Increasing resilience through intense science-practice collaboration in a coastal urban region

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Abstract:

This paper describes how a process of transdisciplinary collaboration between an interdisciplinary team of scientists and of practitioners of different fields (urban and regional administration, harbor related economy, urban politics, civil society) of the urban region of Rostock worked. Rostock is located in the North-Eastern part of Germany, at the Baltic Sea and has around two hundred thousand inhabitants.

Here are presented the results of this collaborative process which mainly consisted of a commonly prepared scenario planning process. This transdisciplinary process lasted for almost three years and dealt mainly with current and future climate change impacts on the coastal town of Rostock and with ongoing and future land-use developments as well as interdependencies of both. The process not only focused on the city as such, but also took into account the wider suburban region and interdependencies between the city and its surroundings. This was also reflected in the stakeholders involved. The main outcomes of this science-practice collaboration were a new actor's network and an urban concept of climate change adaptation adopted by the City Parliament.

The guiding thinking behind the process was based on social-ecological resilience thinking and how to deal with non-linear as well as uncertain developments in order to reach a future sustainable urban development. The process is reflected in its strengths and weaknesses in order to reach that aim as well as in its so far practically implemented and institutionalized outcomes.

1. Introduction

Dealing with future climate change impacts got increased attention during the last years, too. Urban areas are to be especially considered due to their concentration of population, of sensible functions and physical infrastructure[1]. In urban regions, potential climate change impacts are not only depending upon specific characteristics such as their location and topographic situation, but also upon the vulnerability of the society and of ecological assets, upon their institutional as well as socio-economic structure and infrastructure as well as the urban region's capacity to adapt to potential impacts[2].

Land-use planning is also attributed a key role in dealing with climate change impacts as many of them will have a spatial connotation and an effect on land-use and related issues[3]. Coastal urban regions will probably (depending also on which coast they are located) be impacted by sea-level rise and increases in intensity and frequency of storm surges while they are also affected by temperature rise and changed precipitation patterns, as more inland urban regions are, too. In Europe, for instance, not only the number of national strategies on how to adapt to these potential climate change impacts increased, but also the number of local adaptation strategies is increasing. A main challenge for urban regions is to identify the main future climate risks and the related social as well as physical and ecological vulnerabilities and to develop accordingly strategies how to deal with the potential climate change impacts. One of the key problems in doing so in urban and regional development is the question on how to deal with the uncertainty concerning concrete local climate change impacts but also in the urban setting as well as key drivers for land-use development, which are characterized by complexity and uncertainty.

It is not only climate change impacts which alter the urban regions but also their interaction with assets of the urban regions as well as with other influences on their land-use development such as e.g. demographic or economic change. City growth can also affect further floods due to increased soil-sealing which again, might then interact with storm surges, changed precipitation patterns and lead to floods or severe sewage system problems.

Within this problem setting climate change adaptation strategies for coastal urban regions require a broad integration of different methods, disciplines, worldviews and knowledge forms in order to address the inherent complexity, uncertainty and not yet known future developments of climate change impacts[4] therewith making a strong case for integrative, transdisciplinary approaches.

Additionally, if we consider urban regions as social-(technical)-ecological systems and follow up with Folke et al. (2006) and Berkes (2007), who identified four crucial

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[1] Birkmann et al. 2010

[2] IPCC 2014

[3] Revi et al. 2014

[4] IPCC 2007

components that can help to build resilience in a social-ecological system, this speaks even more to follow up with an integrated and learning-oriented process to increase resilience of this system. According to the authors, the first component to build resilience is (1) learning to live with change and uncertainty the ability to learn from disasters and to expect the unexpected. Further they identified (2) securing and developing ecological, social, cultural and economic diversity for re-organisation and renewal as key factors for building resilience. Then, they propose that (3) combining different types of knowledge for social learning can create more resilient conditions. Here, the authors highlight to combine experiential and experimental knowledge and to integrate scientific and lay / locally based knowledge. And, they stress the importance of institutionalising knowledge exchange and of involving all relevant stakeholders. As last principle they propose to (4) strengthen opportunities for self-organisation. Based on these principles, the underling notion of the (scientifically) initiated collaborative process was that knowledge integration as well as learning are key factors that can directly contribute to resilience or indirectly improve the conditions for resilience building.

Hence, this paper presents results on how a process of transdisciplinary collaboration in the urban region of Rostock, located at the German Baltic Sea worked[5]. In the following chapters are presented the process (chapter 2) as well as the results (chapter 3) of this collaborative scenario planning process. The initial guiding thinking behind the process was based on social-ecological resilience thinking and how to deal with non-linear as well as uncertain developments in order to reach a future sustainable urban development. Following up with that, in chapter 4, the process as well as its outcomes is reflected in its strengths and weaknesses in order to reach that aim as well as in its so far practically implemented and institutionalized outcomes.

2. Collaborative science-practice interaction: scenario planning process

2.1 Rationales behind and method chosen

Together with planning practitioners and further stakeholder from the case study region, a transdisciplinary scenario planning process was performed which also used a very basic (and translated) understanding of social-ecological resilience thinking as reference frame. Here, with transdisciplinarity is understood a collaborative research endeavor which is oriented on problems in the complex real-world and on scientific problems and which aims to generate new knowledge for problem-solving[6]. The orientation on real-world-problems means to take into account many different characteristics of the complexity of socio-political, economic, technical and ecological drivers, circumstances as well as future developments. This means to not only consider scientifically generated knowledge of many different disciplines for problem-solving, but also case-specific lay and experientially generated knowledge to perform a collaborative transdisciplinary research process. The aim is to make most out of the combination and even integration of these different perspectives and knowledge forms, to come to sound problem solutions.

[5] Deppisch et al. 2015

[6] Gibbons et al. 1994, Thompson-Klein et al. 2000, Van de Veen and Johnson 2006

As method to be followed within this collaborative process, it was agreed among the scientists and core practitioners from the urban region to rely on scenario planning. This method was proposed by the researchers in order to integrate the aspects of uncertainty with reference to climate change impacts as well as to future land-use developments as well as to integrate a holistic, qualitative and detailed description of multiple potential future situations and their rooting development paths in a consistent way allowing flexibility[7]. Moreover, scenarios can be used to stimulate, provoke and communicate visions about such potential future situations and to enable creativity[8].

O' Brian (2010) stresses the need for alternative processes to the usual practices of applying already pre-defined scenarios in (applied) research processes on global change. These alternatives should then include learning opportunities through participatory processes. Transdisciplinary scenario planning, as conducted in the here reported case, can serve as such an alternative process, involving stakeholders in the discussion of different futures to facilitate common learning. These futures are then formulated on the basis of stakeholders' perspectives and integrate the main drivers for the development of the social-ecological system in question[9].

2.2 Scenario planning process in the coastal urban region of Rostock

The scenario planning process in Rostock, Germany was conducted from 2010 to 2012 to discuss the impacts of climate change on the future spatial development of this coastal urban region with local stakeholders and to develop adaptation strategies to increase future resilience.

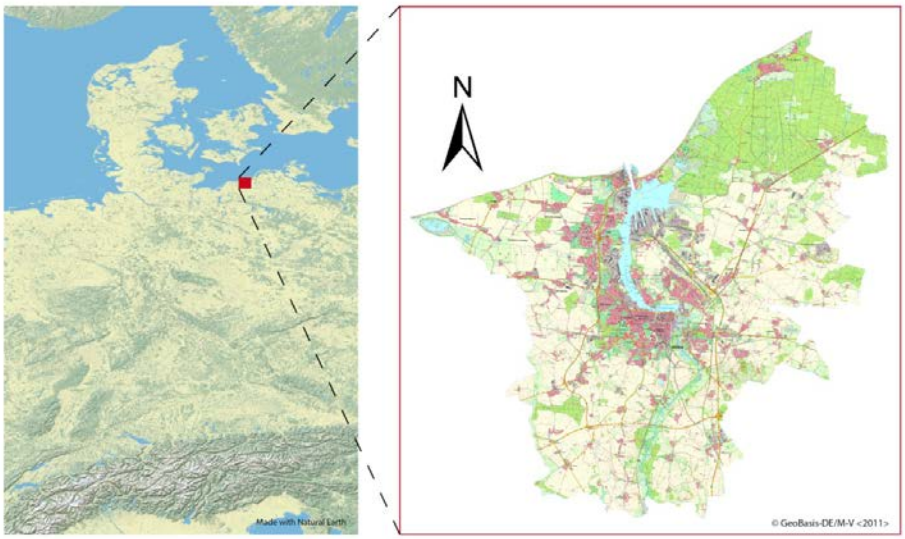
The urban region of Rostock (figure 1) is located at the Baltic Sea coast and is characterised by a medium-sized city (about 200,000 inhabitants) and its surrounding smaller rural communities. The most important economic sectors are the port and the maritime economy and tourism with its long beaches. Over recent decades, the population has been rising, as Rostock is attractive as a university location and as a city of regional importance, offering, for example, culture, entertainment and job opportunities. The main expected climate change impacts storm surges, changed precipitation patterns also with drought periods as well as a rising temperature. The potential sea level rise and coherent coastline changes are of special importance for Rostock.

[7] Godet 2006, Reibnitz 1992, Wilson 1978

[8] Rounsevell and Metzger 2010

[9] MEA 2005

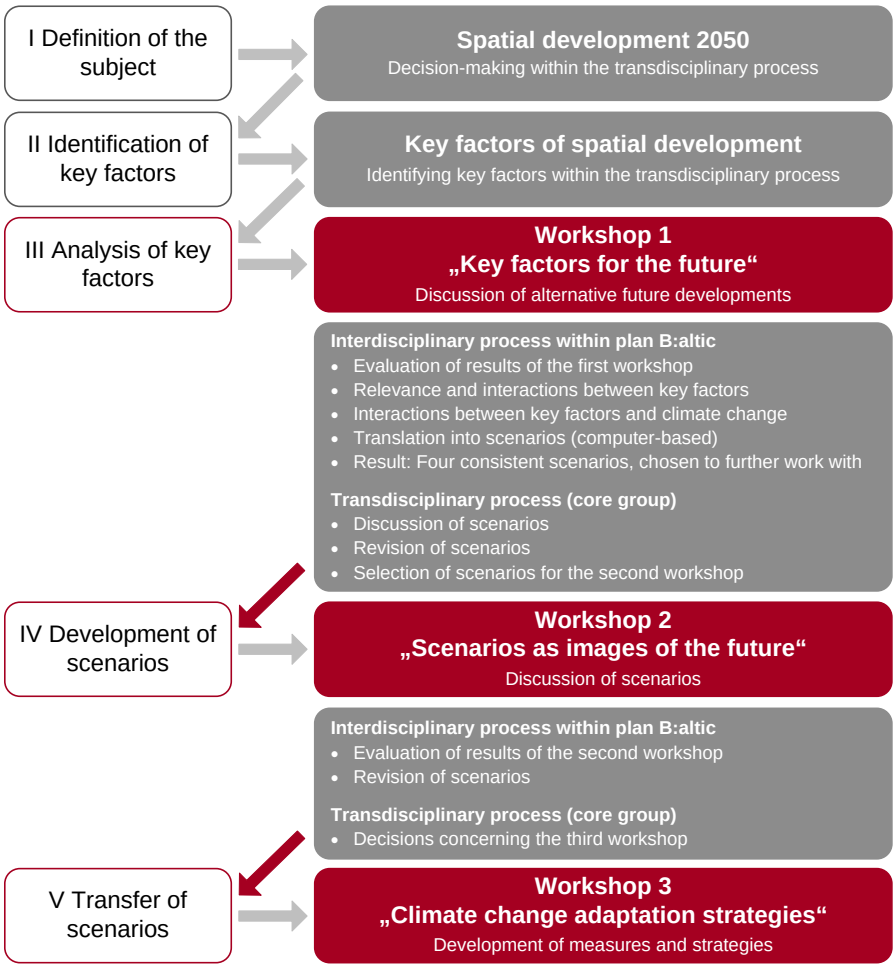
Figure1: left: Location of the urban region of Rostock - right: topographic map of the urban region (500km2)



The scenario planning process was designed and implemented through scientist-practitioner cooperation in a core group involving members of the interdisciplinary research group of the author and different administrative bodies representing the urban region of Rostock. These administrative bodies were the Urban Planning Office and the Environmental Agency of the City of Rostock, the District Planning Office (County of Rostock), the Regional Planning Agency and the State Agency for Agriculture and Environment of Mecklenburg-Vorpommern (responsible for coastal protection), forming together a group of up to 8 persons. This core group served as a platform to discuss all contents tackled within the scenario workshops in-depth and provided in-depth local data and further experiential knowledge. The process consisted of three workshops that opened the way for wider stakeholder participation and integration of local knowledge. The workshops took place in Rostock and involved stakeholders from different disciplines and institutions, ranging from administration, politics, economy and science to civil society. The timeframe for the assessment of future developments was the period until 2050.

The collaborative process involved up to 40 participants per workshop. During a longer phase, next to the main three one-day-workshops with a bigger audience, the intense science–practice collaboration of the core-group took place. The single steps are described in the following paragraphs and visualized in the chart below (figure 2). The process comprised five main phases: (1) the definition of the subject, (2) the identification of key factors, (3) the analysis of the key factors, (4) the development of scenarios and (5) the transfer of the scenarios

Figure 2: The scenario planning process in the urban region of Rostock



During the first meeting of the core group, the method of scenario planning was discussed and developed; also the main challenges of climate change in the urban region of Rostock as well as other potential key factors influencing the future development of the urban region were discussed. The outcomes of this discussion provided the basis for the further scenario planning process.

The first scenario workshop addressed a broad spectrum of potential futures and climate change impacts in the context of land-use development. It is not only climate change that determines the future, but also, and to some extent more significantly, other key factors play a role such as a changing population, economy or settlement structures. Of interest were not only these drivers of future land-use development per se, but also the interactions among these drivers and climate change impacts. After the workshop took place, the research group analyzed the results focusing on the relevance and interactions between key factors and their interactions The results provided the basis to develop scenarios for the future development of the urban region. To handle the multitude of factors and interactions that provided millions of scenarios, a computer tool was used. Taking into account the three criteria of consistency, distinctness and

interpretability, it was possible to pre-select six scenarios out of a huge magnitude of different possible scenarios. During the next meetings with the core group in autumn 2011, these scenarios were presented and discussed. Following up with the outcomes of these discussions, the six scenarios were revised and it was agreed upon to start with four consistent scenarios into the following workshop.

The second workshop presented and discussed the scenarios for the future land-use development of the urban region of Rostock. This dialogue involved around 30 contributors from a different range of backgrounds, representing most of the institutions which were already present at the fist workshop. After this broader and in-depth discussion, the four scenarios were again revised. Another meeting with the core group served for preparing the third scenario workshop. The aim of the last workshop was to develop adaptation measures and strategies for the urban region of Rostock based on the developed scenarios. Action-oriented strategies and measures were developed on how to deal with potential climate change impacts and further future developments, with regard to the specific aspects of the urban region of Rostock. The four final scenarios served as hypothetical test-bed for implementation and robustness of the measures. Finally, the scenario-process was completed with a meeting of the core group, during which the whole process, the results and further proceedings were reflected.

A mixture of methods was applied to gain scientific empirical evidence on this scenario process: (1) documentation and analysis of the results and the courses of the discussions on the workshops, (2) participating observation during the workshops and core-group meetings (3) focus groups after every workshop.

3. Outcomes of the collaborative process and first implementations

This chapter summarizes the results gained during and following this process in terms of explicit outcomes, learning processes as well as broader implementations and consequences.

3.1 Stakeholder participation and new network of actors

The performed process brought together land-use relevant actors of the core city of Rostock and its peri-urban region for the first time. Actors from a broad range of different institutions took part in the workshop series. This formed the basis for a creative discussion atmosphere with a good mixture of sectors. Additionally, the participants representing administration often held high positions, for example leaders of administrative departments. The participants representing other institutions usually were thematically responsible for environment, planning or climate topics.

After finalization of the process, participants reported of the highly added value to get to know who is responsible for the topic of climate change adaptation and land-use development in other institutions, also across municipal boundaries or fields of action. They stated that an informal network emerged through the process, which can also be used for professional purposes and new co-operations going beyond the topic of adaptation to climate change. Since climate change adaptation was not a prominent theme in urban and regional planning before, the meetings were useful for the participants to think and talk about responsibilities in a personal and informal atmosphere.

3.2 Integration of different perspectives and knowledge systems

The scenario process served as a fruitful platform for the intensive exchange and integration of different forms of information, perspectives as well as knowledge systems, in particular scientific, practical or local knowledge. New joint transdisciplinary knowledge was produced[10] that enhanced both, scientific and practical knowledge and that could be interpreted as an improvement of the framework conditions for studying and implementing adaptation to climate change.

For example, during the first workshop, knowledge was exchanged and generated by elaborating fact sheets about potential future developments of 18 key factors that were judged by the transdisciplinary core group to be of great relevance for the future spatial development and/or of high dynamic. The fact sheets for the 4 climate change impacts were produced by science alone, whereas the fact sheets for the other 14 factors integrated data and information provided by the practitioners as well as their views about potential development paths. These fact sheets were repeatedly discussed and further developed within the core group. This intense science-practice cooperation enabled the stakeholders to bring their knowledge about the specific local situation in. And this local knowledge also served as validation or reframing basis for the fact sheets and the associated development paths of the factors. Hence, by integrating the different knowledge forms and by putting the existing knowledge into new frames and contexts, new transdisciplinary knowledge was generated. The scientists and the practitioners were able to enhance their knowledge about spatial development in the urban region of Rostock and about the potential local and regional impacts of climate change.

Additionally, the participants broadened their horizon by discussing various interactions, interrelations and feedbacks between the different key factors. A further advantage was seen by the practitioners that the knowledge exchange contributed to awareness rising not only about climate change, but also about the different perspectives of other participating stakeholders, such as on water quality or the dunes and beaches needed for different purposes.

The formulation of adaptation strategies and measures (subchapter 3.3) is a good example for the generation and exchange of implementation knowledge within the scenario planning process. The measures elaborated in the last workshop addressed nearly all factors as well as the different dimensions of possible measures, such as technical, spatial or communicative measures. From the whole measure discussion, some general strategic approaches were derived, including for example considering climate change impacts in all future planning processes or thinking about a range of possible future developments.

3.3 Initialization of the process to adapt to climate change

The process fostered the awareness towards climate change impacts and the need to think about sustainable land-use patterns in the future of the coastal urban region. Especially at the city level, political meetings were held, including the scientists and the core-group. In consequence, the city council formulated the task for the administration to

[10] see Hagemeier-Klose et al. 2013

elaborate a climate change adaptation strategy. In addition, weather extremes like heavy rainfall events, a drought and a sandstorm occurred during that time, which evoked an increased attention to climate change impacts and opened a window of opportunity for discussions about adaptation.

The strong involvement of a key politician at the urban level, the senator for construction and environmental affairs of Rostock, with the topic was helpful for the acceptance and perception of the scenario process. He arranged a meeting with all senators of the city of Rostock with input from the research group which was the first official meeting focusing on climate change and adaptation on the city level.

Finally, the City Parliament adopted the framework for climate change adaptation in Rostock. The scenario process and its results contributed deeply to the contents of the framework, as it was also adapted time-wise to the political process. Furthermore, the city administration dedicated one person of the environmental administration to deal explicitly with climate change issues. On the county and regional level climate change adaptation now is accepted as important topic, but no concrete initiatives were established.

3.4 Increased resilience through increased capacity to deal with complexity and uncertainty

A multitude of socio-technical-ecological key factors driving land-use development in the urban region as well as the focus on their interdependencies build the basis of the scenario process. To describe the potential future development of the 18 key factors, each of them was supplemented by two to four development paths. In total, 58 development paths were taken into account during the scenario development. This approach had several consequences for the scenario process. First, all these factors and their development paths had to be presented in the first workshop what led to a huge amount of information – holding the risk to overburden the participants. Another consequence was the necessity to use a computer program to handle the multitude of factors and development paths as it would have been not feasible to process the data manually. Despite these difficulties, this approach allowed to tackle the complexity of urban future developments and contributed to raise awareness for complex future developments. Furthermore, the multitude of factors facilitated the integration of participants from different sectors as everyone could identify with some of the factors.

Uncertainty has been expressed through different aspects within the process: the different development paths of the key factors, four different scenarios and so-called surprising events. The different development paths, as well as the different scenarios, contributed to thinking about alternative uncertain futures and to considering uncertainty in the discussion – in contrast to discussing the most probable or a desired future. In the beginning, it presented a challenge to motivate the practitioners to be open for different future developments and not to focus on one desired future. In order to achieve this, the researchers regularly had to repeat this important aspect. Finally, the participants did not question that each of the four scenarios could occur and considered each as being a potential future development. However, the long-term effects of this aspect are not assessed.

Confronting the participants with so-called surprising events added another “level” of uncertainty. Within the workshops, surprising events (related to climate change and

other developments) were introduced into the discussion. For example, an extreme heat wave, a very long period of drought or a severe financial crisis. The participants had to discuss the consequences of these events and possible measures to deal with them. Introducing surprising events forced the participants to think about developments that were not included in the four scenarios and that exceeded the uncertainty that has already been an integral part of the scenarios. Due to the surprising events, the range of developments that had to be considered in the discussion increased. These surprising events probably increased the acceptance of uncertain future developments. As everyone has experienced surprising events before (e.g. a sand storm or a heavy rainfall) and uncertainty is a genuine attribute of these events, the participants did not doubt the occurrence of such events in the case study region.

4. Discussion and reflection - increasing resilience of a coastal urban region through this collaborative process

The applied scenario method showed that it helps to discuss climate change impacts on land-use in an integrative manner and to initiate discussions on how to deal with complexity and uncertainty. Especially the integrative perspective on land-use and complex social, economic and ecologic relations were cited as one of the two main added values by the participating actors. The second positive effect was the establishment of a new urban-rural network across sectors and logics of action. The knowledge about responsibilities or potential cooperation partners could be seen as a base for ongoing climate change adaptation efforts in the urban region. Some of these responsibilities have already been manifested during the preparation of the framework concept for climate change adaptation of Rostock.

The performed intense dialogue between practice and science has shown that such a process is demanding but can generate new transdisciplinary knowledge. This was especially the case with reference to the assessment of potential climate change impacts in the urban region, the development of scenarios and of strategies on how to deal with change processes and potential surprising events. These outcomes were also adopted by the City Parliament and initiated a strategy building process on how to deal with potential climate change impacts. That way, such a scenario process can put the concept of social-ecological resilience into practice as it offers the conditions for integrating complexity and associated uncertainty.

Taking this as basis, a scenario planning process such as this assists with improving the understanding of the characteristics and dependencies within a social-ecological system of an urban region. The knowledge integration has provided deeper insights into how the future social-ecological system of the urban region of Rostock could look like. It facilitated the discussion on region-specific issues, local and regional impacts and possible adaptation strategies, which would not have been possible from a solely scientific perspective. For the participants, it was a new and challenging, but positively judged and important experience to discuss future spatial development. Complexities were considered that had hitherto been unaddressed. A range of mutual influences, interrelations and interdependencies could be discussed with other stakeholders who shared similar concerns but with different knowledge and perspectives. This made clear

that the social and the ecological systems are not two separate parts, but should be considered as a joint entity. This understanding among the stakeholders can be interpreted as a social learning process. This process also showed that both, science and practice can benefit from such intense participation and from the joint transdisciplinary knowledge generation.

The process met the majority of the four important components required for building resilience, formulated above [11]. The integration of the complex interdependencies between the 18 key factors in addition to the consideration of different development paths open the way for considering alternative future scenarios. This helps to manage changing conditions, complexities and uncertainties because it contributes to learning to expect the unexpected. Knowledge exchange and generation is a key outcome of the scenario process, which meets the third component of combining different types of knowledge. By initiating the process, a shared opinion about the need for adaptation to climate change has been generated that could be interpreted as a social learning effort that also helps to create opportunities for later self-organization.

O'Brian (2012)[12] argues that current research is focused on adaptation to ongoing or anticipated changes and hardly on how transforming systems to adapt to long-term effects of environmental change. A participatory scenario planning process can facilitate building the resilience of an urban region, by initiating social learning, by forming a platform for cooperation and exchange and by incorporating relevant stakeholders into the process of adaptation and eventually also transformation. This might be a small, but first step to focus on adaptation not only to an anticipated future but to a range of alternative futures and thus to learn more about how social-ecological systems can change.

However, to reach real transformation, it is important to have the politicians on board who take the key decisions. Due to the focus and limited resources of the research group, the participants were predominantly experts or in administrative positions, only few political actors took part in the process. Therefore the responsibilities were partly of informal character, thus no capacity to directly decide and act was assigned, but the outcomes of the process had to be transported to the realm of politics. That way, it worked for the city level, as a key politician of the City was directly involved. But it did not really worked for the county – or even the regional level, as there were no politicians acquired from these levels. That is why, if we look at the outcomes and implementation states, we have an official political adaptation strategy at the city level but not across the city boundaries, even though the process highlighted the urban–rural social and ecological interdependencies. Here, it can be doubted at a first glance, if looked only at formal results, if resilience was increased. However, the urban region as a whole can profit from an increased resilience of its urban core and the informal weak ties which emerged during the process spanning across administrative boundaries are of an added value in order to build resilience in the meaning of being prepared to deal with change and uncertainty.

[11] Berkes 2007, Folke et al. 2006

[12] O'Brian 2012

5. Conclusions

There are many challenges to coastal urban regions coming along with future climate change impacts and further change processes. If we consider urban regions as interdependent social-ecological systems, this renders the picture even more complex and uncertain and exhibits the many potential states of not knowing to practitioners of land-use planning, city as well as regional administration, politics, business and civil society. This participatory process provided the potential to question existing norms and expectations because all participants were asked to confront uncertainties and imagine different possible futures[13].This sheds light especially on the normative challenges on how to deal with the collective resource land for the sake of future generations[14].

While it is possible to integrate complexity in such a transdisciplinary process, it needs a high amount of human resources and motivation, not only from the research team but also from the practitioners, especially from the core group. This holds also true for successful communication with the participants and building awareness among the local and regional stakeholders. Combining the challenges of discussing a complex and uncertain future, of integrating different forms of knowledge and of trying to initiate a process of adaptation, the whole scenario planning process was a challenging task for all participating actors from science and practice.

Transdisciplinary scenario planning with intensive stakeholder engagement can facilitate social learning and build social-ecological resilience to climate change impacts. Participants' understanding about the urban region and its possible future was modified and extended. Their intensive participation facilitated mutual understanding, considering a range of future courses of action and a general consensus that adaptation is necessary and should be tackled at a regional level. However, the need for transformation was not seen by all participants.

The process also showed that it is important to involve politicians from all relevant levels and across administrative boundaries in such a transdisciplinary process in order to increase resilience of the whole urban region. Even if the administration prepares the decision, it is finally the political level which takes the decisions on possible land-use forms as well as on urban and regional development and paves the way to increase resilience or even transformation in order to reach a sustainable development of the costal urban region.

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[13] Berkhout et al. 2002, Vliet et al. 2010

[14] Baier 1984

collaboration.

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