Developing New Images of Rurality

Interactive 3D Visualizations for Participative Landscape Planning Workshops in the Entlebuch UNESCO Biosphere Reserve

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Abstract: Currently, there are several social and economic forces that will cause visible changes to the rural landscape. Strategies that accommodate these changes are being sought through the participation of local populations. New visions of rurality as well as new visual tools that support participation processes are needed in this social and economic context. Such tools were evaluated as part of the EU project VisuLands and in collaboration with the Entlebuch UNESCO Biosphere Reserve (the Swiss case study site). The results of the study outline the strengths and weaknesses of the tools. The discussion of the planning topics took place in locally established panels, and the key benefits of the visualizations were that they helped to raise awareness of the issues and to illustrate and communicate important landscape processes. In particular, if issues are related to topography or dynamic landscape processes, the tools stimulate discussion and facilitate the visual evaluation of development alternatives.

Background

Many of the current challenges in landscape change across Switzerland correspond to similar developments in other parts of Europe, for example, the abandonment of agricultural land in peripheral areas and increasing urbanization at the fringe of the cities. Although some of the changes will affect land cover and rural landscape patterns in different ways across Europe, landscape change is high on the political agenda and it is important to improve the understanding of the outcomes of landscape planning decisions. Following the Rio Declaration on Environment and Development (United Nations 1992), it is commonly acknowledged that landscape change has to take place in a sustainable way that incorporates environmental, social and economic aspects, but mainly considers the needs of future generations. Overall, new visions of rurality are needed.

In this context, public participation is seen as a major requirement for the realization of sustainable landscape policies in the long term and has been included in national as well as international legislation, for example, the Aarhus Convention (UNECE 1998). Public participation is sought in order to give political decisions a broader justification, it gives stakeholders the chance to contribute local knowledge and it is suggested that it improves the acceptance of planning decisions in the long term. However, public participation in landscape planning often lacks a common understanding of the long-term changes and their driving forces, which are very difficult to communicate in traditional ways (Lange et al. 2003). Therefore, both new visions of rurality and new instruments are needed to show the relationships between the visual qualities and other landscape functions.

EU project VisuLands

The main objective of the EU project VisuLands is to develop and test interactive landscape visualizations as new tools for public participation in landscape planning. These tools are based on geodata and they allow the spatial analysis and flexible visualization of the current state as well as future scenario alternatives. In order to combine the assessment of the visual qualities of the landscape with other aspects of sustainability, the visualizations are presented in combination with a set of indicators that were developed through the project. In summary, the principal objectives are:

- To develop visualization techniques to assess future landscapes.
- To develop quantitative landscape indicators of landscape change.
- To provide a robust set of preference models applicable to European landscapes.
- To link visual qualities to production, ecological, cultural and amenity functions.
- To test the effectiveness of visualization tools in communicating the outcomes of policy and planning decisions on landscape evolution.
- To exploit the project results and tools through the production of educational materials and outreach schemes for professional training purposes and for the public.
Method

Case study analysis

Repeated testing during the development of the visualizations should ensure that the final visualization tools meet the end users’ needs. Therefore, a social-empirical research design was set up to provide a structure for collecting and analyzing feedback. Since the impact of the 3D visualizations had to be assessed with regard to several aspects within the rather complex context of participative landscape planning, the qualitative approach of case study analysis was seen as the most suitable (Flick et al. 2003). In this process, the data was gathered in the field, i.e., in real planning situations.

Special focus was placed on using different perspectives on the phenomena in order to produce a more comprehensive picture of the 3D visualizations’ usability. Thus, the data was collected over several workshops with different stakeholders working on various topics related to landscape development. The methods for data collection comprise observation of and group discussions with the workshop participants as well as in-depth interviews with key actors. These have been documented in protocols and, when possible, on audio or video tape. Later, the interviews were transcribed on basis of these tapes.

The data was then analyzed by coding and clustering, using a combined method of grounded theory and qualitative content analysis (Strauss 1998; Diekmann 2005). In order to ensure an objective analysis, two researchers conducted independent observations, following a set of structured observation guidelines, and compared the results afterwards. In addition, quantitative methods were used to enlighten single aspects of the 3D visualizations’ functionality. This approach of carefully combining different data sources, researchers, and methods is called triangulation (Kelle, Erzberger 2003; Flick 2004).

This led to the development of new hypotheses, concepts and theoretical explanations with regard to the impact of the 3D visualizations and their effectiveness in illustrating visual landscape qualities, integrating non-visual indicators with other landscape qualities, and using them in workshops that focused on the development of scenarios of landscape change. The results from earlier workshops were used to iteratively improve the tools (Figure 1).

Case study site – Entlebuch UNESCO Biosphere Reserve

In the VisuLands project, the 3D landscape visualizations were produced for various European
regions, in cooperation with local stakeholders, in order to assess the usability of the tools. In Switzerland, the Entlebuch UNESCO Biosphere Reserve (UBE) was chosen as the case study site. It is located in the main valley between Lucerne and Bern and is famous for its cultural landscape of (inter-)national significance. The diverse, agricultural landscape contains important habitats for plants and animals, for example, karst areas, forests and unique moorlands.

Biosphere reserves are sites recognized under the UNESCO’s Man and the Biosphere Program that innovate and demonstrate approaches to conservation and sustainable development (http://www.unesco.org/mab/mabProg.shtml). The Entlebuch site is special because the inhabitants proposed their region as a UNESCO Biosphere Reserve in a bottom-up process. In a participative procedure, they compiled a basic strategy, and the inhabitants of all eight municipalities voted in favor of it. Only one year later, in 2001, Entlebuch was designated as one of the first biosphere reserves based on the Sevilla Strategy (Ruoss et al. 2002). In accordance with the Sevilla requirements, the biosphere reserve was structured into core areas, which are protected sites for conserving biological diversity, a buffer zone that surrounds the core areas and is used for cooperative activities compatible with sound ecological practices, and a flexible transition area, which contains a variety of land uses and where different stakeholders work together to manage and develop the area’s resources in a sustainable manner (UNESCO 2006).

In the following years, social, economic and environmental projects were set up in local and regional teams and specialist forums. These teams addressed problems related to current trends in population growth and distribution, increasing demands for energy and natural resources, globalization of the economy and the effects of trade patterns on rural areas, erosion of cultural distinctiveness, along with centralization and difficulty of access to relevant information, and the uneven spread of technological innovations. These same issues are found in other European regions (UNESCO Biosphere Entlebuch 2006; UNESCO 2006).

Landscape development is a central topic in most of the projects because a beautiful and ecologically stable landscape is recognized as the basis for a healthy life and, furthermore, provides natural capital for tourism and constitutes a powerful mechanism for promoting regional products (Ruoss et al. 2002). Already established panels and workshops provided the means to involve Entlebuch’s local community in sophisticated participation processes and, in this case, provided a very good basis for testing the visualization tools and gathering feedback on their usability.

Seven workshops on the topics of settlement patterns, tourism, forest management, and future agricultural management concepts for local farms used the visualization tools. These were facilitated by members of the biosphere’s regional management and took place locally. The 3D visualizations were integrated into the workshop moderation, and the VisuLands team presented them on demand. In all cases, the content of the visualizations was discussed beforehand with the experts and facilitators conducting the workshops.

In the following section, the production and application of 3D visualizations used in two thematically different workshops or series of workshops are described.

**Case Study Examples**

**Tourism workshop**

In 2004, the Entlebuch UNESCO Biosphere Reserve coordinated a workshop to consider the long-term visions of winter tourism, to support strategic planning for the future, and to collect stakeholder views on threats and opportunities to the industry. Most visitors to the area around Sörenberg (1165–2350 m above sea level), take part in winter sports, so safe snow conditions are of great importance, as is long-term quality and the infrastructure required to match demand.

The process was led by the moderator, using the tools as needed to aid, inform, or stimulate discussion, or to challenge possible misunderstandings. The workshop on tourism started with a summary of the existing infrastructure that supports tourism in the area. The landscape visualizations provided the visual aids for this workshop by showing the distribution of winter tourism facilities compared with those for hiking and biking routes for summer tourism. Ski slopes, lifts, and hiking paths were progressively projected onto a 3D model of the area and then presented from different viewpoints, selected by the moderator or participants. On the basis of this information, a key observation was that all of the skiing facilities are very much concentrated in the area close to Sörenberg, whereas summer facilities are dispersed across the region and, in conclusion, that summer and winter tourism have varying impacts on the transport infrastructure.
One issue that the moderator wished to have at the forefront of discussion was that of exploring strategies for adaptation to potential changes in climate. Together with the moderator and based on studies by Föhn (1990) and Elsasser and Bürki (2003), one of three possible scenarios, a future level of probable safe snow conditions of 1500 m in 50 years, was chosen as an example to stimulate discussion. The views of the area were projected using the visualization tools, with areas below the snowline colored green (Figure 2). Although participants had an impression of the estimates of temperature, precipitation and snowline from general information about climate change, the effect of the visualization tools was to cause some discomfort and astonishment at some of the potential impacts in different areas of the valley. After this demonstration, the focus of the discussion shifted from the enhancement of winter sports to alternatives of hiking, educational and agricultural tourism.

In addition, the analysis of the interactions between the moderator and the participants and the references that people made to the visualizations helped to clarify the role of the moderator and the visualizations. It seems that in this setting, the visualizations are mainly a tool for the moderator. The moderator utilized the visualizations to support his arguments as well as the discussion, whereas the participants referred less often to the visualizations in their arguments, although they did watch and discuss the visualizations.

Given these observations, what are the requirements for the interactivity of the tools in this type of collaborative process? As part of a current PhD thesis, this question was addressed in group discussions, in interviews during the workshop as well as in subsequent workshops and questionnaires. At this point, it may be concluded that the collaborative setting puts a higher demand on interactivity than other forms of participation that require less involvement from the participants. For the discussion of spatial issues in rural areas, real-time movement is especially helpful to give the moderator the necessary flexibility to show areas of interest as well as specific perspectives. In the tourism workshop, spatial analyses were also applied to the model, and participants asked the visualization team to include additional statistical data on traffic numbers. In comparison, the illustration of alternative planning scenarios and of changes over time gained increasing importance during the agriculture workshops (Schroth et al. 2005).
In particular, feedback from the workshop suggested that the elevation analysis, and its use by the moderator, had an impact on the location of future skiing facilities and the concepts of tourism strategies. Although discussion was encouraged, one participant felt uncomfortable working with the 3D images, because he considered them to be “manipulative”. Such concerns are frequently raised when computer-generated visualizations are used in planning and they should be taken seriously, for instance, by focusing further research on both more transparent technical solutions and inclusive participation processes.

Agriculture workshops

The characteristic landscape of the Entlebuch area has been shaped by agriculture, especially cattle breeding and dairy farming. Facing the future challenges of European trends in agriculture that come along with market liberalization and declining subsidies, local farmers of the UBE, administrative representatives, experts, and scientists worked together to develop a concept for future management systems on the alpine farms within the structure of the EU project Lacope – Landscape Development, Biodiversity and Co-operative Livestock System (www.lacope.net). The visualization tools were used in three of the Lacope workshops.

From the beginning, a strong collaboration between the teams of the Lacope and the VisuLands projects was established. The first step was to define the use of the visualizations in the planning workshop. According to the trends and the scenario already developed by the stakeholders (i.e., expected lower income from agri-
culture), a restructuring of the alpine farms had been described. As a consequence, views of the landscape would change vastly as much of the open areas would be subject to succession from meadow to forest. This scenario was visualized to provide an impetus for discussions on alternative development concepts.

Local experts described the spatial-functional relationships of alpine pastures in terms of land-use change during the workshops. These were enhanced by a literature review [e.g., Pezzatti 2001; Gotsch et al. 2004]. In a next step, these qualitative descriptions were reduced to quantifiable criteria, for example, distance between farm buildings and pasture, height above sea level, slope, and the current type of management, and then translated into a spatially explicit GIS database. The detailed GIS data comprised, among others, a digital elevation model (DEM) with 10 m resolution, and a map of vegetation types on the alpine pastures was very well suited for a specific visualization approach, i.e., the 3D visualizations with rather geo-specific geometry and textures, looked quite realistic (Bishop, Lange 2005).

A time horizon of 30 years for the scenarios was seen as useful since numerous ecological and economic variables cannot be anticipated beyond 30 years with enough certainty. A time period of five years was chosen to demonstrate economic changes due to management alternatives, which was provided by the Lacope team. Two further time periods of 15 years and 30 years from today were seen as more useful for showing the impact of development on the vegetation, and thus the landscape view.

Specific visualizations were produced with the software package, Visual Nature Studio (VNS; www.3dnatur.com) demonstrating the impact of undergrazing and abandonment of the alpine pastures resulting from the agricultural trend scenario and its effects on interdependent aspects of aesthetic, ecological and economic aspects. A series of specific overview visualizations showed the shift in the landscape mosaic (Figure 4).

Different possibilities of future landscape management were discussed. Specific visualizations of smaller areas should elucidate their qualitative differences with regard to ecological, economic and social aspects. An assessment of the view of the landscape and the shift in the species composition was offered based on the renderings. These would give indications of the ecological intactness of the vegetation types and allow appraisals of the quality of fodder and therefore the productivity of the pasture over time. Therefore, the vegetation types were representationally stylized by exaggerating their key species and the indicators of the direction of long-term development (Figure 5).

3D models generated with the software package LandXplorer (http://www.3dgeo.de) were used to present the different criteria that influence landscape change in their spatial context in a more symbolic style, which is a rather abstract representation of the landscape (Bishop, Lange 2005). In the presentation, different layers with polygons to indicate the spatial dimension of the criteria were draped on the virtual model (for an example of a symbolic model, see Figure 2). In the first Lacope workshop, these visualizations explained the spatial data basis for the generation of previously developed specific visualizations. In a second representation, the symbolic model supported an input presentation of scientific results by displaying indicators with economic relevance for farming, for example, the adequacy of the pastures for different cattle types. Another time, the polygons used as the data basis for the scenarios given in specific visualizations were shown simultaneously in the symbolic model. Both visualization types were presented in a loop so that the participants were able to see them several times to study, comment and open the discussion on alternative management scenarios.
Results

In the analysis of the results, one focus was placed on assessing the quality of the design of the relevant planning information in the 3D visualizations that support the processing of certain planning tasks (Wissen et al. 2005; Lange et al. 2005). Overall, the 3D visualizations were shown to be very suitable for raising people’s awareness and supporting the collection of information. They are also rather efficient for documenting and presenting the status of planning when checking the plausibility and consequences of planned measures.

Up to now, different software packages needed to be purchased to produce all the visualization types for an exercise such as this study, since there was a lack of software with full functionality. With regard to limited resources in terms of money and time for the development of 3D visualizations in participatory processes, it is not likely that many facilitators can afford to purchase and learn multiple software systems. Therefore, the study tried to find differences in the relative strengths of software as decision support tools.

Specific-detail visualizations are most useful as a means of involving lay people by raising their awareness through recalling or anticipating experiences at a very early planning stage and supporting the collection of information to capture participants’ issues. In addition, the specific type of visualization proved valuable as a support when checking the plausibility and consequences of planned measures (e.g., the evaluation of the correctness of a concept such as the process of forest growth on alpine pastures).

Presenting the status of planning to lay people worked very well with the use of symbolic visualizations. However, a high level of information aggregation is necessary to make them a valuable tool for lay people. The symbolic-detail visualizations used in the workshops seemed to be too complex in some cases.

Experts were able to deal with the symbolic visualizations much better than lay people. Experts are used to symbolic representations and therefore seem to gain much more information from them than lay people. Spatial relations of land-use information with the topography were easily understood. Thus, these types are well suited for the collection of experts’ opinions. In particular, detailed visualizations provide a good basis for discussing certain aspects of a plan or development. Both symbolic visualization types supported the checking of data completeness and accuracy. A brief overview on these results is given in Figure 6.

In real-time visualizations, the choice of visualization types is extended by the various possibilities to explore and communicate the virtual landscape interactively. The case study examples provide evidence that a higher level of participation, for instance, a collaborative setting, requires a higher level of interactivity in order to be flexible enough to respond to the demands of the participants and an open-ended planning discussion. Real-time movement may also support the experience of topography, but the option to switch among the three alternative scenarios and to change among the three timeframes seemed to be more important in this context.

Fig. 6: Visualization types and their qualities with respect to processing certain planning tasks (3D visualizations by VisuLands 2005; geodata courtesy of GIS Canton Lucerne)
Discussion

The Alps are rather well documented by geodata, which offer the opportunity to create realistic virtual landscape models to support the analysis of current and future landscape change. In the political process, it will be of special interest to use these visualizations to support the assessment of future changes in the rural landscape as a consequence of today’s policies.

One main advantage of the 3D visualizations is that they offer relevant planning information in a form that is easy to digest by people without a planning background. This is especially true for the rather difficult task of imagining future landscape visual qualities and long-term processes of landscape change. This enhances the communication among all the participants, i.e., the transfer of information in both directions. In this way, 3D visualizations offer an instrument to create a common thought and argumentation process. Integrating the views of different stakeholders and elaborating a long-term vision for regional rural landscape change is a prerequisite for sustainable landscape management (Antrop 2006).

Further analysis of the data gained in the planning workshops of the UBE promises more insights regarding the impact of 3D visualizations on the understanding of planning information, communications, and the planning process. These will be described in two forthcoming PhD theses.

However, the successful application of the 3D visualizations also depends on the framework conditions under which the visualizations are used. Personal responsibility by the local public is necessary in order for them to actively take part in the development of new visions for their region. Therefore, participative processes should be supported not only by new tools, efforts should also be made to establish functioning participative structures characterized by a partnership of the participants.

References


