A Scenario and Monitoring Based Planning Approach to Strengthen the Resilience of the Cultural Landscape

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Abstract: Uncertainty is a fundamental part of planning. However, the long planning cycles of regional planning in Germany make it even more difficult to steer regional development in times of rapid change. With this case study from the Leipzig (Germany) region, we would like to explain the procedure in the research project StadtLandNavi. Based on a scenario-based approach, we want to show how decision processes can be supported. As a central tool, a monitoring system will be used to dynamically track the development of individual scenarios and to react to emerging changes. A main focus is the development and stabilization of the technical and administrative system, which is necessary to steer the process outside the planning cycles.

Keywords: Strategic planning, monitoring, indicators, landscape resilience

1 Introduction

Dynamic transformation and increasingly unpredictable processes are omnipresent and pose great challenges to landscape development in many places. Accordingly, planners and decision makers are asked by the scientific community to learn how to cope with uncertainties (BIRKMANN et al. 2016). Therefore, a flexible and adaptive approach to planning in general, as well as landscape development in particular, should be taken. In contrast, there is the requirement to create certainty in possible land uses and to be orderly (WILKINSON 2011, RAUWS et al. 2014, HILLIER 2017). This is the logic of formal regulations and the German regional plan, which is a static document developed over a period of 10-15 years.

With this background, the research project StadtLandNavi, funded by the Federal Ministry of Education and Research, develops and implements procedures to deal with uncertainties in landscape development. These procedures that are aimed at increasing resilience of the landscape are based on an approach called strategic navigation. One principle of this approach is allowing for situate orientation, viz. an iterative process conditioned by the respective situation with numerous references back and forth (HUTTER et al. 2019). We consider monitoring a prerequisite for strategic navigation as it allows for a continuous review of long-term targets in the region with regard to their achievement and, if necessary, points out necessary adjustments in planning measures.

In this paper we reflect on the establishing of the monitoring method the research project pursues. We refer to the case study region of Leipzig -West Saxony in Germany. The territory of the region complies with the regional planning unit, which adopted its regional plan in December 2020. A previous study identified increasing drought in conjunction with heavy

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rainfall events as one challenge for resilience of landscapes in the Leipzig-West Saxony region (SCHMIDT 2020). Accordingly, we focus on heavy rainfall as an example for laying out our approach.

The paper is structured as follows. Firstly, we introduce our understanding of resilience. Subsequently, we elaborate on strategic navigation. The main part of the paper describes the method we developed in order to analyze landscape's resilience as well as our approach for an ongoing monitoring. This is followed by a brief discussion, as well preliminary conclusions and outlook, due to the fact that we present first results of an ongoing research project.

2 Landscape Resilience and Strategic Navigation

2.1 Landscape Resilience

Landscape resilience can be understood as the ability of a landscape to adapt and renew itself, thus its ability to maintain, renew and strengthen its own fundamental landscape qualities despite continuous changes (see SCHMIDT 2020, RAITH et al. 2017, DAWLEY 2010, WALKER & SALT 2006). Every landscape has its own individual resilience profile. Nevertheless, case studies in SCHMIDT (2020) have shown that three principles of resilience play a decisive role in landscapes of completely different types, and with completely different types of disturbance and stress factors:

1) The principle of redundant diversity

Resilience is not promoted by diversity or redundancy alone, but by a landscape-specific balance between diversity and redundancy.

2) The principle of robust elasticity

Similarly, it is not only a question of the resistance of landscape structures, but also of a balanced ratio between elasticity and resistance or robustness appropriate to the respective landscape.

3) The principle of decentralized concentration

Landscape resilience is also promoted by a landscape-specific ratio between autarky and exchange or centrality and decentralization. The principle of decentralized concentration has long been established in regional planning. Just as a balance is needed between decentralization and centrality, a balance is also needed between autarky and interconnectedness.

The principles of landscape resilience can be found both on the level of actors and their actions in a landscape and on its physical-material level. They are of a general nature. This means, that even if each landscape possesses its own individual expression of the principles, it is important that no excessive one-sidedness arises. This is all the more important because cultural landscapes should fulfil multiple functions. Therefore, their "safety net" of landscape resilience must be all the more extensive. The decisive factor is the overall size of the network. For the following Figure 1 this means: The larger the area of the tensioned "safety net" is, the more balanced the specific resilience profile and the more resilient the landscape system are when unforeseen developments occur.

The following three criteria have proved to be helpful for a more differentiated assessment of landscape resilience:

1) Degree of provision of ecosystem services or degree of fulfilment of landscape functions

2) Degree of conservation of the landscape character

3) Speed of adaptation of the landscape system

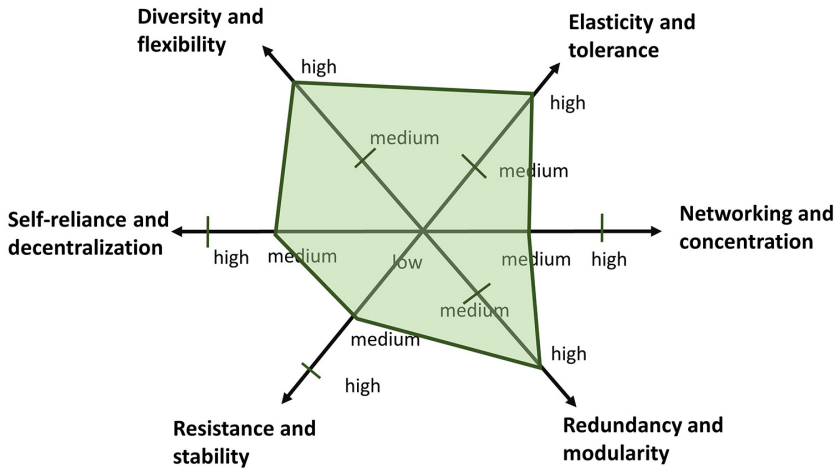

Fig. 1: Example of a safety net as an abstract visualization of landscape resilience

2.2 Strategic Navigation

Knowledge can be considered a prerequisite for developing resilient landscapes. If individuals or groups perceive a deficit of knowledge that is relevant to their intentions and actions, this is referred to as uncertainty (ABBOTT 2005). With regard to climatic phenomena, uncertainties range between the poles of predictable probability of their occurrence and intensity and their complete unpredictability. The planning discussion also points to further dimensions of missing knowledge in planning processes:

- Cause and effect relationships of planning measures and their implementation
- Goals, strategies, and actions of different actors in a region
- Value-based views by different persons (Abbott 2005)

In this way planning decisions are characterised as wicked problems (Rittel/Webber 1973), viz. developing resilient landscapes has a social dimension as well. With regard to dealing with uncertainty, this results in different approaches: 1. reduction with analyses, 2. recognition of a possible surprise by unforeseen events, and 3. creation of a common frame of reference to align views and actions of actors (KWAKKEL et al. 2010, HILLIER 2017, ZANDVOORT et al. 2018). In the following sections we focus on the first and the second category.

If there are agreed upon goals for resilient landscape design, a tentative, experimental approach can be seen as an appropriate way to deal with uncertainty. This can be characterized as an iterative learning process of testing different means for achieving goals, feeding back on achieved effects, and adjusting means for achieving goals (CHRISTENSEN 1985, BALDUCCI

et al. 2011). Thus, two different levels can be distinguished for resilient landscape design: the level of long-term orientation, which enables flexible action; and its implementation with small-scale plans and projects (HILLIER 2011, RAUWS et al. 2014). Such an experimental approach is referred to below as strategic navigation. Navigation emphasizes the need to act adaptively (WILKINSON 2011). MICHEL FOUCAULT (1982 cited in (HILLIER 2011)) understands it as a journey directed towards a goal and confronted with unforeseen obstacles. The later can be overcome combining knowledge, structured procedures, and skill. Orientation of action towards a goal is also highlighted by CATHY WILKINSON (2011), who describes navigation in more detail with the adjective strategic. Against the background of emergent effects of planning and rapid change, she emphasizes the ability to pursue an intention strategically. Accordingly, a strategic plan is understood as a document that represents speculative paths for a spatial sub-area that are directed into the future (HILLIER 2017). Its function is thus to clarify pressure for action, provide orientation and record agreements (RAUWS et al. 2014).

The discussion on strategic planning highlights a transformative claim of planning as well. PATSY HEALEY (1997) defines strategic planning as a societal process in which diverse individuals from different institutions and in different positions come together to shape planning processes and develop content and strategies for managing spatial change. Such a multi-layered process is characterized by uncertainty (HUTTER et al. 2019), which can be responded to with situative orientation. This denotes an iterative process conditioned by the respective situation with numerous references back and forth (HUTTER et al. 2019). Fundamental to skillful strategy development is thus a judgment that is sensitive to the specific nature of spatio-temporal development (HEALEY 2009). Thus, resilient landscape development faces the challenge to base decisions on updated knowledge (WILKINSON 2011). The challenge of constant uncertainty of future developments can be met by a monitoring-based approach. Monitoring has the task of providing information and reflecting on goals and assessments (Jacoby 2009). Furthermore, it is the task of monitoring to provide suitable indicators to assess the achievement of objectives and the current situation of a region. For a spatial allocation it is necessary to use data with a concrete spatial reference. Additionally, suitable evaluation scales have to be developed and appropriate geo-data have to be collected and analyzed for identification. In order to meet the requirements of strategic navigation, monitoring is a dynamic process. For this reason, it is necessary to build the underlying data base on existing sources as far as possible, or to establish appropriate agreements for long-term collection and provision. Monitoring is thus very much dependent on the necessary degree of detail of the observation, the necessary cyclical updating and the suitability of the basic data sets used for target evaluation.

3 Indicator-based Approach in the Region of Leipzig to Strengthen the Resilience against Heavy Rain Events

3.1 Modelling Scenarios

The field of heavy rainfall events is to be considered as one major challenge the cultivated landscape has to face. In addition to extended dry and drought phases, heavy rainfall events in particular have increased in the past. When precipitation does fall, it is often more concentrated. Comparing the period 1991-2015 with the climate normal period, both the number of days with heavy rain events and the intensity of heavy rain per event day have increased

almost across the whole planning region (FRANKE 2019). In this context, heavy rainfall can lead to increased soil erosion. This is not only problematic as an economical factor, but also in terms of cultural landscape. A lack of agricultural use in large parts of the planning region would be inconceivable, especially with regard to the uniqueness and identity of certain subareas. The topicality of the issue is testified by the occurrence of numerous massive heavy rainfall events in recent years. It becomes clear that the high climatic dynamics of the last decades require a continuation of data examination and analysis. In this way, trends, risks and opportunities could be recorded better and adaptation measures could be placed in a more targeted manner (SMUL 2015).

The assessment focusing the probability of occurrence of heavy rainfall events is based on a Saxony-wide study that considers heavy rainfall in detail with regard to rainfall depth, days of exceedance, mean intensity and frequency of occurrence within the period 1961-2015 (LFULG 2017). In the planning region Leipzig-West Saxony, more days with heavy rain with partly decreasing intensity could be observed than in the remaining areas of Saxony. The frequency of occurrence increases especially in summer, particularly in the second growing season (July to September).

In addition to the probability of heavy rain events, resilience depends on natural conditions: landscapes react differently to the sudden occurrence of water masses and the associated increased removal of soil substrate. Landscape resilience differs from landscape to landscape. The assessment of water erosion disposition is an integral part of a landscape planning analysis. It indicates which areas of the landscape have the greatest natural risk of increased soil substrate erosion by water. Basically, a distinction must be made between natural causes and erosion promoted by land use. The evaluation is based on the slope inclination and slope shape, the soil type, and the average precipitation amounts and intensity. An evaluation focusing on the natural risk of water erosion could be processed using a standardized official calculation procedure (ABAG according to DIN 19708).

Not only the susceptibility of the landscape to lose soil substrate through rain-impacted flows poses a risk during heavy rain events. The pronounced ability of water to seep into the soil (infiltration) should be also considered in the assessment. This indicator is largely constant and calculated for each region based on the soil type and terrain properties.

In addition to the specific soil properties mentioned above, the retention capacity is also strongly determined by the respective land use (land use-related retention capacity): the vegetation cover acts also as a relevant partial indicator but is supplemented by the respective degree of soil sealing. The applied methodology is based on a vulnerability study for the model region Leipzig-West Saxony within the framework of the model project of regional planning KlimaMORO (SCHMIDT et al. 2011).

In order to identify parts of the landscape that are particularly vulnerable to heavy rainfall events, water erosion disposition and retention capacity are considered together. Both indicators are directly linked to each other: for example, the damage caused by water erosion increases if the soil substrate does not absorb surface water quickly enough – it consequently has a low retention capacity. Avoidance capacities could only be considered to a limited extent within the scope of the analysis. The reason for this is, among other things, the uncertain data and information situation considering the agricultural management methods and details of the crop cultivation on a regional level. Furthermore, it is foreseeable that these are data

that can hardly be estimated for the future so that a considerable degree of uncertainty remains (SCHMIDT et al. 2011). In contrast, agricultural land represents by far the largest share of land use of the region's area (SCHMIDT et al. 2019).

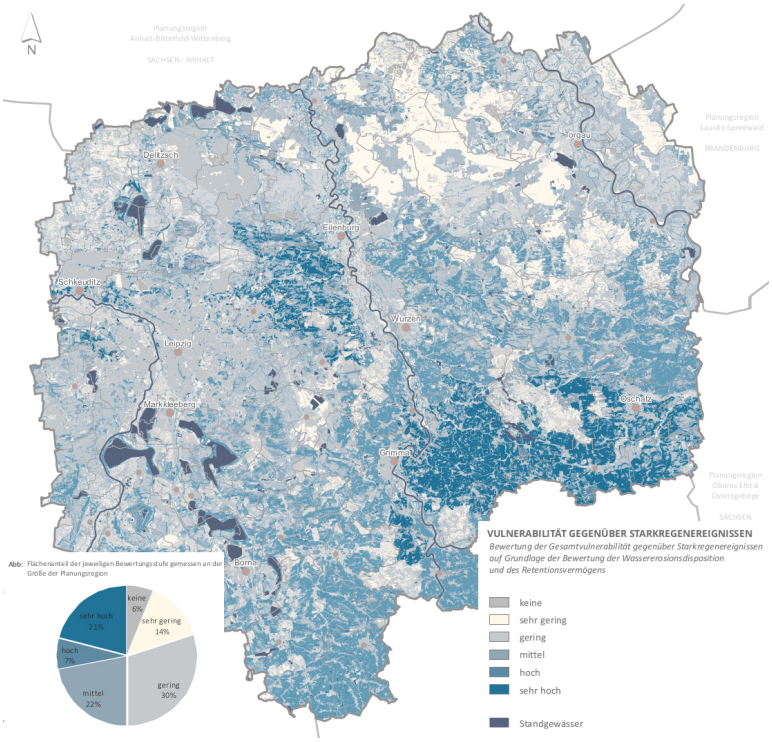

Fig. 2: Assessment of the vulnerability of the landscape in case of heavy rainfall events depending on the water erosion disposition as well as the retention capacity. Areas with a dark coloration (with the exception of flowing and standing waters) show an increased risk towards the impacts of heavy rain events (SCHMIDT et al. 2019).

The natural indicators, such as water storage capacity, soil type and relief, form the basis of the analysis. For a monitoring system in the sense of strategic navigation, however, those sub-indicators are of particular interest that, on the one hand, could be change, and on the other hand, would influence the analyses. With regard to the example just explained, this includes in particular the land use data, which are extraordinarily well suited for a spatially comprehensive monitoring tool due to the nationwide uniform and available basic landscape model. If the land use in particularly endangered areas is changed, e. g. by a year-round land cover, this can be mapped by re-processing with updated geodata and enables a possible necessary planning reaction. Additionally, the updating, combination, detailing and stabilization of the data sets of the natural sub-indicators lead to a significant improvement concerning the data basis over time. As a result, this increases the precision of the model-based indicator as well and the indicator gets closer and closer concerning landscape reality. The more the analysis fits reality, the better the basis for decision-making for resource-conserving and sustainable land management in the sense of strategic navigation.

Another factor that can be taken into account when assessing potential risk areas during heavy rain events is the mapping of runoff paths. They document recurrent erosion processes and thus highlight the areas with the greatest soil substrate losses. The individual trajectories differ in length and intensity and also represent suitable starting points for counteracting water erosion in agriculturally dominated areas.

The natural factors determining the sensitivity of the cultural landscape are known in the Leipzig region and are hardly subject to change. The uncertainty here is accordingly low. However, the natural factors define the framework within which the variable, use-related factors must be regularly monitored. The typical planning periods at the regional level of 10 – 15 years are too long to react appropriately to possible undesirable developments with adapted measures.

Other scenarios and indicators that will be developed for the region consider landscape resilience to drought stress, dust storms, and flood events in agriculture and forestry. Furthermore, the changes of the cultural landscape with regard to technogenic overprinting, landscape image and recreational effectiveness of open spaces in the region are to be monitored. After the necessary methodology has been developed by the research project, it is currently being coordinated and adapted with experts from regional, district and urban planning. Subsequently, the monitoring tool will be established and released for use by all actors in the region and the public.

3.2 Monitoring

When applied to monitoring resilience of a landscape to heavy rain events, one has to take into account that the indicator exposure to water erosion is composed of fixed and dynamic factors. For monitoring, it is crucial to look at the highly variable sub-indicators on a regular basis. There are several sources of information that allow an assessment of the hazard or the reduced hazard through implemented measures. In the area of agricultural management, this is, on the one hand, the crop type composition. On the other hand, the percentage of land that is cultivated with soil-conserving techniques as well as currently fallow land or temporary conversions of erosion-prone land into grassland. In the area of the biotope equipment of the cultivated landscape, these can be hedges and embankments or compensation areas with erosion-reducing management objectives.

Our work shows that necessary data for monitoring is available from a wide variety of authorities. However, these information flows are not established at the planning level. Neither are there agreements on the provision of data, nor are the data available for a one-time analysis of the current situation. This is the main challenge in establishing a monitoring system. The aim of the StadtLandNavi project is therefore, after the analysis of the demand situation, to take the first steps for long-term safeguarding of data flows in the region. This safeguarding is based on the creation of automatic mechanisms for the provision of data. If individual basic data for the indicators are updated, the data stock in the monitoring system is updated by automatic processes and the indicators, the degree of target achievement and threats are recalculated. The actuality should always be based on the most current initial data set. This makes it possible to monitor the achievement of objectives or the threats to the scenarios outside of planning cycles and with little personnel effort.

In addition to the purely preparatory observation, several exemplary measures will be implemented in the landscape, such as increasing resilience. By means of monitoring, the effects

of the measures implemented in practice will become visible and evaluable. This should lay the first foundations for monitoring to support decisions as to when measures are necessary and how they work. At the same time, individual examples already provide a first catalog of what can be implemented to improve or achieve the goals of the individual scenarios.

Since monitoring is an ongoing and continuous process, it is not sufficient to develop the methodological basis. Successful establishment requires anchoring the system on a technical basis as well as on an administrative level in the region. In a first step, an actor in the region has to be found who takes over the maintenance of a monitoring system. This includes the maintenance of the technical basis and access rights of a service- and WebGIS-based system as well as any necessary adjustments of data sources during operation, support requests and governance tasks. During the ongoing operation of a monitoring system, it is to be expected that adjustments in the area of governance will become necessary. This can be the extension of the user group or contractual adjustments in the procurement of basic data or license models. The challenge here is to find an actor, or several actors, in the region where both the personnel basis is anchored and the necessary accepted authority is available to curate the contents of the monitoring system. Such an actor can be an already existing structure such as a regional planning association, a county, a well-staffed municipality or a metropolitan region in addition to a newly founded company. Contracts then ensure the provision of data, the provision of specific information for the internal use of individual actors and the public, and the financing of personnel and ongoing technical maintenance on the part of the curator.

4 Discussion

We propose that the outlined monitoring procedures may support planning actors in the Leipzig region to connect the overarching goal of resilience with down to earth implementation measures. The evolving knowledge base may allow for strategic navigation in landscape development.

The combination of analysis of the cultural landscape, derivation of necessary data flows for institutionalization of monitoring, creation of a technical basis in the region and finally exemplary implementation of measures is costly, but at the same time promising. The pure theoretical analysis and indicator development cannot lead to an implementation by the actors on site by their own resources. Therefore, StadtLandNavi processes tasks that are independent and superordinate of everyday work. Based on our preliminary results, we propose that the biggest challenges for ongoing monitoring required for strategic navigation are establishing data provision and defining responsibilities for the ongoing monitoring procedures. This requires agreements with the responsible body of the monitoring with regard to the type of provision (data standards, services, rights and visibility rules) with all management entities of the necessary source data sets. In addition, from a methodological point of view, it is sometimes necessary to extend existing data collections or even create new ones in order to achieve the necessary level of detail. The first examples, which have been developed in the research project and will be further developed in the next two years, are a signal for the necessity and feasibility on a political level.

5 Conclusion and Outlook

An important aspect of monitoring cultural landscape development is institutionalization. Discussions with actors in the region have already produced several expressions of intent. Currently it is being decided with which actor the technological basis will be implemented. Start-up financing for the adaptation of the monitoring system, which is currently still anchored in the research project, is available. The operation is thus secured for the duration of the project until 2022. Subsequently, the operation and further development based on the current experience and suitability of the system can continue to serve as planning support. Further topics besides the cultural landscape are planned and already in the first evaluation regarding suitability. These are sustainable land management, securing of recreational functions and housing demand analyses.

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