in Climate Change Adaptation in the Broads Ecosystem

The above-described evolution of climate adaptation in the Broads ecosystem can be interpreted as a relatively successful social learning process, because evidences of changing practices, management policies, institutional structures, and actors' behavior can be identified. The changes can in many cases be directly linked to the availability of new information, the input of innovative knowledge by various actors, insights gained from scientific research, and changes in the decision making context. Many challenges remain before an effective mechanism of social learning for bridging scales and levels will be implemented in The Broads national park.

To assess in greater detail how social learning has contributed to building channels for cross-scale and multi-level integration in climate change adaptation in the case study, we will now shed some light on the question of if and how the problems of ignorance, mismatch, and plurality have been addressed, what type of social learning has occurred, and which factors seem to have been particularly important for the social learning to happen.

In this empirical analysis of the Broads case study, there are many examples illustrating both the challenges of bridging scales and levels in climate change adaptation and how social learning processes can help addressing them.

Social learning for addressing ignorance of scales and levels. The common problem of ignorance was and is prevalent in various aspects, including scientific information about scenarios and effects of climate change in the area, multi-level management and integration of local knowledge.

Before the 1990s when climate change was not yet on the agenda of sectoral planning agencies, ignorance of scientific information about possible long-term effects of climate change existed. At present, notwithstanding several advances and learning efforts in the field of climate scenario development at various levels, local development planning is still insufficiently attuned to the potential impacts of climate change. For example, local climate change data only starts to be scaled down to local impacts. Knowledge is rare of how exactly the different global IPCC scenarios would play out in terms of expected changes in precipitation patterns, average temperatures, and sea level rise and how this information can be integrated in local planning. At the same time, scenarios at global and national levels (which also ground guidelines for local development) as well as standards for environmental quality (e. g. the WFD and the Habitat Directive) usually do not take into account information about specific local effects, e. g. eutrophication and decreasing water quality as result of climate change in the Broads.

The later example of the EU directives can also indicate ignorance related to management. EA and NE as national-level agencies responsible for implementation of the WFD and Habitat Directives may ignore local objectives of more flexible climate-proof development. Ignorance is also apparent in that the WFD does not directly include the aspects of climate change adaptation. In absence of any guidance form the EU, member states and local watersheds are still lack information of how to include aspects of climate change adaptation in the plans (cf. Interview 2). Another persisting example of ignorance can be seen in the possible neglect of the potential impacts of climate change and need for adaptation measures in new regional development plans (Interview 2). Furthermore, platforms and procedures for integration of the local knowledge need to be further developed.

Nevertheless, several advances in overcoming ignorance have been made that can be attributed to effective social learning processes: better integration and more local assessments of potential climate change impacts are now available. Actors in regional and national instructions (e. g. EA) are collaborating with scientific counterparts and stakeholders at the local level (the Broads Forum) which increases the usefulness of the assessments and advices. The Broads Authority in its attempt to create alliances with the institutions as different spatial and administrative levels (e. g. EA and NE, and bordering authorities), experiments with ways to deliver the local information to the other levels and create "communities of practices" for co-managing the Broads area. Another example can be seen in the creation and current re-framing of the Broads Forum for better integrating local knowledge, which is a response to new political conditions and changes in management behavior of the Broads Authority.

Social learning for addressing mismatch of scales and levels. Mismatches in climate change adaptation can exist between the ecosystem boundaries, the administrative borders and management structures, the scales of scientific information and management requirements, and resources allocated at different levels and for different purposes. Such mismatches exhibit important barriers to the creation and implementation of complex adaptation strategies. If assessment and management do not address a phenomenon at the level at which it occurs, understanding of the system must remain incomplete and changes in the ecosystem behavior cannot be induced effectively.

The case of climate change adaptation in the Broads shows numerous examples of mismatch between the spatial and administrative scales. Particularly relevant is the mismatch between the ecosystem boundaries and the area administrated by the Broads Authority since the coastal zones, upstream parts of river catchments and other areas adjacent to the national park are still outside of the Authority's influence. Furthermore, the adaptation strategy prepared by Natural England delineates the Broads as a natural character area on the bases of its natural habitats while important interactions with local land use dynamics, economic activities and development in the broader ecosystem remain only vaguely considered. Another example can be seen in the national flood-protection regulations that are concentrated only on some designated "flood-prone areas" and thus increasing the fragmentation of management.

An example for the mismatch between scientific information and management objectives is apparent in that data on water availability and risk management are dispersed between assessments at different agencies responsible for the climate change scenarios at the national level (UK CIP) and evaluation of flood risk (DEFRA).

At odds are also the local stakeholders' long-term objectives of climate change adaptation and the rather short-term oriented financial investments from the national level. Local stakeholders perceive the resources provided by the national level as insufficient and rather ineffectively distributed.

In addition to these persisting problems, positive examples of social learning for overcoming issues of mismatch can be found. The Broads authority, after gaining the management responsibility over the area in 1989, has successfully increased its capacity to address climate change adaptation issues at the ecosystem scale. The last extension of the BA's control over the planning in the area may also be seen as an effect of learning processes at upper levels that finally led to the decision to empower local administrations as a condition for more sustainable planning. Besides, several re-framing of the BA structures e.g. toward more integral management of river catchments, indicate an effort to reflect on the management practices and to adapt to policy changes at the upper levels. Similar to the challenge of ignorance, the creation of the Committee for Coordinated Actions for Adaptation between the BA, the EA and the NE can be considered as a significant advance in learning for overcoming mismatch between spatial and administrative scales of management for climate adaptation. At the same time, the Broads case shows how the introduction of polices with good intentions may also have the side effect of further complicating the governance structures: new planning system introduced by the RSS may interfere with the established planning and management structures.

To address current mismatches between management objectives at different scales (i. e. meeting the standards for water quality as defined by the WFD), the Broads Authority currently applies at the national level to have the Broads National Park designated as an experimental area for local adaptation strategies in UK. The proposal, which for example includes the introduction of flexible water quality standards, is a highly innovative response to the management problem and can be interpreted as a result of successful learning.

The mismatch between scientific information and management targets is currently being addressed in involving local stakeholders in discussing the allocation of measures for coastal flood defense, evaluating risks related to sea level rise by the EA, and scenarios suggested in the Adaptation Strategy by the NE (Natural England, 2008). The stakeholder involvement can be seen as a result of learning at the local and upper levels, aimed at designing more effective practices of decision-making.

One of the most crucial factors for overcoming mismatch might be local leadership to facilitate better communication between scientific results and the people making decisions (Interview 2).

Social learning for addressing plurality of scales and levels. The challenge of plurality in cross-scale and multi-level climate change adaptation lies in the need to identify and consciously address the multiple perceptions of the impacts and potential mechanisms for effective adaptation. The Broads case exhibits two examples of plurality challenges: the multiple objectives of actors representing different scales and levels and the trade-offs between short- and long-term approaches to climate change adaptation.

Multiple objectives, interests, and future visions are advocated by actors at different levels and cross-scale. The various sectors involved such as navigation, tourism, agriculture, nature protection etc. all have independent and sometimes conflicting perspectives on climate change adaptation. Furthermore, actors from one sector but different levels in the hierarchy may have slightly different objectives as well. It is important to stress that these cross-scale and multi-level plurality relates to issues of power distribution and prioritization between objectives. For example, the objectives of ecosystem preservation lobbied at the national level obviously receive more priorities including financial support. At the same time, responsibility for complex strategy for local adaptation to greater extent remains at the local level with less resources and capacity to act.

Plurality also becomes apparent in valuing trade-offs between short- and long-term management solutions for adaptation. Flood protection (i. e. based on technical measures including holding a sea line as long as possible by banks) is seen as primary short-time goal and supported by number of actors. At the same time, other actors, including scientists and stakeholders at the upper levels (NE and, also, BA) may advocate for longer-term solutions, i. e. supporting scenarios, which imply unavoidable changes of ecosystem and land-use (see Text Box 2.1).

Social learning about approaches for addressing the issue of plurality is reflected in the advances made towards more complex planning. A salient example is the introduction of broad stakeholder consultation in the development of the Broads Plan, which can be seen as a major result of learning for better management.

TEXT BOX 2.1.

Let Nature to Take Its Course?: debates around adaptation measures.

One of the four scenarios the Adaptation Plan for the Broads Character Area by Natural England (NE) (Natural England, 2008) suggests to "Let Nature to Take Its Course". The scenario implies that the areas along the North Sea coast now protected from flooding e. g. by "beach feeding" for the cost of significant financial investments, will be let for gradual flooding by the sea as a result of climate change and sinking of the coast line. The option implied a loss of land now partly used for agriculture. Several villages along the coast would need to be relocated. As the benefits, this scenario suggested creating new wild life habitats in the abandoned areas and significant decrease of the climate change risks in the longer run. The draft version of the plan was discussed at the stakeholder workshop with the representatives of the Broads Authority, local communities, municipalities and scientific experts in February 2008. Shortly after the workshop BBC reported on public oppositions against the plan (http://news.bbc.co.uk/2/hi/uk_news/england/norfolk/7338079.stm) supported by the NGO Broads Society and local communities. The NE needed to provide explanation, i. e. that all the options had suggestive character and was developed by the Adaptation Plan alongside with the other strategies following more "business-us-usual" passes.

This example may illustrate how learning, triggered by a crisis in relations between the actors (Holling & Sanderson, 1996), revealed the challenge of "plurality" in cross-scale and cross-level interaction. The actors at different levels had different perceptions of the time-span of adaptation strategies (longer in case of NE and shorter for protesting public) and of at which level the decisions should be located. The case also stressed the importance of adequate and timely representation of information across the levels that can be also done thorough a boundary organization.

Additionally, a reframing has taken place in that climate issues are now one of the cross-cutting themes of regional development in the Broads plan. In this regard, climate change and the need for adaptation can be seen as a boundary object that allows multiple stakeholder perspective and helps integrating the formerly competing sectors of nature and landscape protection, industry, and recreation. It has been recognized among the actors that co-management is crucial for effective climate change adaptation (Interviews 1, 2, 3).

Social learning concerning plurality in the "time-frames" of the visions has also occurred through conducting wide stakeholder engagement (Interview 2). As a result of this learning, almost all actors involved are now at least aware about the existence of alternative strategies for future development.

However, reaching agreements on which pathway to choose is still an ambitious goal. From this perspective, consultation by the Natural England on the adaptation strategy for the Broads' valuable ecosystem became an important event that triggered a conflict but also helped to clarify positions of actors at different levels and scales. Other examples are the consultations conducted between the Environmental Agency and local stakeholders to discuss how to respond to the potential local effects of climate change and the remaining degree of uncertainty in the Broads. In this effort, internal and external communication has been identified as the main factor of success.

2.3.6. Types of social learning for addressing issues of scales and levels

Most social learning in the Broads represents single-loop learning or "adaptation of information" (cf. Siebenhüner, 2002a). For example, the introduction of the new "whole river valley management" system which resulted in better integration of spatial and administrative scales occurred rather in compliance with requirements of the WFD than as a result of changing management behavior of the Broads Authority. Single loop learning may also refer to new technological solutions and funding schemes to maintain the existing system of flood protection based on banks along the rivers and the coast. These solutions address the issues of cross-level and cross scale interaction but only aim for changes of management tasks (like seeking financial resources from institutions at levels that were previously not considered appropriate) rather than challenging existing power structures (e.g. convincing the Government to prioritize the issues of complex planning at the local level against sectoral interests of nature protection and water management).

However, there are also several learning events that can be interpreted as double loop learning. The Broads Plan 2004 is an innovative management approach that combines different development objectives and introduces new management structure to respond to the challenges of climate and other environmental changes (Interview 1). Remarkably, the Broads Plan combined previous academic research results with intensive stakeholder consultations, thus integrating information and visions from different scales and levels. An institutional response to overcome plurality, ignorance, and mismatch between spatial and management scales is the establishment of a joint committee on local adaptation that includes representative from the BA, EA, and NE. In this committee, the organizations aim at *"looking for adaptation strategies that all three agencies can agree on and can implement even though they have different implementation areas of responsibility"* (Interview 1). Another example of double loop learning was the shift in problem perception towards realizing and accepting the possible long-term impacts of unavoidable climate change. As one interviewee remarked, *"there have been a lot of people maintaining the Broads at their current states. But we have to understand that the Broads will […] likely to become more saline in character. […] That process will notably continue. I think we have to accept this when we starting to understand how we will manage the system"* (Interview 3). Although controversial, this vision indicates an attempt to match the current management objectives and responses to the temporal scales of the ecosystem dynamic under climate change. Currently implemented "substitute policy" (i.e. creating new artificial lakes further in land to replace the existing broads) and

Natural England's (2008) suggestion to replace areas with limited agricultural value with flooded wildlife habitats represent two possible examples of such "reframed" responses.

2.3.7. Promising strategies for effective social learning for addressing issues of scales and levels

The Broads case exhibits many examples in which the strategies of establishing structures of co-management, creating arrangements for institutional interplay, and implementing boundary organizations have led to the creation of effective mechanisms of social learning for bridging scales and levels. The Broads example also shows how society iteratively learns to use these structures more effectively for integration and use of the information and capacities at different levels and scales adapting to the current demands and situation. Whereas several solutions related to co-management and institutional interplay have been already mentioned, in our view the Broads Authority as boundary organization deserves particular attention.

Since its installation in 1989, the Broads Authority has increasingly served as a boundary organization for social learning and for enhancing capacities for bridging scales and levels in climate change adaptation. In many cases, the authority assumed a critical role in acquiring, transferring and applying information (e. g. scientific information and policy decisions), initiating cooperation between the actors and institutions at different levels and scales, raising awareness (both at the local and upper levels) about the effects of climate change for the Broads, and enhancing participation. Many actors in the region recognize and value the Broads Authority's function as a boundary organization. Despite some criticism, it is perceived as legitimate platform for communication and facilitation of information transfer, stakeholder dialogue and learning. In the nearest future, the role of the Authority may even increase due to increased awareness of the Authority's capacity as a boundary organization and support from national tendencies to empower local administrations.

Although the Broads Authority presents us with a case in which a local planning and management authority serves as a boundary organization for facilitating social learning, institutions of other governmental or non-governmental status can also successfully assume this role. For example, in the Helgeå River catchment in Sweden, a non-governmental institution (the Ecomuseum Kristianstads Vattenrike) helps facilitating communication and knowledge transfer for adaptive co-management (P. Olsson et al., unpublished manuscript referred by Cash et al., 2006). Since various kinds of institutions of different official status adopt boundary organization functions, flexible and locally adapted strategies for establishing and fostering such organizations seem appropriate, rather than prescriptions of certain institutional settings.

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