Reflexive regional governance – a framework for enhancing adaptiveness of environmental governance

Working Paper

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Abstract

Most problems of modern societies can not sufficiently be addressed by conventional forms of policy making where state actors collect the necessary expertise, develop a regulatory solution and implement it through legislative and executive processes. The uncertainties, complexities, interconnectedness, multiple layers and the numerous potential consequences of any (regulatory) solution necessitate a governance approach that recognizes these problem characteristics.

To explore key issues related to governance of highly uncertain and complex problems we build upon a comparative study on adaptation to climate change in six water sensitive regions of the European Alps (in Austria, France, Italy, Slovenia and Switzerland). Each case study applied the same methodology, including interviews with regional stakeholders and a questionnaire measuring the importance of various factors (barriers and drivers) for adaptation.

The study highlights the importance of social, political, institutional and management factors in addition to legal, economic and technological conditions. All measured 70 factors were relevant in at least one case study region, but their importance differed to a large extent between the regions. Therefore, there is no specific best way of adaptation, but adaptation should be tailored to the regional conditions. This points to the usefulness of a regional governance approach and the importance of carefully analyzing the specific regional conditions. The only factor which was identified in all case studies as a very important barrier towards adaptation to climate change was the lack of planning and management tools that consider climate change.

In order to fill this gap of pragmatic governance approaches for uncertain and complex problems like adaptation to climate change we develop a reflexive regional governance approach. Reflexive governance is a practice of decision making that includes (a) interaction among diverse stakeholders, (b) deliberation between different bodies of knowledge from science and other societal groups, and (c) adaptation to novel developments inside or outside the governance system.

Based on a relational understanding of space the level of functional regions (e.g. drought regions, flooding regions) seems particularly suited to realize reflexive governance. Compared to adaptation on a federal or national level, regional governance allows for a more problem-oriented and stakeholder-specific perspective, while compared to the local level regional strategies can include a broader portfolio of potential decisions. Furthermore, the regional level of decision making is not as institutionalized as other levels so that the described adaptive reflexive governance approach can be realized more easily and flexible.

Based on our empirical data and larger research on adaptive governance we propose the following cornerstones of a reflexive regional governance framework: Learning: Trans- and interdisciplinary systemic exploration of regional conditions, regular monitoring and policy review; Cooperation: Regional stakeholder forum for realizing fair governance and “interactor”, cross sectoral and intercommunal cooperation; Communication: Building awareness and knowledge; Education: Building competencies for dealing with the complexity and uncertainty of the addressed problem and for taking part in the reflexive regional governance process; Leadership: Ensuring commitment and leadership; Resources: Generating financial, social, human, legal, and technological resources

1 Introduction

Most problems of modern societies on local, regional, national and global levels (e.g. environmental protection and conservation, economic development, social welfare, adaptation to global environmental change) can not sufficiently be addressed by conventional forms of policy making where state actors collect the necessary expertise, develop a regulatory solution and implement it through legislative and executive processes. The uncertainties, complexities, interconnectedness, multiple layers and the numerous potential consequences of any (regulatory) solution necessitate a governance approach that recognizes these problem characteristics. Generally, governance deals with the question how social relations or interactions – in companies or regions – are coordinated. This general meaning of governance as “social coordination” (Mayntz 1993, 11) expresses the changing conditions in society, economics and politics.

To develop our reflexive regional governance approach (RRGA) we build upon a comparison of six regional case studies on adaptation to climate change in water sensitive regions of the European Alps (two case studies in Austria, respectively one case study in France, Italy, Slovenia and Switzerland). Adaptation to climate change refers to "adjustments to reduce vulnerability or enhance resilience in response to observed or expected changes in climate and associated extreme weather events" (Adger et al. 2007, p. 720). Adaptation is necessary because even if the often propagated goal of stabilising the global mean temperature to 2 °C above pre-industrial levels is achieved through stringent world-wide mitigation actions to stabilise global greenhouse gas concentrations, some climate change impacts will remain, at least in the short-and medium-term (Parry et al., 2007), making precautionary adaptation to climate change imperative to reduce vulnerability. Adaptation to climate change is characterized by high levels of uncertainty, complexity and interconnectedness. Even with further refined impact models, future climate change impacts will remain uncertain to some extent because economic, societal and technological development, the resulting greenhouse gas emissions and their respective effects on the climate system will be continuing sources of uncertainty. Climate change impacts affect most sectors and regions and all levels of decision-making and they highly depend on non-climatic factors. For example, the level of heat-related fatalities in an affected region strongly depends on age distribution and the quality of public health care. Adaptation decisions can have numerous consequences and side effects, including the potential for maladaptation (adaptation that results in more harm than benefit). The long time horizon for climate change, which is very likely to extend beyond this century (Parry et al., 2007), adds to the complexity of adaptation decisions.

The answer to highly complex and uncertain problems mostly given in the environmental policy and management literature is the plea for adaptive management and adaptive governance. The idea of *adaptive management* has been discussed in ecosystem management for quite some time (Holling, 1978; Walters, 1986; Pahl-Wostl, 1995; Lee, 1999). "Adaptive management refers to a systematic process for continually improving management policies and practices by learning from the outcomes of implemented management strategies" (Pahl-Wostl, 2007, p. 51) on the basis of systematic monitoring and evaluation. Furthermore, it seems useful not to build only on experiences from the outcomes of implemented strategies but also account for research results on the addressed problem (e.g. new research results on potential climate change impacts). The literature on *adaptive governance*, which is younger and less comprehensive than the literature on adaptive management (Hatfield-Dodds et al., 2007), pays more attention to issues of power, legitimacy and fairness. Adaptive governance refers to the social and institutional arrangements that provide an organizing framework for adaptive management (Dietz et al., 2003). Adaptive management and adaptive governance are expected to increase adaptiveness. Biermann et al. (2009) introduce the notion of *adaptiveness* as an umbrella term for a set of related concepts. It links to concepts of vulnerability, resilience, robustness and adaptive capacity. Adaptiveness refers to the capacity to adapt in response to, or in anticipation of, changes in the environment. Adaptiveness allows a social actor or group or social-ecological system to maintain those functions essential for its survival; lacking adaptiveness thus jeopardizes its existence (Biermann et al., 2009).

The results of the six regional case studies on adaptation to climate change in water sensitive regions of the European Alps (presented in the next section) point to the lack of pragmatic governance approaches that consider climate change. In order to fill this gap the third section of this paper develops a list of key elements of a reflexive regional governance approach – based on an integration of reflexive governance and regional governance. It is assumed that by effectively implementing the described key elements of a reflexive regional governance framework adaptiveness of the region will be the result. The final section of this paper discusses the limitations of a reflexive regional governance approach and future research needs.

2 Case Studies: Adaptation to climate change and water resource problems in the European Alps

Water resources in the European Alps are sensitive to climate change because they depend on snow and glacial melt water in spring and summer as well as on snow in winter. A decrease of snow cover and melt water, in combination with the expected shift in precipitation patterns (mainly a decrease

in summer) will change the temporal and spatial pattern of water availability in the future in a way that will create a demand of appropriate adaptation measures in sensitive regions. The vulnerability of water resources in the Alps is increased even more by other developments, mainly rising water demand, e.g. for artificial snow making.

2.1 Methodology

The case studies on water management under the conditions of climate change were conducted in six water sensitive regions five different countries of the European Alps: River Lavant valley (Austria), Valais (Switzerland), South Tyrol (Italy), Savoy (France), Mt Hochschwab, Soča river basin (Slovenia and Italy), and Mt Rax, Mt Schneeberg and Mt Schneealpe (Austria). Data collection for the case studies combined a review of existing material on each case study region and interviews with regional stakeholders, decision developers and experts. A 2-day expert workshop identified key results and lessons learnt from the case studies. In order to identify the most important hindering factors (barriers) and supportive factors (drivers) of adaptation to water resource issues in the case studies, the case study authors completed a questionnaire based upon the results of the expert workshop, barriers to and drivers of adaptation described in the 3rd and 4th Assessment Reports of the IPCC (Adger et al., 2007; Smit and Pilifosova, 2001) and various publications on water management (including Falkenmark, 2007; GWP, 2000; Newig et al., 2005; Ostrom, 2008; Pahl-Wostl, 2005). 70 potential barriers and drivers (e.g. political will for adaptation) were included in the questionnaire which were grouped in eight categories (e.g. political context). The barriers and drivers were rated by the case study authors as "very important", "partly important" or "unimportant" for adaptation to climate change in the region. Table 1 includes a shortened list of the drivers incorporated in the questionnaire. The barriers were to a large extent descriptions of the lack of the drivers.

Table 1: Potential drivers for adaptation to climate change and water resource problems

Political context
- Political will for adaptation
- Consistency of policy objectives
- …

Legal context
- Sufficient mandate for action
- No regulative restrictions for action
- Consistency of regulations
- Property rights / land ownership
- Water rights (water abstraction and use)
- …

Governance & management context
- Availability of planning and management tools that consider climate change
- Mainstreaming of adaptation into existing planning and management procedures
- Clear formal or informal procedures and responsibilities for action
- Long-term, integrative and flexible institutional and organizational arrangements
- Institutional / organizational capacity to deal with extreme events like droughts
- (Individual) leadership
- Integration of all relevant stakeholders, coordination of water use (cross-sectoral, inter-regional, vertical coordination between different policy levels)
- Conflict resolution mechanisms
- Monitoring system for water resource problems
- Accompanying research programmes
- Information exchange
- …

Awareness & Information/ Education & Skills
- Awareness of / knowledge about climate change impacts / water resource problems and adaptation options
- Competencies for decision making under uncertainty
- Communication and cooperation skills
- …

Equity
- Fair access to resources & decision making
- Fair distribution of benefits from adaptation
- …

Social & cultural context
- Openness for new forms of water management
- Discourse-oriented, participatory culture of decision making
- …

Economic context
- Access to economic resources
- Financial incentives for adaptation
- …

Technological context
- Access to (new) technology
- Existing technological infrastructure for adaptation
- …

2.2 Results

The main result of the questionnaire relevant in the context of this paper was that all the barriers and drivers named in the questionnaire were relevant in at least one case study, but their importance differed to a large extent between the six regions. Whereas the importance of "political will for adaptation" was evaluated as a very important driver of adaptation in one region, its importance was ranked as minor in another region. Actually, the initial hope of measuring a wide range of potentially influential barriers and drivers in a standardized questionnaire was to identify a small group of barriers and drivers evaluated as very important in all regions and identify a large group of barriers and drivers evaluated as unimportant in all regions. The questionnaire results matched not at all with this hope. None of the 70 measured drivers and barriers could be excluded as irrelevant for adaptation because every barrier or driver was relevant in at least one case study and almost all barriers and drivers had very diverse importance weightings in the different regional cases. Therefore, there seems to be no generalizable pattern of typical barriers to and drivers of adaptation to climate change, but adaptation needs to be tailored to the regionally specific pattern of barriers and drivers. This points to the usefulness of a tailor-made regional governance approach that includes reflexive governance elements to carefully analyze and monitor specific regional conditions.

Interpreting the case studies as pointing to the usefulness of a regional governance approach was also supported by further results. Many of the stakeholders interviewed in the case studies stressed the importance of cross-sectoral coordination in regional water resource management. Whereas cross-sectoral coordination often seems to work well on the local level (e.g. in Valais) it seems to be lacking at the regional level where it will be probably more and more necessary in the future due to the increasing demand for water in some sectors and the risk of decreasing water availability because of climate change. Furthermore, in the future the need for inter-communal water transfers and an associated coordination of water use will probably increase – again pointing to the usefulness of water governance on the regional level.

In the questionnaire only the lack of planning and management tools that consider climate change was identified as a very important barrier in all cases. This shows that although such tools exist (e.g. Willows & Connell, 2003; Lim et al. 2005), they seem not to be known among local and regional decision-makers. Obviously, there is a need to disseminate such tools more strongly. Nevertheless, better management and governance tools seem to be necessary especially for adaptation on the regional scale – to help realize the tailor-made regional governance approach which appears useful based on the results described before.

Analysing the results by the eight general categories of the barriers and drivers revealed that in every case study at least one of the barriers or drivers of the six categories – political context, legal context, governance & management context, awareness & information/ education & skills, economic context, technological context – was ranked as partly or very important for adaptation. Some case study authors were not certain about the importance of the barriers and drivers belonging to the categories equity and social & cultural factors. Yet, the results tended to show that equity, social and cultural barriers and drivers were also relevant in all regional cases. Because the eight categories were relevant in all six case study regions it seems likely that they are also important in other regions facing the problem of adapting to water resource problems under the conditions of climate change. Therefore it can be recommended that governance approaches for adaptation to climate change should take into account the political, legal, economic and technological context as well as factors in the governance and management system and on the individual level (awareness & information/ education & skills).

2.3 Discussion

Generally, the case studies highlighted that legal requirements (e.g. EU Water Framework Directive, priority uses), economic incentives (e.g. water prices, water markets), the availability of technological adaptation solutions (e.g. drop irrigation) and especially concrete water resource problems seem to be important as triggers and boundary conditions for adaptation. The adaptation processes themselves seem to depend more on the people involved — their motivation, interests, knowledge, perceptions, competences and the availability of leaders and facilitators — and governance factors such as the management of the adaptation process, effective stakeholder participation and the nature of cooperative structures between different actors and stakeholders.

This outcome documents the importance of social, political, governance and management factors in addition to legal, economic and technological conditions and is very much in accordance with results from new studies carried out since the 3rd Assessment Report of the IPCC (Smit and Pilifosova, 2001). These studies show that adaptation to climate change is influenced not only by economic development and technology, but also by social factors such as human capital (education, skills, etc.) and governance structures (Berkhout et al., 2006; Brooks and Adger 2005; Eriksen and Kelly, 2007; Klein and Smith, 2003; Næss et al., 2005; Tompkins, 2005). There are many examples where social capital, social networks, values, perceptions, interests, customs, and traditions affect the capability of communities to adapt to risks related to climate change (Adger et al., 2007).

3 Integrating reflexive and regional governance for building adaptiveness

The results of the six regional case studies on adaptation to climate change in water sensitive regions of the European Alps point to the lack and usefulness of a pragmatic tailor-made regional reflexive governance approach that

- includes reflexive governance elements to carefully analyze and monitor specific conditions and practices of decision making,
- includes regional governance elements to carefully analyze and monitor regionally specific actor constellations and interactions in a multi-level governance framework,
- addresses the political, legal, economic and technological context, factors in the organizational and management environment and on the individual level (awareness & information/ education & skills).

In order to fill this gap of a pragmatic tailor-made regional governance approach this section develops – based on the lessons learnt from the case studies and by integrating reflexive governance with regional governance – a list of key elements of a reflexive regional governance approach.

3.1 Reflexive governance

Reflexive governance refers to a new practice of decision making that can address long-term, highly complex and highly uncertain societal problems like climate change adaptation – including strong particatory elements described as necessary for a flexible and participatory adaptation process. Based on Grothmann and Siebenhüner (2009) we define reflexive governance as a rule setting and rule implementation process that includes interaction, deliberation and adaptation as areas of collective behavior. Each of the three elements highlights particular aspects of reflexive governance processes. In sum, they bring together an understanding of reflexivity that focuses on the role of knowledge in governance processes and on its generation, processes, re-reflection, dissemination and dynamic interaction with other bodies and forms of knowledge. In detail these elements are characterized as follows.

Interaction: Governance is a process involving a diverse set of actors including regulatory agencies, non-governmental actors as well as other stakeholders. All actors pursue individual interests, maintain particular rationales and avail of specific resources (Scharpf 1997). Reflexive governance thus integrates different actors in the governance process. Different stakeholders interact in the processes of policy goal formulation, strategy development as well as the implementation of solutions (Voß & Kemp 2006).

Deliberation: Reflexive governance acknowledges the fact that knowledge is being generated in various domains and communities. Hence, there is not one unitary knowledge and truth system but multiple. In addition, knowledge and truth claims are voiced by numerous different groups of society. It is no longer unanimously accepted that scientific knowledge is the only form of objective and true knowledge on which political decisions should rest. Different claims and bodies of knowledge often clash and struggle for greater attention in governance processes. Reflexive governance addresses this challenge by applying deliberative forms of knowledge generation. These involve transdisciplinary forms of learning where different bodies of knowledge from science and

other societal groups such as business communities or non-governmental organizations bring together their knowledge, especially with regard to systemic long-term effects (van Asselt & Rijkens-Klomp 2002, Kasemir et al. 2003, Siebenhüner 2004, Voß & Kemp 2006).

Adaptation: Processes of reflexive governance need to be dynamic over time to allow for adaptation to novel developments inside or outside the governance system. Therefore, an iterative development of flexible strategies and institutions seems most adequate to encounter dynamic external and internal processes in particular with regard to social-ecological systems dynamics. These strategies can rather easily be adapted or altered to new conditions such as hitherto unknown environmental threats or social dynamics (Gigerenzer 2000, Holling 1978). Reflexive governance thus cannot result in solutions that are deemed to be applicable indefinitely but it has to be aware that governance processes need to be adaptive and that actors have to regularly reassess the applicability of the policies they decided (Voß & Kemp 2006). Therefore reflexive governance includes central ideas of adaptive management and adaptive governance (cf. the introduction of this paper).

3.2 Regional governance

Regional governance refers to ongoing processes of regionalisation and the rescaling of politics, comprising network-like structures and the combination of different mechanisms of coordination as well as involving public and private actors. Regional governance is better defined normatively than empirically (Fürst 2003). In order to conceptualise regional governance analytically for empirical studies three categories of analysis are suggested (Pütz 2004):

- actor constellation (involving public and private actors);
- mode of interaction (competition, cooperation, hierarchy);
- spatiality (region, scale).

The first two categories 'actor constellation' and 'mode of interaction' are based on the actor-centred institutionalism of Mayntz/Scharpf (1995) and Kooiman's (2003) governance theory, which both regard interaction as its central study object.

Spatiality of governance is suggested as a third category of analysis conceptualising regions based on a relational understanding of space and conceptualising governance as multi-scale-governance. We define regions in institutional terms as territorial entities that are constructed and reproduced through a range of sociospatial relations, connections, practices, and discourses, rather than as administrative or economic units (Paasi 1991, Storper 1997). Regions could be defined by intraregional functional linkages, by specific regional problems (e.g. flooding, drought) or by projects with regional impacts (e.g. river restoration, irrigation systems, technical snow production infrastructure). Regions can be conceived as regional spaces of (inter)action or cooperation. Regional governance is vertically embedded in a political-administrative system of multi-level-governance. Moreover, this third category refers to the debate about politics of scale and the re-scaling of politics, which addresses the question of the appropriate scale of governance for sustainable development. Focusing on scale stresses the missing coherence between administrative units (e.g. municipality, planning region) on the one side and the functional spaces of spatial planning issues ("problem region") on the other. It is necessary to conceptualise regional governance as a spatially conscious concept because of the path dependence of regional development. The regionally specific cultures of politics and public administration and the regionally specific situations are crucial framing conditions for the analysis of regional governance (Benz/Fürst 2003).

Regions are all the more effective when capable of organising collective action and meeting the challenges of inter-regional competition and coordination (Fürst, 2003, p. 446). The regional governance capacity refers to a region's capacity to work on issues and solve problems collectively (Le Galès, 1998; Norris, 2001; Pütz, 2004; Savitch & Vogel, 2000). Therefore, the key issue in regional adaptation to (global) environmental change is to incorporate a multitude of stakeholders from different sectors, different scales and neighbouring regions. The participation of stakeholders is important to integrate knowledge and experience from different fields. Involving stakeholders is also important in order to prevent cross-sectoral and inter-regional conflicts (Pütz/Vogelpohl 2007).

Measures to improve the regional governance capacity for environmental issues are:

- Tackling environmental issues and natural resources problems within the issue's functional perimeters, not in administrative units (e.g. tackle water resources problems within river basins or catchment areas);
- Establishing of a regional consensus about adaptation goals, strategies and implementation measures;
- Agreeing upon mechanisms of conflict solving and prevention;
- Establishing regional leadership;
- Democratic legitimation of the regional governance scheme;
- Embedding regional governance of environmental issues and natural resources in integrated natural resources management concepts or management plans.

3.3 Reflexive regional governance

Based on the case studies presented in section 2, the elements of reflexive governance and regional governance sketched out in sections 3.1 and 3.2 and literature on management and governance principles for adaptation to climate change we propose the following cornerstones of a reflexive regional governance approach. There is no general recommendation for the ideal design of *specific* structures and processes of reflexive regional governance because various regions differ too much to define governance structures and processes in detail (see results of the six regional case studies in the European Alps in section 2). Nevertheless, more *general* cornerstones for building regional adaptiveness can be defined which particularly stress learning elements to address the specific regional conditions in the governance process. The proposed cornerstones are learning (see 3.3.1), cooperation(see 3.3.2), communication (see 3.3.3), education (see 3.3.4), leadership (see 3.3.5) and resources (see 3.3.6).

3.3.1 Learning: Trans- and interdisciplinary systemic exploration of regional conditions, regular monitoring and policy review

To address the complexity of influential factors, regional analyses and learning processes should follow an inter- and transdisciplinary systemic approach that needs considerable resources. "While the interrelationships among land use decisions, regional development and environmental quality have long been recognized, traditionally, investment and policy making have concentrated on individual systems – water, energy, transport, health and so on" (Ruth, 2006, p. 393). Instead, "choosing a systems perspective rather than analyses that focus on individual aspects of the issues" (Ruth, 2006, p. 394) should be applied. Because the factors that need to be addressed include environmental, economic and social aspects analyses and learning processes need to be interdisciplinary, including insights from the natural and the social sciences. Nevertheless, much knowledge – especially knowledge on potential barriers and drivers of adaptation in a specific region – is not available in the form of scientific publications. Hence, it seems advisable to include deliberative forms of knowledge generation. These involve participatory transdisciplinary forms of social learning where different bodies of knowledge from science and other societal groups such as business communities or non-governmental organizations bring together their knowledge (van Asselt & Rijkens-Klomp, 2002; Grothmann & Siebenhüner, 2009; Kasemir et al., 2003; Siebenhüner, 2004; Voß & Kemp, 2006).

More specifically, analyses of and learning about a problem like climate change should address the following aspects to develop adaptive regional governance strategies:

- risks and opportunities emerging from the problem addressed (in the short and long term, e.g. potential positive and negative impacts of climate change)[1],
- available adaptation options (including behavioral, technological, infrastructural, informational, institutional, organizational, and economic options),

[1] Explorations of risks and opportunities potentially emerging from the problem addressed (e.g. climate change) should also consider other problems and developments (e.g. demographic change), as these will also influence the resulting risks and opportunities (e.g. heat fatalities).

- criteria-based evaluations of the adaptation options (including criteria such as availability, feasibility, effectiveness, risk reduction potential / opportunity utilization potential, urgency, equitability, cultural acceptability, legitimacy, sustainable use of resources, potential side-effects, and criteria to deal with uncertainty like flexibility, reversibility, robustness, no/low-regret, win-win (cf. Hallegatte, 2009; Prutsch et al, 2009),
- potential barriers to and drivers of the adaptation options' realization (taking into account the political, legal, economic and technological context as well as factors in the governance and management system and on the individual level like awareness, knowledge and skills; Grothmann et al., 2009).

Analysts and decision makers frequently neglect unforeseen, often undesirable, side effects that themselves require actions later on. "Urban and regional planning and development are replete with examples of 'solutions' to problems that in themselves grow into larger problems – such as expansions of roads to accommodate growing traffic volumes, thus stimulating development that require further expansion of roads, or increased proliferation of air conditioning that increases energy consumption and emissions and thus contributes to heat island effects that in turn are addressed with the expansion of air conditioning" (Ruth, 2009, p. 395).

Therefore, the analysis of regional conditions should also include analyzing the role of path dependencies and potential lock-in effects. Evolutionary concepts inspired a lot of studies of adaptation, adaptive management or generally coping with change. Regions have been a key object of interest for evolutionary concepts representing an appropriate focus for the understanding of local and regional adaptation to global (economic, environmental) change. The notion of evolution has been associated in the social sciences with a lot of classic traditions and authors (see Hirsch and Gillespie (2001) or Hodgson (2009) for overviews of the etymological roots and the disciplinary history of the concept of evolution). Despite these traditions and different meanings (e.g. mere change, qualitative development, progress), two key themes are evident (Grabher 2009): discontent with static or equilibrium theory or approaches that neglect vital driving forces, such as innovation and technology; recognition of the fact that outcomes often result from unpredictable processes.

Regional studies have also, over the past 15 years, drawn upon ideas from evolutionary theorists in trying to understand processes of regional growth, decline and change. The investigation of regional development processes needs to consider both local context and historical development of regional phenomena. Recently, the concepts of 'path dependence' and 'lock-in' became particularly prominent in terms of the historical dimension of regional development (Boschma and Lambooy 1999, Martin/Sunley 2006). The idea of path dependence is that a series of events can trigger a process, whose outcome is one of different possible ones evolving as a consequence of the history of the process or system. The concept's very general scope refers equally to social dynamics and developmental sequences in biology or physics. Path dependence can be regarded as technological 'lock-in', as dynamic increasing returns, and as institutional hysteresis. The concept refers to the historical impression of institutions, which can be legally, organisationally or socioculturally defined. Path dependence can cause positive feedbacks and can also constrict regional governance and adaptation processes, when enclosed in specific paths (lock-in) (Martin 2006).

Regional evolutionary concepts stress 'place dependence' and 'embeddedness' of governance and adaptation processes alongside 'path dependence' (Hess 2004, Boschma/Frenken 2006, Martin/Sunley 2006). Accordingly, different places and regions are characterised by different modes and styles of path dependence. But regional governance is not only dependent on regional context and characteristics but is also determined by technological and institutional change and 'windows of opportunity'. Thus, historical regional governance paths are not inevitably given but could rather be affected by political or societal decisions (Hassink 2005). Although the issue of regional path creation is thus equally important, it has been rarely discussed (Martin/Sunley 2006).

Due to remaining informational uncertainties, the potential for understanding risks, opportunities, adaptation options and potential barriers and drivers of adaptation is limited. Therefore, risks, opportunities, adaptation options and potential barriers and drivers of adaptation should be estimated and ranked instead of precisely assessed (Grothmann et al., 2009). Generally, adaptation should be based on the precautionary principle. The precautionary principle demands that the

absence of full scientific certainty should not be used as an excuse to postpone adaptation when there is a risk of serious or irreversible harm. Because informational uncertainty (knowledge deficits about future risks, opportunities, effectiveness of adaptation, barriers and drivers) can only be reduced to some extent adaptation processes should also focus on the reduction of normative uncertainty. Normative uncertainty refers to uncertainty about goals and actions and also relates to the question of acceptable risks. Especially participatory decision processes can reduce normative uncertainty to a large extent (Newig et al., 2005). For example, strong stakeholder participation in a water-sensitive region can clarify priorities (e.g. on tourism) and acceptable risks (e.g. agricultural losses).

Participatory processes can also help to prioritize specific risks, opportunities, adaptation options and barriers and drivers. One approach are stakeholder agreements on criteria for prioritization. Often used criteria for prioritizing adaptation options under uncertainty relate to win-win and no/low regret options. Win-win options have multiple benefits, such as insulation of buildings – useful for protecting the inhabitants from heat waves and protecting the climate from CO_2 emissions. Low-regret actions are beneficial in all plausible futures, such as insurance against a range of hazards.

For building adaptiveness reflexive regional governance needs to be an ongoing process of learning – built upon systematic and regular monitoring and evaluation. The monitoring and evaluation scheme should not only address the effects of implemented adaptation measures but should also include a regular review of new (scientific) knowledge on the problem addressed, on risks and opportunities emerging from the problem, available adaptation options and barriers and drivers of adaptation options. But learning can include even more aspects. Here the differentiation of simple, double- and triple-loop learning from management theory is useful. Single-loop learning refers to an incremental improvement of adaptation strategies without questioning the underlying assumptions. Double-loop learning refers to a revisiting of assumptions (e.g. about cause–effect relationships) within a value-normative framework. In triple-loop learning one starts to reconsider underlying values and beliefs, world views, if assumptions within a world view do not hold anymore (Pahl-Wostl 2009). This implies that governance itself needs to be adaptive if it is to effectively support the learning process towards increased adaptiveness.

Most often adaptation monitoring should follow the same time frames as those used to evaluate the main relevant existing policies (into which adaptation often needs to be mainstreamed). As for the criteria for prioritization adaptation options also monitoring and evaluation schemes should be based on stakeholder agreements. It is most often useful that an independent organisation conducts the monitoring and evaluation. Results from monitoring and evaluation should be shared with all participating stakeholders.

This adaptive management approach enables the decision makers to change former decisions and adaptation measures based on new knowledge. On the other side, planners in government as well as in business need planning reliability for their investments. Therefore, in adjusting former decisions based on new knowledge adaptive management often needs to stick to specific time intervals which are economically reasonable (Grothmann et al., 2009).

3.3.2 Cooperation: Regional stakeholder forum for realizing fair governance and "interactor", cross sectoral and intercommunal cooperation

The importance of cooperative governance approaches to uncertain and complex problems like climate change has already been stressed in the previous section on trans- and interdisciplinary learning. Generally, cooperative governance processes address the uncertainties, complexities, interconnectedness, multitude of actors and interests by a diverse set of processes and institutions such as multi-stakeholder dialogue, deliberative processes, private regulation, voluntary reporting schemes and the like (see Commission on Global Governance, 1995; Stoll-Kleemann et al., 2006).

Cooperative processes of various stakeholders and experts support social learning, decision making and effective adaptation. More specifically, cooperation can help to reduce normative uncertainty (see 3.3.1) and to prioritize specific risks, opportunities, adaptation options and barriers and drivers. Stakeholder and public involvement is also important to build consensus on criteria for monitoring and evaluation, which are essential elements of adaptive management and governance schemes, but also to detect unwanted effects of adaptation measures (as part of the monitoring

process). Furthermore, cooperative processes empower stakeholders to take adaptive actions themselves by sharing knowledge and responsibility in participatory processes, can reduce conflicts and identify synergies between adaptation activities of various stakeholders and – by addressing the concerns of all relevant stakeholders – improve the likely fairness of decisions and actions (thus ensuring that adaptation decisions and actions have broad support and better chances of success).

It appears useful that reflexive regional governance organizes interaction and cooperation along the following dimensions:

- interdisciplinary cooperative learning of experts from different disciplines, including most often natural and social scientists, in the region and outside the region;
- transdisciplinary cooperative learning of scientists and stakeholders in the region and outside the region;
- "interactor" cooperative learning, decision making and cooperative adaptation action of business, policy, administration, NGOs, and society in the region (e.g. public-private partnerships in flood protection);
- cross sectoral cooperative learning, decision making and cooperative adaptation action of different affected sectors in the region (e.g. cooperation of agriculture and forestry which is important for water purification);
- intercommunal cooperation of different communes / municipalities in the region (mostly between representatives of various governmental agencies);
- interregional cooperation of adjacent regions (to avoid conflicts and use synergies of regional solutions, e.g. in flood protection) and regions sharing the same problem (to learn from each other);
- multilevel cooperation between different levels of policy (local, regional, federal, national, international).

All relevant stakeholders of different sectors and decision levels (e.g. governments, business, NGOs, the public) should be involved early on and throughout the process to realize fair governance. Particular attention should be given to including groups that are often marginally represented in participatory processes, e.g. low-income groups (which for example sometimes also need financial support for travel costs to take part in the regional stakeholder forums).

A regional stakeholder forum including representatives from all relevant stakeholder groups seems to be useful as the core element of cooperation in reflexive regional governance processes. It depends on the initial regional conditions whether an existing stakeholder network can be used or if a new network needs to be developed. Based on experiences from local Agenda 21 processes it seems necessary to democratically legitimize the regional stakeholder forum (to build legitimacy). In addition, experiences from local Agenda 21 processes also show that decisions of the regional stakeholder forum have some binding character for the represented stakeholders (to build motivation for long-term participation in the forum). Certainly, not all dimensions of cooperation can and should be achieved in the regional stakeholder platform. Interdisciplinary cooperative learning of experts from different disciplines and transdisciplinary cooperative learning of scientists and stakeholders in the region and outside the region often need to be realized in smaller (experts) groups. Nevertheless, the regional stakeholder platform can be employed to attain "interactor", cross sectoral and intercommunal cooperation in the region. For realizing interregional cooperation and multilevel cooperation representatives can be elected by the regional stakeholder platform.

3.3.3 Communication: Building awareness and knowledge

Not all individual stakeholders can be included in the regional stakeholder forum which consists of representatives of the various stakeholder groups. Therefore, understandable and transparent communication of the learning results (regarding for example risks, opportunities, adaptation options and potential barriers and drivers of adaptation in the region) and decisions of the regional stakeholder forum is essential to build awareness and knowledge among all stakeholders. Such communication should be two-sided to allow individual stakeholders who are not members of the regional stakeholder forum to raise additional issues or communicate disagreement with decisions

taken by the regional stakeholder forum. Internet platforms allow easy access to information, can easily be updated (allowing to make learning results immediately available) and can also be used for efficient two-sided communication. Nevertheless, personal communication should complement online information especially in the implementation phase because face-to-face communication is more effective in stimulating action than written information (Mosler & Gutscher, 1998).

3.3.4 Education: Building competencies for dealing with the complexity and uncertainty of the problem and for taking part in the reflexive regional governance process

Most often the focus on knowledge and awareness alone is not sufficient realize the governance of highly complex and uncertain problems (e.g. climate change impacts) the reflexive regional governance approach is developed for. As Grothmann and Siebenhüner (2009) point out often neglected are the necessary competencies of individual actors to effectively steer and participate in governance processes for such problems. A competency involves the ability to meet complex demands, by drawing on, mobilizing and managing psychosocial resources (including knowledge, motivations, emotions, skills, attitudes, values and social support) in a particular context (cf. OECD 2005, Rychen & Salganik 2003). A competency is more than just knowledge and skills. The competency concept also involves motivational and emotional components.

Grothmann and Siebenhüner (2009) propose to differentiate between general competencies that seem to be relevant for all reflexive governance processes – independent of the specific governance problem they address (interaction competency, deliberation competency and adaptation competency) – and competencies that are problem-specific (e.g. uncertainty competency necessary for dealing with potential climate change impacts). They propose to systematically select persons who possess these competencies for taking part in the reflexive governance process and to educate people in these competencies (either during the governance process, e.g. by training modules in workshops, or on a more general level, e.g. in school education).

3.3.5 Leadership: Ensuring commitment and leadership

"Without leadership society is often unable to respond to the long-term, large scale challenges that affect humanity and institutions stagnate. Leadership is a driver for change, showing a direction, motivating others to follow voluntarily and/or using coercive measures to promote conformity to a certain development path" (Gupta et al., 2008, p. 14). Adaptation to a long-term problem like climate change requires a clear commitment from decision makers (e.g. political leaders, business managers) at inception that they will support the adaptation process in the long-term, also with sufficient resources (Prutsch et al., 2009).

In governance processes for highly complex and uncertain problems the leading person or organization should particularly promote variety and creativity, dialogue and understanding (Gupta et al., 2008), and learning on all dimensions (simple, double- and triple-loop, see 3.3.1). This implies that especially for the leader the competencies sketched out in 3.3.4 are essential so that she or he is highly reflexive and willing to reshape the regional governance architecture if this turns out to be necessary. Leadership should be democratically legitimized. In reflexive regional governance this can be realized by elections in the regional stakeholder forum.

3.3.6 Resources: Generating financial, social, human, legal, and technological resources

As Gupta et al. (2008) point out, the effectiveness of institutions often depends on its ability to generate resources. "Institutional norms and rules should call for the generation of resources in order for that social actors implementing these rules are able to do so. Clearly, the context within which institutions exist will also have a major influence on whether such institutions are able to raise resources and the success of institutions in being able to do so will be relative. Such resources can include financial, social, human, legal, and technological resources (Gupta et al., p. 14).

In reflexive regional governance generating these resources is particularly difficult because regional institutions most often have only a limited amount of resources at their disposal. Therefore, the resources have to acquired from external funding agencies or have to be contributed by participating local, federal, national or business stakeholders.

4 Limitations of a reflexive regional governance approach and future research needs

This working paper presents a first draft of potential cornerstones of a reflexive regional governance approach in order to enhance the adaptiveness of environmental governance. Further improvements are needed especially with regard to making use of first experiences from regional governance approaches for adaptation to climate change in European countries. It might also be useful to consider experiences from other environmental governance issues with a strong "regional" component such as the implementation of the Water Framework Directive or the implementation of biodiversity and nature conservation goals through national parks, regional nature parks, biosphere reserves or others. Moreover, potential tensions and contradictions between the different cornerstones (for example between leadership and cooperation) need to be addressed.

Future research should operationalize and test the described reflexive regional governance approach and compare it with "traditional" local or national governance approaches to answer the question whether a reflexive regional governance approach is really suited as an effective policy approach to build adaptiveness to the highly complex and uncertain problems of modern societies. An advantage of a reflexive regional governance approach might be that it is less institutionalized, more flexible and closer to concrete environmental issues and adaptation needs. To put it shortly, evidence suggests that the regional scale might be a very appropriate scale for adaptation to global environmental change. This hypothesis needs testing and more evidence from further empirical studies from different regions.

Further research should also identify both the regional conditions of environmental governance as well as the local and regional needs of adaptation. It is assumed that environmental governance and adaptiveness differ from global and national to regional/local scales. To date there is a lot of research on global environmental governance, multi-level governance and its implications for national environmental policies. But it remains unclear how these governance shifts are translated to the regional scale and into concrete stakeholder action at the local and regional scale. This is important because adaptation to global environmental change is not only a matter of new governance modes or institutional shifts but it is also a matter of tackling concrete problems (e.g. flooding, drought, forest fires, health issues). Climate change impacts are perceived and felt locally. Also, adaptation to climate change needs to take action at the local and regional scale. In order to understand the regional needs and context of adaptiveness and environmental governance further research should also consider an evolutionary perspective and focus on how to unlock regional practices and institutions from path dependency.

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