Supplement 2: Key elements of the participatory approach in the Niraj-MAES project

Box 1: The Stakeholder Advisory Board (SAB)

The implementation of the research project was substantially supported by an Advisory Board representing local experts from a wide range of fields (municipalities, regional development, agriculture, forestry, water management, tourism, education, regional associations, regional press). The Board, comprising 16 members, met four times during the one year research process, and members were also consulted individually regarding questions related to their areas of expertise. The main task of the Board was professional supervision, advisory work and ensuring credibility: every important step and result of the study was discussed with them and their suggestions were built into the research aims, analyses, models and evaluations. All members of the Board lived and worked in the project area, and half of them came from the Niraj-valley, while the other half represent the Târnava Mică part of the study area.

The four formal SAB meetings provided vital inputs for the project:

- SAB I (07/2015):
    - Discuss the project goals, timeline, and the SAB role and mandate
    - identify the main issues in local level and how to make the research relevant
    - identify a shortlist of relevant ES for the study region
- SAB II (09/2015):
    - identify the final set of ES types and ecosystem condition aspects to be mapped and modelled
    - give guidance on locally available datasets for modelling / quantifying indicators of condition, ES capacity, and ES actual use.
- SAB III (02/2016):
    - present and discuss matrix workshop outcomes (with a focus on the matrix models and the proposed extension rules)
    - identify the most influential drivers for the scenario planning exercise
- SAB IV (06/2016):
    - discuss the main ES mapping and scenario planning outcomes
    - identify key messages

Box 2: Identifying key stakeholders

A stakeholder analysis was conducted in order to identify the major institutional players and their key representatives influencing or influenced by the ES flows in the study region (Hauck et al., 2016). Empirical data gathering was carried out with semi-structured interviews with questions addressing ES directly and indirectly (local natural values, changes noticed, future visions, etc).

In the selection of the interviewees we tried to cover a range of stakeholders and land users as wide as possible. To identify potential interviewees a snowball approach was used until reaching saturation (Patton, 2002; Kvale, 2005). The interviews were documented anonymously.

The results were used in multiple ways: a stakeholder map (Rastogi et al., 2010) was drawn, key stakeholders were selected and invited to participate in the workshops. Furthermore, a simple qualitative content analysis (Forman & Darmschroder, 2008) was performed by extracting all ‘potential’ ecosystem services, and related ‘key issues’ (problems and/or conflicts related to agriculture, forest management, water management etc.) mentioned by the interviewees. The extracted ‘initial list of potential ES’ was then used as a key input for the 1st SAB meeting (SAB1).

Box 3: Eliciting stakeholder preferences

In order to assess the importance that local stakeholders assign to different ES, we made two surveys: one among the general local public, the other with representatives of local businesses. Both audiences were presented the same shortlist of relevant ES (the output of the 1st SAB meeting) which were scored according to their perceived importance following a predefined survey structure.

The general survey was combined with a visual methodology where respondents were asked to review the photographs illustrating locally relevant ecosystem services and to choose the most important ones from the panel (‘photo elicitation’ García-Llorente, 2012; Kelemen et al., 2015). After each choice respondents were asked to justify why they thought that certain ecosystem service was of importance to them, which allowed us to collect qualitative information on what made different services valuable to local people (what are the relevant value dimensions in this specific context). Respondents were also asked if any relevant ecosystem services were missing from the panel to ensure that the priority list of ecosystem services was inclusive. Data was collected by 28 undergraduate students, who participated in a half-day online training organized prior to the field work. They worked in pairs: one of them held the photo panel while the other one asked the questions and noted the answers. Seven pairs worked in settlements along the river Niraj, and another seven pairs worked along the river Târnava for three days. Since data collection was scheduled to a weekend of a major regional festival (1-2 Aug 2015), student pairs initiated discussions with respondents while walking on the streets of settlements belonging to the research area.

To perform a preference assessment among the small and medium-sized companies of the region (typically related to agriculture) we used a modified version of the Corporate Ecosystem Services Review (ESR; Hanson et al., 2012). ESR was originally designed for corporate leaders to facilitate the development of a corporate strategy based on the analysis of a business’s dependence on natural capital (ecosystem services) and its impact on these. We simplified the ESR methodology with a focus on the dependency side of the dependency-impact matrix, since typical companies of the region do not have relevant data on their impacts and, of course, have no interest in presenting their activity in a negative light. Data was collected by two pairs of surveyors in Aug-Sep 2016. An initial set of local companies were selected based from a regional business catalogue, and some further businesses were recommended by the respondents on request (snowballing). In total the leaders / representatives of 55 local businesses were asked in 14 settlements of the two river valleys. When choosing the businesses we wanted our survey to cover a wide variety of economic activities so that we could find out about the economic involvement of these businesses in as many different economic sectors and spheres of activity as possible. 90% of these companies can-be seen as micro-businesses with a further four small and five medium-sized ones.

Box 4: Creating scenarios

Ecosystems that provide their essential services are complicated natural systems. We affect their operation with every decision, be it cutting down a tree, building a new road or pension, or stopping grazing on a hill. However, making the right decisions is not an easy task: often private interest flies in the face of public interest, short term runs counter to long term. Furthermore, we do not understand the interrelatedness of the complex systems either, hence we have difficulty seeing clearly the possible consequences of our decisions. Moreover, our future is threatened by countless uncertain economic, social or environmental factors from climate change to geopolitical processes which make decision-making or even giving advice on concrete issues all the more difficult.

However, there is an option in the arsenal of science for tackling such deeply uncertain and complex issues: scenario planning. The main aim of scenario planning is to condense the unknown and uncertain factors into a few different but internally consistent scenarios by considering the main driving forces and covering the main uncertainties of the future. Scenarios focus on the common, joint effect of different factors. They create the impression as if we were studying how the different colours and shapes move on a large tapestry if one thread or the other is pulled.

Scenario planning is not a scientific process in the strict sense of the word: without the extensive participation of and dialogue between those involved, there is no chance of understanding interrelatedness or identifying values and threats. Accordingly, during scenario planning and evaluation we intended to address and involve all major social and professional layers of the local community. Without the participation of the experts of sectors including agriculture, forestry, water management, tourism, education, and others, the results achieved can easily show internal contradictions and can poorly reflect natural relationships as well as local and social idiosyncrasies.

The scenario planning process and its results are shown in detail in Kalóczkai et al. (2017)

Box 5: The matrix workshops

The majority of ES models created during the project were developed through structured interactions with local experts in two intensive work sessions called 'matrix workshops'. After considering the interview results and SAB recommendations, six ES were selected and modelled this way: *honey*, *timber*, *hay*, *berry*, *tourism* and *erosion*.
Two half-day matrix workshops were organized, each discussing three ES. Small expert groups were formed with 3-4 experts per ES. Experts were invited and assigned to groups based on their expertise, identifying a primary and a secondary field of expertise for each of them. The groups developed simple tier 1 models by assigning relative scores between 1-10 for each matrix cell, addressing the estimated capacity of each ecosystem type to supply the selected ES. In case of some ES, sub-categories of ecosystem types and influencing factors were identified to assist a subsequent upgrade to tier 2 (rule-based) models. Such rules (and some of the matrix scores) were fine tuned after the workshop, based on additional expert consultations, the SAB, and/or literature data.

The outline of a matrix workshop was the following:

- Plenary 1:
    - short explanation of the ES context and the actual exercise
- Group work 1 -- scoring (3-4 experts +1 facilitator, focussing on the ES of their primary expertise):
    - get familiar with the task, the base map and the ecosystem types (quick questions and answers)
    - scoring: take the ecosystem types one by one, and
        - identify potential subtypes that would have different scores
        - score the ES supply capacity of each ecosystem (sub)type
        - identify further environmental factors that might affect the ES capacity
    - fixing the scale:
        - name the 'best habitat' at country-level (Romania) and score that habitat too (to place the local scores into a national context)
        - assign physical units to a few key scores (e.g. the two ends and the midpoint of the scale, wherever possible)
- Break, groups are reorganised
- Group work 2 -- validation (3-4 experts +1 facilitator, focussing on the ES of their secondary expertise):
    - check the subtypes and scores set by the first group
    - recommend revision for any disputed results (with justification)
- Break
- Plenary 2:
    - matrix models are projected both as a table, and as ES capacity maps (using the Quickscan GIS environment)
    - issues raised by the verification groups are discussed until reaching a consensus

  - the tables and the maps projected are adjusted on the spot (instant visual feedback)
- The whole process is documented in detail

Key lessons from the matrix workshop:

- we used the school grading system of Romania, which was expected and found to be easily understood by the local experts
- it was important to constantly remind the experts to “stay within the study area” -- many experts had experiences in the higher parts of the Carpathians, which would lead to misleading scores for this region
- it was easier to start with the ecosystem (sub)types with the lowest (score 1) and highest (score 10) capacity ecosystem type, then score all the rest in between.
- splitting ecosystem types to subtypes was very useful both for resolving disputes and enhancing consensus, as well as for a later creation of rules and/or fine-tuning the ecosystem map
- allowing ranges (and not just fixed scores values) could also speed up the consensus

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