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Research, part of a Special Feature on Sustainable Land-Use Practices in Mountain Regions: Integrative Analysis of Ecosystem Dynamics Under Global Change, Social-Economic Impacts, and Policy Implications

Constructing Consistent Multiscale Scenarios by Transdisciplinary Processes: the Case of Mountain Regions Facing Global Change

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ABSTRACT. Alpine regions in Europe, in particular, face demanding local challenges, e.g., the decline in the agriculture and timber industries, and are also prone to global changes, such as in climate, with potentially severe impacts on tourism. We focus on the Visp region in the Upper Valais, Switzerland, and ask how the process of stakeholder involvement in research practice can contribute to a better understanding of the specific challenges and future development of mountainous regions under global change. Based on a coupled human-environment system (HES) perspective, we carried out a formative scenario analysis to develop a set of scenarios for the future directions of the Visp region. In addition, we linked these regional scenarios to context scenarios developed at the global and Swiss levels via an external consistency analysis. This method allows the coupling of both the scenario building process and the scenarios as such. We used a functional-dynamic approach to theory-practice cooperation, i.e., the involvement of key stakeholders from, for example, tourism, forestry, and administration, differed in type and intensity during the steps of the research process. In our study, we experienced strong problem awareness among the stakeholders concerning the impacts of global change and local challenges. The guiding research question was commonly defined and problem ownership was more or less balanced. We arrived at six multiscale scenarios that open up future trajectories for the Visp region, and present generic strategies to cope with global and local challenges. The results show that local identity, spatial planning, community budget, and demographic development are important steering elements in the region's future development. We suggest that method-guided transdisciplinary processes result in a richer picture and a more systemic understanding, which enable a discussion of critical and surprising issues.

Key Words: *global change; human-environment systems; mountain regions; scenario analysis; sustainability science; Switzerland; transdisciplinarity*

INTRODUCTION

Since European industrialization, Swiss mountain regions have undergone fundamental societal and economic changes (Collantes 2009). The populations in many remote villages have decreased and become concentrated in small towns on the valley floors. Traditional sectors, such as the agriculture and timber industries, declined whereas the service sector, particularly tourism, has become the economic backbone in many regions (Federal Office for Spatial Development 2005, Kopainsky 2005, Soliva 2007, Schild and Sharma 2011). These societal and economic transitions were often accompanied by expanded settlement and infrastructure as well as declining agricultural activities. Thus, they tended to result in considerable changes in ecosystem services, such as scenic beauty, recreation, and avalanche protection (Grêt-Regamey et al. 2008). At the same time, the Swiss alpine regions have been projected to experience severe climate change impacts, for instance, decreased snow reliability, melting of glaciers, and a higher frequency of natural hazards (Beniston 2005, OcCC 2007).

To achieve a better understanding of these kinds of real-world challenges, besides basic research by natural science yielding generalizable results, there is a need for interdisciplinary frameworks that take into account the complexity of human-environment systems (HES), and relate natural to social science knowledge (Folke 2006, Liu et al. 2007, Ostrom 2009, Scholz 2011). Multiscale scenarios have been suggested as a useful method for achieving this (Scholz and Tietje 2002, Biggs et al. 2007, Kok et al. 2007, Zurek and Henrichs 2007). However, interdisciplinarity frameworks are a first necessary, but not a sufficient step to achieve a more comprehensive understanding of a region studied. To acknowledge problems that regional inhabitants and decision makers perceive as the most pressing, and to consider regional specificities, scientists need to go beyond an interdisciplinary "science for society" paradigm, and move to a transdisciplinary mode of "science with society" (Scholz 2011). Transdisciplinarity starts from the assumption that scientists and practitioners are experts in different knowledge domains in which both sides may benefit from a mutual learning process (Scholz et al. 2006, Stauffacher et al. 2008). This transdisciplinary learning process may result in socially robust knowledge and a more comprehensive systemic understanding of the problem at hand.

We focused on the Visp region in the Upper Valais, Switzerland, a typical inner alpine region, and aimed to build a systemic and contextualized, stakeholder-based understanding

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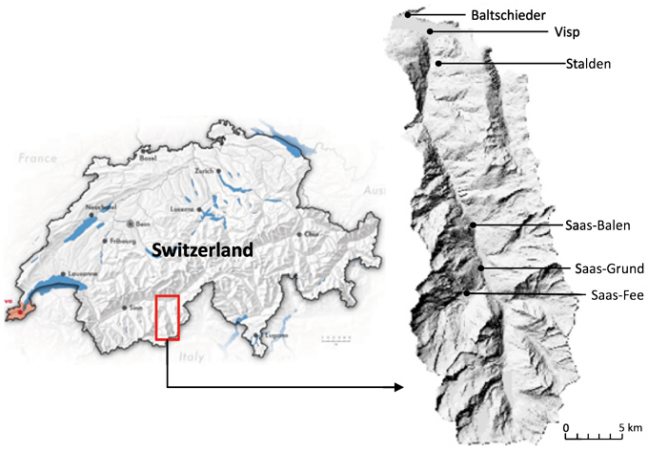
of this region. We specifically asked how the process of stakeholder involvement in research practice could contribute to a better understanding of the challenges and future development of mountain regions facing global change. To answer this question, we set up scenarios for the Visp region and linked them to context scenarios, also termed shell scenarios, developed for the global and Swiss scales. We developed these multiscale scenarios in close collaboration with key stakeholders from the Visp region, working in tourism, forestry, and administration, for instance. The aim was twofold: first, to shed light on the methodological question of how to produce multiscale scenarios by combining expertise about global to national developments with knowledge on more specific regional developments. The second aim was to arrive at a more systemic and stakeholder-based understanding of the study region by means of scenarios, i.e., an illustration to anticipate possible futures of the Visp region. This study was conducted in the frame of MOUNTLAND (http://www.cces.ethz.ch/projects/sulu/MOUNTLAND), an integrative project that deals with the challenges of global change in Swiss mountain regions and its impact on ecosystem services (Huber et al. 2013*a*,*b*).

THE STUDY REGION

Any analysis of a coupled human-environment system should start with a comprehensive understanding of the environment (Scholz 2011). The Visp region is part of the district of Visp and is located in the canton of Valais in southern Switzerland (Fig. 1). We will only use the term "Visp region" to refer to the study region, including the Saas Valley, and speak of the "district of Visp" and the "city of Visp" to express these other meanings. The district of Visp, including the Saas Valley, was discovered as early as the fourth century BC. After medieval times, life in the Saas Valley was still shaped by its inaccessibility, and farming was the basic source of subsistence. Despite adverse conditions and several crises, the valley finally became more populated during the 18th and 19th centuries because the inhabitants relied on their traditional skills and knowledge (Senglet 1991). With respect to local challenges today, the district of Visp is typical of many other alpine regions because employment in primary sectors, i.e., agriculture, the timber industry, and fisheries, declined by 43% between 1995 and 2008. At that same time, employment increased by 4% in the secondary sector, e.g., construction and chemical industries, and by 18% in the third sector, e.g., tourism. (Statistical Office Valais 2010, Swiss Areal Statistic 2012).

With a total area of 34,349 km², the Visp region spans the area from the remote side valley of Baltschieder and the city of Visp (651 m; picture A in Fig. 2) to the main valleys of the Visp and Saas rivers. Important tourism destinations, such as Saas-Fee (1798 m), the Mattmark reservoir, and the Italian border are all located at high elevations in the south. The region represents one of the most important tourist destinations in Switzerland (picture C in Fig. 2), and it also has strong economic activities in industry and waterpower (Zajc et al. 2004).

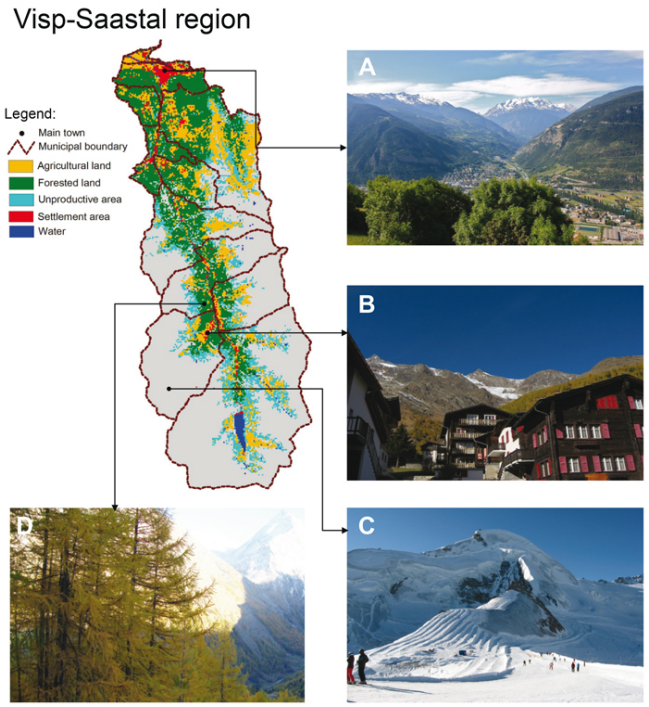
Fig. 1. Geographic location and topographical map of the Visp region in the Upper Valais, Switzerland.



The Visp region is characterized by a continental inner-alpine climate with relatively low precipitation and moderate temperatures. As illustrated in Figure 2, different land use types can be found in the study region. Compared to 1985, forested land increased by 576 ha, at the expense of agricultural areas, and the other land use types did not change significantly (Swiss Areal Statistic 2012).

The impacts of climate change may become a serious threat to Swiss mountain regions (OcCC 2007). Projected changes in temperature range from +1.2 °C to +2.8 °C in the winter, and from +1.7 °C to +2.5 °C in the summer. Projected precipitation changes range from -1.4 mm to +8.9 mm in the winter and from -8.1 mm to +1.1 mm in the summer, for 2040–2060 (Walz et al. in review). For the Visp region, it is projected that glaciers might melt to almost 60% (Huss et al. 2010). The likelihood of natural hazards, such as mudslides, landslides, avalanches, rock falls, and floods depends on changes in temperature and precipitation, and is likely to increase by 2050 (OcCC 2007, Bättig et al. 2011). Each of these phenomena will potentially cause severe impacts on tourism, both directly, e.g., through impacts on infrastructure, such as cable railways, and indirectly, e.g., through a drop in the number of visitors due to fear of natural hazards (Nöthiger and Elsasser 2004). In addition, snow reliability is a crucial factor for winter tourism, such as in Saas-Fee, and it will alter with climatic change (Rixen et al. 2011).

Fig. 2. Illustration of the study area showing main land use types and four subregions: the valley entrance to the city of Visp (A), historical houses (B), glaciers tourism above Saas-Fee (C), and a forested area (D). Pictures were taken by the project team. In 2009, agriculture accounted for 4023 ha (11.7% of the whole region), forested/wooded areas 7631 ha (22.2%), settlement/urban 853 ha (2.5%), unproductive vegetation areas 3837 ha (11.2%), bare land (glaciers and rocky surfaces) 17,464 ha (50.8%), and water surface 541 ha (1.6%).



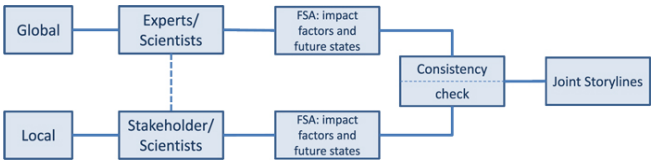
DESIGN AND METHODS

We aimed to develop a systemic understanding of the Visp region, its challenges, and possible future development trajectories. Based on a stakeholder analysis and selection, we conducted a formative scenario analysis (FSA) for the Visp region and linked the results to context scenarios via an external consistency analysis (Fig. 3). The multiscale scenarios have been developed in close collaboration with key stakeholders from the study region (Table 1).

Stakeholder analysis and selection

Human systems can be represented as hierarchically organized and can include several levels, such as the individual, the organization, and the institution (Scholz 2011). With the hierarchy of human systems in mind, we carried out a stakeholder analysis (Reed et al. 2009) to cover the most important human systems and sectors, e.g., tourism, forestry, agriculture, planning, and industry, in the Visp region. We also aimed to include representatives from as many communities as possible. As a result, we invited 16 people working in tourism, forestry, agriculture (winery), the chemical industry, administration and policy, nature conservation, and water management. Participation was voluntary for each workshop and no expenses were paid.

Fig. 3. Design of our scenario study combining the global/national and the local levels by means of an external consistency analysis to arrive at joint storylines.



Formative scenario analysis including external consistency analysis

In cooperation with the stakeholders, we carried out a scenario analysis. One aim of scenarios is to widen perspectives and to clarify crucial decision points in the light of a variety of possible futures (Scholz and Tietje 2002, Kok et al. 2007, Durance and Godet 2010). They can serve various functions in transition processes, for instance, establishing the basis for capacity building and strategy formation, as well as providing input variables for computer models (Wiek et al. 2006).

We used an FSA, which is a highly transparent method of integrating qualitative and quantitative knowledge and gives form to a set of consistent and plausible scenarios of future development (Scholz and Tietje 2002, Spoerri et al. 2009). The analysis comprised 12 steps that can be subgrouped into 5 different phases (Fig. 4). These are: system and goal definition, definition of context scenarios, system analysis, projection phase, and local and multiscale scenario selection and interpretation phase (Spoerri et al. 2009). In addition, we combined the FSA with a functional-dynamic approach to transdisciplinary processes (Stauffacher et al. 2008, Krütli et al. 2010, Trutnevyte et al. 2011; T. Von Wirth, U. Wissen Hayek, A. Kunze, N. Neuenschwander, M. Stauffacher, G. Schmitt, and R. W. Scholz, *unpublished manuscript*) to establish a mutual learning process between scientists and practitioners. The involvement of stakeholders differed in intensity and type along the steps of the FSA, and ranged from information, e.g., reporting results via e-mail, and consultation, e.g., via e-mail conversations and telephone inquiries, to collaboration, i.e., mutual learning processes in workshops.

(1) System and goal definition:

The system boundaries and the goals of the MOUNTLAND project were discussed with a steering group of stakeholders

Table 1. Participating stakeholders in Workshops 1 to 3.

Participants Workshop 1 Date: 06.05.2010	Participants Workshop 2 Date: 28.07.2010	Participants Workshop 3 Date: 09.05.2011
(1) Member of the district council Municipality Baltschieder: Department for Infrastructure, transport, energy	(1) Member of the district council Municipality Baltschieder: Department for Infrastructure, transport, energy	(1) Member of the district council Municipality Baltschieder: Department for Infrastructure, transport, energy
(2) District forest ranger Saastal, head avalanche alert service Saastal	(2) District forest ranger Saastal, head avalanche alert service Saastal	(2) District forest ranger Saastal, head avalanche alert service Saastal
(3) Spatial Planner, Upper-Valais	(3) Spatial Planner, Upper-Valais	(3) Spatial Planner, Upper Valais
(4) Register holder farming community center manager Saas-Grund	(9) Winemaker, Cellarmaster St. Jodern winery	(5) Project Manager in the regional and economic center of Upper Valais
(5) Project Manager in the regional and economic center of Upper Valais	(5) Project Manager in the regional and economic center of Upper Valais	(10) Director Tourism Saas-Fee/ Saas-Tal
(6) Advisory office and applied glaciology	(6) Advisory office and applied glaciology	(11) Head of Construction and Planning, Visp
(7) Managing Director of the Swiss Parks Network, formerly Regional Coordinator of the Upper Valais, Switzerland WWF, CIPRA and former president of Alpine Initiative	(7) Managing Director of the Swiss Parks Network, formerly Regional Coordinator of the Upper Valais, Switzerland WWF, CIPRA and former president of Alpine Initiative	
(8) Head of Construction and Planning, Visp	(10) Director Tourism Saas-Fee/ Saas-Tal	
	(11) Head of Construction and Planning, Visp	
	(4) Register holder farming community center manager Saas-Grund	

before the actual initiation of our study. In the first workshop of our study, the system boundaries were defined for the Visp region, with a time horizon of 2050. In addition, the guiding question, which asked how to orient land use measures to achieve desirable long-term development, including the maintenance of well-being and important ecosystem services despite prevalent global change, was identified (step 1.1).

(2) Definition of context scenarios:
The context scenario group of MOUNTLAND derived basic assumptions from the Intergovernmental Panel on Climate Change (IPCC) scenarios and customized these scenarios to the specific land use focus and purposes of MOUNTLAND. Four context scenarios were thus developed (step 2.1): growth and convergence, regional centers, green growth, and local sustainability (A. Walz, J. M. Braendle, D. J. Lang, F. S. Brand, S. Briner, C. Elkin, C. Hirschi, R. Huber, H. Lischke, and D. R. Schmatz, *unpublished manuscript*).

(3) System analysis:
A particularly important aspect of the first meeting with the regional stakeholders was getting to know each other and building mutual trust. For the scenarios, we identified current and future opportunities and challenges of the study region in individual brainstorming sessions and group discussions, to gain insights into the structure, function, and history of the case. Prepared with knowledge from available literature and the constraints set by the context scenarios, together with the stakeholders, we identified the most important impact factors for the regional scenarios (step 3.1). Each of these factors was defined as a "system element that influences the behavior or is influenced by other system elements" (Spoerri et al. 2009:593). In subsequent work, we unified overlapping factors to arrive at a still manageable final list of 20 impact factors. We have grouped these impact factors according to the following sectors: environment, construction, policy, agriculture, forestry, renewable energy, tourism, economy, and social developments (Table 2, columns 1 and 2). The first two factors correspond to the environment, whereas the other factors represent the human part of the coupled human-environment system. The impact factors differ with respect to their active or passive function in the system. This can be illustrated by means of a system grid (Fig. 5), a feature the scenario software used allowed us to produce.

During the impact assessment (step 3.2), we assessed all direct impacts between all pairs of impact factors in an impact matrix (Appendix 1) using an ordinal scale, i.e., from -2: strong impedimental impact, to +2: strong conducive impact. The impact assessment was conducted by two of the authors separately. We additionally consulted specific stakeholders by e-mail, focusing on their respective fields of competence. In cases of disagreement, either discussion resulted in a joint value or the intermediate value of the individual judgments was used. For the impact analysis (step 3.3), we used system analysis software (Tietje 2010) that also included a Mic-Mac analysis that assessed the indirect effects one factor displayed on another factor via a chain of still other factors (Scholz and Tietje 2002). In this step, because it mainly consisted of technical work, stakeholders were only informed about the current process.

(4) Projection phase:
For each impact factor, we identified possible and plausible future states (step 4.1), representing trends and surprising or innovative development directions (Table 2, column 3). This

Table 2. Impact factors of our study system with definitions and description of their respective future states. It is important to note that the impact factors differ in their complexity. Please also note that in a genuine formative scenario analysis (FSA) all future states are defined complementary to each other. We did not completely follow this approach in our study, particularly if future states are defined as a combination of aspects. In these cases, some of the future states may be partly overlapping.

Impact factors	Definitions	Characteristic developments-future states
1) Damage through natural hazards and extreme natural events	Frequency and intensity of damage caused by natural hazards and extreme events (drought, forest fires, floods, avalanches, rockfall, land slides, heavy rainfall)	1) Marked local consequences of climate change Melting of glaciers by 75-90%, high increase in the frequency of extreme events and high direct and indirect damage 2) Medium local consequences of climate change Melting of glaciers by 50-75%, lower increase in the frequency of extreme events, moderate direct and indirect damage 3) Low local consequences of climate change Melting of glaciers by up to 50%, very small increase in the frequency of extreme events, small direct and indirect damage
2) Environmental Quality	Extent of the provision of environmental services by local ecosystems: diversity of species, habitats and landscape features, scenic beauty, recreation, protected areas	1) High environmental quality By maintaining and expanding the protected areas 2) Moderate environmental quality Preservation of cultural heritage and traditional landscapes; traditional farming 3) Low environmental quality Economically productive region leads to high loss of environmental services
3) Construction activities and quality of built environment	Extent and quality of construction (e.g., dealing with old buildings, traditions, percentage of typical regional buildings, handling and construction of second homes); sealing (of soil)	1) Moderate extension of construction activities with poor quality Second homes in Saas-Fee and Saas-Valley due to high demand 2) High extension of construction activities with poor quality Urban sprawl and homogenization leads to high construction activity in housing and commercial buildings 3) Low or no extension of construction activities with increased quality Regionally specific construction and settlement quality
4) Hazard protection measures	Inventory of and investment in measures to protect against natural hazards	1) High level protection policy Anticipatory coordination structure for all natural hazards and high investment 2) Low level protection policy Low investment and low problem anticipation
5) Spatial Planning	Way of cantonal and municipal land use planning and zoning policies (degree of coordination between the municipalities, the presence and seriousness of the rules for qualifying and use of zones)	1) Very restrictive planning and zoning activities Sustainable regional development as aim, curbing urban sprawl 2) Moderate restrictive planning and zoning activities A positive process for the resolution of spatial conflicts 3) 'Laissez-faire' planning and zoning activities Spatial policy and zoning plans allowing for sprawl
6) Nature protection measures	Intensity and area fraction of the measures of the canton and the communities for conservation: protected areas of all categories, landscape conservation, species protection	1) Extension of nature protection measures Solidarity of nature conservation and tourism; creation of national parks, elaboration of concepts for regional landscape development 2) Reduction of nature protection measures Extensive tourism vs. conservation; low investment in nature conservation, drop of protected areas
7) Support of enterprises for local goods	Promotion, the number and condition of regional processing plants for agricultural and forestry products and their marketing, diversity of regional product range	1) Strong support of enterprises for local goods Marketing of local high quality agricultural products 2) No or moderate support of enterprises for local goods Marketing local products is not promoted
8) Type of agricultural management	Extent, type, and intensity of agricultural management; motivation for such agricultural activities (food production, breeding, etc.)	1) Intensification and extension of agriculture Extension of value chains; quality products with the brand Wallis; extension of subsidies 2) Integrated agriculture Conservation of cultural landscapes and rural tourism; traditional agriculture on biodiversity-rich areas; intensive and extensive grassland

(con'd)

			3) Decrease of agriculture Agricultural land is pushed back by competition from infrastructure and settlement areas
9)	Type of forest management	Extent, type, intensity of forest management	1) Intensification and extension of forestry Expansion of serious management approaches by coupling subsidies from the federal and cantonal level 2) Integrated forest management sustainable silviculture especially for landscape conservation and recreation 3) Decrease of forestry Climate change impacts; composition of forest species significantly varies, forest is heavily damaged by summer drought, beetles, fire, and landslides
10)	Renewable energy management	Utilizing the potential of renewable resources (water, wind, biomass, solar) as an energy source, ownership structure and distribution of the resulting revenue (local, foreign companies, etc.)	1) Increase of renewables Export product 'Energy Upper Vallais'; significant expansion of solar energy, increase hydropower production, and promotion of training in energy sciences in the region 2) Status quo or reduction of renewables No further expansion- preservation of existing capacity (hydro power)
11)	Touristic infrastructure: strategy and investment	Investments in and current inventory of tourism infrastructure	1) Structural change in tourism and high investment Renewal and creative improvement of tourism infrastructure. Capacity for innovation (adapting to changing needs) gaining strength. 2) Moderate change and investment Agrotourism; economic partnership between agriculture and tourism 3) Structural change caused by climate change and low investment Touristic infrastructure is heavily affected by the thawing of permafrost and unstable snow conditions.
12)	Destination management	Existence, structure and budget of initiatives for regional marketing, branding, labeling, or cooperation with strong brands in various industries (tourism, farming, forestry)	1) Expansion of the destination management Continued trend toward common destination management (region), including extensive forestry and agriculture 2) Stagnation or decrease of destination management Weakened trend toward common destination management (region)
13)	Development of economic sectors	The share of the sectors, to be calculated of the production process of goods and services (output produced), minus the value of intermediate consumption, regional economic performance by sector: 1) Agriculture / Forestry 2) Industry 3) Services (especially tourism)	1) Structural change of third sector (services) Tourism breaks down. Shift to other services (IT, call centers, educational institutions, energy services) and industry. 2) Increase of second sector ('renewable energies') "Energy Saastal" — focus on and steep increase in renewable energies (hydropower, solar, biomasss). 3) Governed shrinking of third sector (winter tourism) Shrinking process by e.g., decommissioning payments. Diversification of tourism activities and year-round tourism, such as mountain biking, hiking in summer and winter, sustainable eco-tourism and agrotourism 4) Shrinkage of the second sector (industry) Because of comparably poorer site conditions; relocation of major companies. Keeping the top destination tourism: focus on intensive tourism in ever higher elevations
14)	Budget of municipalities	Financial position of municipalities: amount of revenue compared to expenses, indebtedness, tax rate	1) Higher budget Increased revenues 2) Lower budget Reduced financial flexibility; lower tax income
15)	Strategies for business support	Steering the degree of attractiveness of the region for businesses => tax burden on legal persons => Promotion of education (workers)	1) Care for and gain of locational advantage Keeping the existing and attracting new industries thanks to location advantages (energy costs, well-trained labor force) 2) No care for and loss of locational advantages Profile drops compared to other places (also internationally); because of high energy costs, decreasing number of skilled labor force

(con'd)

16) Population change & composition	Development of the local demographic structure (% change); ratio of immigration / emigration, age structure, shares of immigrants	1) Small demographic fluctuations (increase or decrease by up to 15%) Openness to cultural change in the region; willingness to stay in the valley and work there; tendency to rejuvenate but preserving traditions 2) Large inflows of nonresidents (more than 15%) Mostly foreigners / nonresidents (young Swiss people without local identity) 3) Large out-migration (brain drain; more than 15%) Aging of the population by emigration of young and skilled people
17) Quality of life: basic needs and recreation	Coverage of basic material needs, cost of living, recreation quality	1) Improve the quality of life Basic needs covered, relatively low cost, high quality recreation 2) Consistent quality of life Basic needs covered, high cost, high quality recreation 3) Reduced quality of life Basic needs not covered, costs are relatively high: increase in consumer prices (especially housing and energy, reduced recreational quality)
18) Strategies for social and economic conditions for inhabitants	Portfolio of and investment in/promotion of services to residents in the areas of culture, sports, recreation, basic services	1) Increasing attractiveness for residents Increase in spending on service public; lower taxes in mountain communities, primary health care, day care centers 2) Decreasing attractiveness for residents Mild increase in spending on service public
19) Local identity	Importance of the region, its products and traditions in the everyday lives of residents	1) High importance of local identity Local cultural identity is for instance used in regional marketing and marketed by means of agricultural products, used in tourism and construction activity 2) Medium importance of local identity Does not play a major role, is not rejected 3) Low importance of local identity Loss of cultural identity, traditional knowledge is lost
20) Cooperation of communities and institutions	Division of work with regard to public interest on several levels (community, civic community, families, individuals), degree of cooperation (coordination/cooperation) between the levels (of different communities)	1) Fusion of the communities Visp, Baltschieder, and Visperterminen In particular institutions considering land use 2) High degree of coherence among municipalities Collective definition of objectives and optimized processes, up to comprehensive and synergistic municipal mergers, linking tourism offers 3) Low degree of coherence among municipalities Coordination problems, no cooperation; strong development toward "centers;" death of certain villages

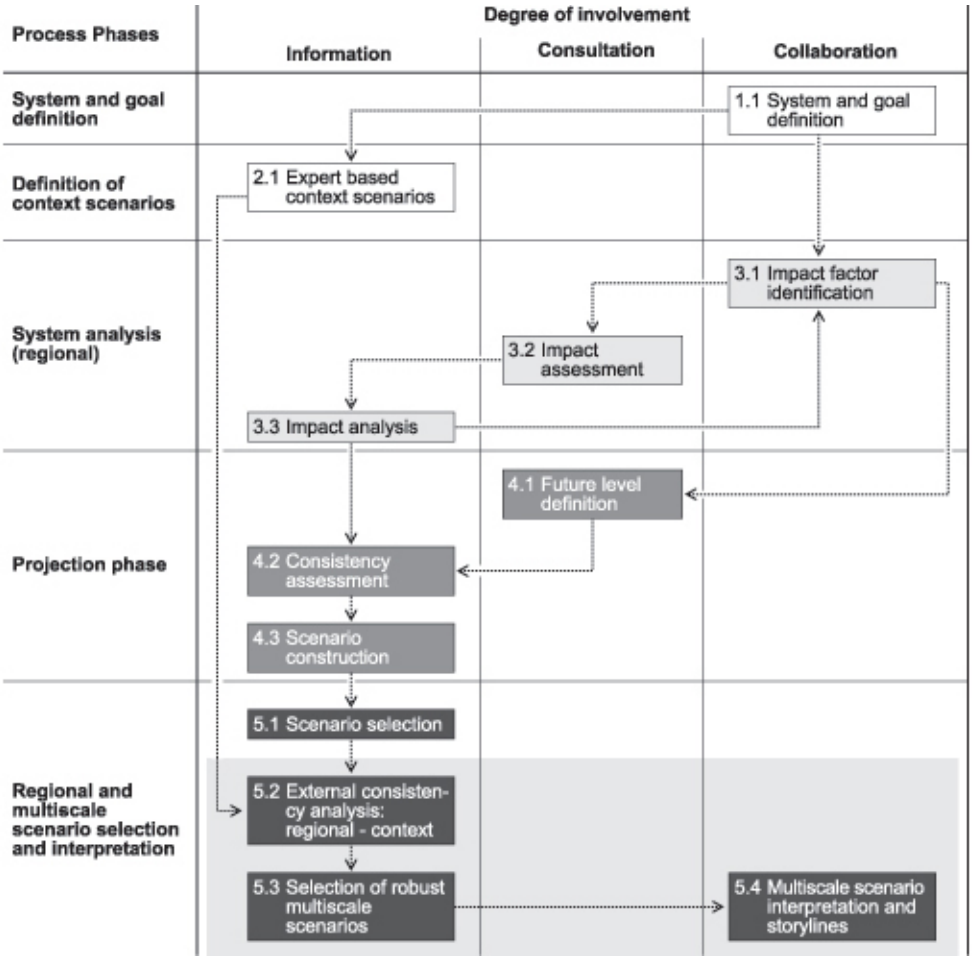
step was conducted based on relevant literature, as well as on e-mail conversations with three stakeholders. The aim was to be as concrete and quantitative as possible, for instance, using percentage values for increase/decrease of migration from Swiss Statistics projections. We got important information from the stakeholders, especially with respect to the issues of construction activities, spatial planning, development of economic sectors, and cooperation. We also consulted scientific experts from the project team to clarify specific topics, with respect to forestry policy, for instance. In the consistency assessment (step 4.2), we determined the relationship between all future levels of all impact factors with reference to an ordinal scale (-2 to +2) according to Tietje (2005). The consistency relations were assessed by two of the authors separately. As for the impact assessment, in cases of disagreement, discussions lead either to an agreed value or to a compromise using the intermediate value of the individual judgments. The consistency matrix can be found in Appendix 2.

The scenarios were constructed from the consistency matrix (step 4.3) facilitated by standard software for consistency analysis (Tietje 2010). This software calculated consistency indices for all possible scenarios, and for each scenario showed the number of inconsistencies, the additive consistency, i.e., the sum of all consistency values, and the multiplicative consistency, i.e., the product of all consistency values (Tietje 2005). A scenario was then understood as “a complete combination of specific future levels of all impact factors” (Spoerri et al. 2009:594-595). In total, the software produced 181,398,528 possible scenarios.

(5) Local and multiscale scenario selection and interpretation phase:

The final set of scenarios for the Visp region was selected from this number of scenarios by applying three criteria from Tietje (2005): (1) local efficiency, (2) the distance-to-selected criterion, and (3) the max-min criterion. This allowed us to arrive at a representative set of highly consistent scenarios.

Fig. 4. The formative scenario analysis and an external consistency analysis in combination with a functional-dynamic approach to theory-practice cooperation (based on Scholz and Tietje 2002, Stauffacher et al. 2008, Spoerri et al. 2009, Krütli et al. 2010, Trutnevyte et al. 2011). The figure illustrates steps 1.1 to 5.4 of our analysis. The arrows indicate possible sequences within a formative scenario analysis (FSA). The arrow that is drawn from "impact analysis" back to "impact factor identification" illustrates that the selection of impact factors can be reassessed by using the impact analysis. The figure has been developed with reference to von Wirth et al. (2012).

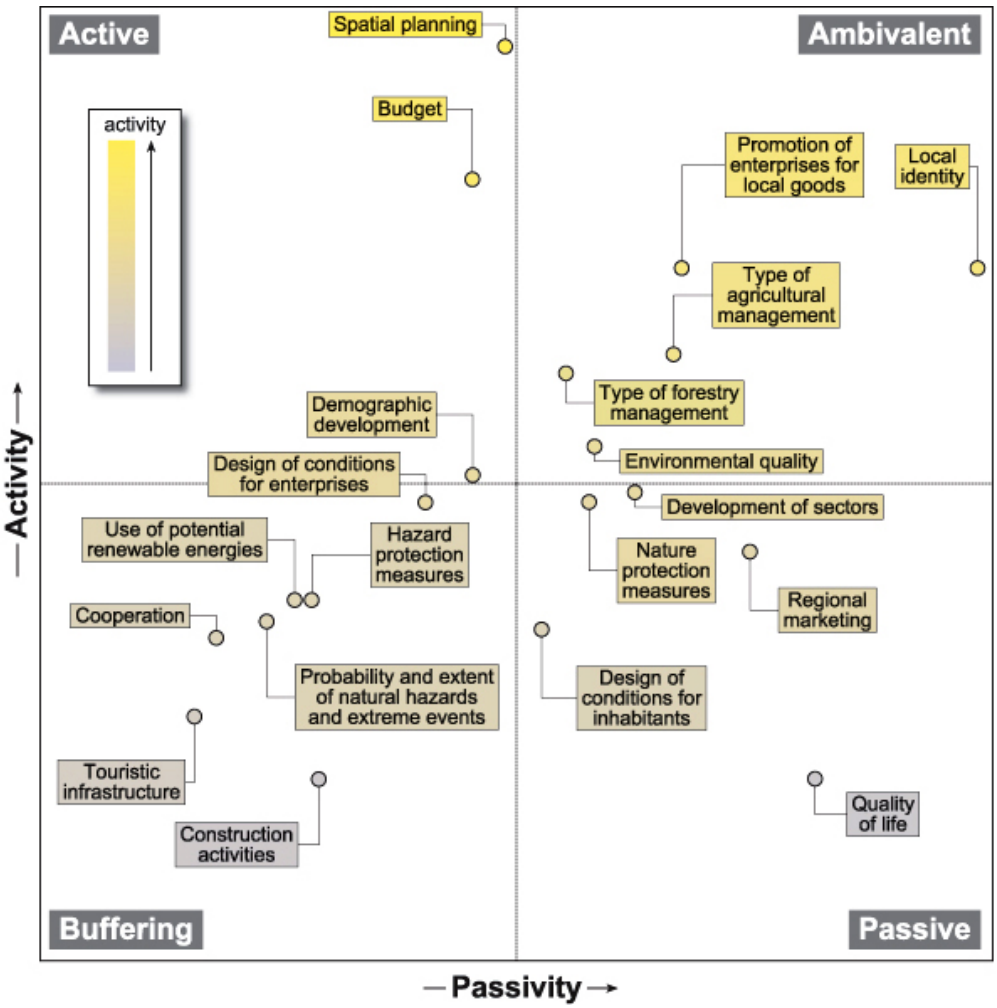


Using this selection procedure, we chose a set of six scenarios (step 5.1): clumping risks, think big, backward development, retirement residence, export product energy Upper Valais, and take the reins. The regional scenarios were illustrated as a combination of specific future states of impact factors in the tables that explain the six multiscale scenarios (Tables 3, 4 and Appendices 3, 4, 5, 6).

A major step was to link both sets of scenarios, i.e., the regional and the context scenarios, by means of an external consistency analysis (Wiek et al. 2001, Dürr 2006). We first assessed the consistency between (1) the set of future states of the six selected regional scenarios for the Visp region, and (2) the set of future states of the four context scenarios developed by the context scenario group for the Swiss and international levels as described in step 2.1. Each pair of future states (a pair consists of one future state of an impact factor of the selected regional scenarios and one future state of an impact factor of the context scenarios) was rated on a consistency scale (-2 to +2). Subsequently, we added the consistency ratings for each combination of the six regional and the four context scenarios. Thus, we calculated for each of the 24 multiscale scenario combinations the additive consistency values, ranging from 20 to 39 (step 5.2). The consistency ratings helped to narrow down the full set of scenarios to the selected set.

To select consistent multiscale scenarios (step 5.3), we used two interplaying criteria, i.e., (1) a cutoff value for the additive consistency of 23.4, 40% below the maximum value because this excluded the rather inconsistent multiscale combinations

Fig. 5. System grid showing the relative activity/passivity of the impact factors of the local scenarios as derived by the system analysis. The underlying values were omitted for simplicity. The activity and passivity ranks of local identity were three and one, respectively. Spatial planning ranked first for activity and 12 for passivity.



but left a sufficient number, and (2) representativeness, to arrive at a set of multiscale scenarios that covered all local and all context scenarios. Using this procedure, we selected six multiscale scenarios.

In the third workshop, we finally interpreted the selected multiscale scenarios with the stakeholders (step 5.4). Again, an important mutual learning process took place. The scientifically built scenarios were enriched by the local knowledge and experience of the stakeholders, and discussions arose about the consistency of specific future states and surprising development directions. The values and interests of stakeholders gathered in this workshop helped us to formulate catchy, contextualized, and plausible story lines.

RESULTS

We restricted ourselves to presenting (1) the system grid derived from the system analysis for the scenarios for the Visp region, and (2) the story lines of two of the multiscale scenarios. Important intermediate results, i.e., the impact matrix, the consistency matrix, and the other four multiscale scenarios are included in the appendices.

System grid

Activity is understood to be the effect of an impact factor on all the other impact factors, whereas passivity refers to the extent to which an impact factor is affected by all the other impact factors (Fig. 5). Impact analysis includes the indirect impacts derived from a Mic-Mac analysis (steps 2.2 and 2.3). Correspondingly, the impact factors can be grouped into four categories: active, ambivalent, passive, and buffering (Scholz

Table 3. Multiscale scenario "clumping risks in a neoliberal world" combining future states of growth and convergence (context) and clumping risks (the Visp region).

Context: growth and convergence
Global Trends: A1B
Climate: A1B
Population CH: 9.5 Mio
Migration within CH: Migration to Agglomeration
Accessibility of mountain regions: High Increase
Tourism Development: Exploitive
Natural Resource Management: Exploitive
Environmental Awareness: Technical Solutions
Consumption Patterns: Global Production
Economic Growth: High Increase
Agricultural Markets: Decline in prices
Wood Prices : Stable Prices
Energy Consumption: Stable Consumption
Technol. Innovation in Agriculture: High Innovation Rate
Energy Policy: New Priorities
Nature Conservation : Reduction
Climate Policy: Low Emission Reduction Aims
Spat Planning Policy: Laisser-Faire
Agricultural Policy: Liberalization
The Visp region: clumping risks
Medium local consequences of climate change
High environmental quality
Increase in regionally specific construction and settlement quality
Low level protection policy
Moderate restrictive planning and zoning activities
Extension of nature protection measures
No support of enterprises for local goods
Decrease of agriculture
Difficult management of forests
Status quo of renewables
Structural change caused by climate change and low investment
Expansion of the destination management
Shrinkage of the second sector (industry)
Lower budget
Loss of locational advantages
Large out-migration (brain drain; more than 15%)
Reduced quality of life
Decreasing attractiveness for residents
Medium importance of local identity
High degree of coherence among municipalities
Storyline: clumping risks in a neoliberal world
The region is hit hard by several detrimental national and international developments. The globally unabated climate change results in Switzerland in temperature changes, with increases of +2.2° in winter and +2.3° in summer and a precipitation of -1.4 mm in winter and -8.1 mm in summer, results to the melting of glaciers by 90%, reduces the frequency of snow-secure weather conditions and increases drought and frequency of fires (+17%) in summer. In addition, the massive damages done on the mountain railways and the high competition among skiing regions lead to the decrease of gains in tourism. Because of the liberalization of the federal agricultural policy and the falling prices of agricultural products, the employment rate and the used area in agriculture shrink. Lonza follows the national trend and abandons the location of Visp to move to lowland agglomerations. Consequently, many well-educated people emigrate from the region. Moreover, forestry is strongly affected by the dry climatic conditions in summer. These disadvantageous developments amount to a "clumping risk." To counteract these negative conditions, the region tries to jointly invest in top destination tourism and its marketing. This strategy, howver, partly fails. Tax deficits lead to a decrease in the financial margin of the communities and affect the infrastructure for basic services, culture and sports as well as the overall quality of life. The population of the region faces the consequences of these detrimental developments. Cooperation between communities is high, but it is not enough to solve the problem.

Table 4. Multiscale scenario "realize potentials based on green growth" combining future states of green growth (context) and think big (the Visp region).

Context: green growth
Global Trends: A1B
Climate: A1B
Population CH: 9.5 Mio
Migration within CH: Migration to Agglomeration
Accessibility of mountain regions: High Increase
Tourism Development: Exploitive
Natural Resource Management: Exploitive
Environmental Awareness: Technical Solutions
Consumption Patterns: Global Production
Economic Growth: High Increase
Agricultural Markets: Decline in prices
Wood Prices : Stable Prices
Energy Consumption: Stable Consumption
Technol. Innovation in Agriculture: High Innovation Rate
Energy Policy: New Priorities
Nature Conservation : Reduction
Climate Policy: Low Emission Reduction Aims
Spat Planning Policy: Laisser-Faire
Agricultural Policy: Liberalisation
The Visp region: think big
Low local consequences of climate change
Preserved environmental quality
Increase in regionally specific construction and settlement quality
High level protection policy
Moderate restrictive planning and zoning activities
Extension of nature protection measures
Strong support of enterprises for local goods
Integrated agriculture
Integrated forest management
Increase of renewables
Moderate change and investment
Expansion of the destination management
Governed shrinking of third sector (winter tourism)
Higher budget
Care for locational advantage
Small demographic fluctuations (increase or decrease by up to 15%)
Improved quality of life
Increasing attractiveness for residents
High importance of local identity
High degree of coherence among municipalities
Short description: realize potentials based on green growth
The tourism sector in the Visp region greatly benefits from the global trends. The ir change is kept low both by an orchestrated international mitigation policy and by ar (technical and natural) adaptation measures (in Switzerland temperature: +1.2° in w summer; precipitation: +8.9 mm in winter and +1.1 mm in summer). Recreational a tourism, glacier experiences, and sustainable tourism in the Alps are very popular a and internationally. A joint destination management in the region takes up this trend labels and innovative concepts (Think Big: Oberwallis: Matter-/ Saas-valley, "highe Europe," stronger link to agrotourism), resulting to the rise of the number of tourist during the winter and summer. This development is supported by a strategy that fos heritage and environmental quality of the region. An ecologically focused federal p prices of agricultural products facilitate a regionally typical agriculture and the com local products. Sustainable forestry contributes to the high recreational value of the local identity of the population supports the cultural heritage in the region, which is regionally typical construction activity and the establishment of learning centers for Because of the positive economic development and the care for the cultural heritage quality of life and the population (distribution) remains more or less constant over t

and Tietje 2002, Spoerri et al. 2009). The values (not shown in Figure 5) are not to be understood in absolute terms; rather, they indicate the relative activity/passivity of the respective factors.

Derived from Figure 5, three impact factors, i.e., spatial planning, budget, and demographic development, were counted as active and represented control factors for system regulations (for all the characterizations of these categories see Spoerri et al. 2009). This result mirrored the perspective of the local stakeholders and was plausible, for instance, when considering the central role of the zoning plan, a spatial planning measure of the communities. Five factors, i.e., environmental quality, type of forestry management, type of agricultural management, promotion of enterprises for local goods, and local identity, were denoted ambivalent, indicating that these factors were highly important, having high values for both passivity and activity. At the same time, these system elements are highly sensitive and their effects on the system's dynamics are unpredictable. Five factors, i.e., quality of life, design of conditions for inhabitants, regional marketing, nature protection measures, and development of sectors were passive. Thus, these factors are reactive in nature and represent indicators of the system state. Finally, seven factors, i.e., construction activities, touristic infrastructure, cooperation, use of potential renewable energies, hazard protection measures, design of conditions for enterprises, and probability and extent of natural hazards and extreme events, were buffering and considered stabilizers of the system.

In addition, we can derive that the active factor, spatial planning, exerted the strongest influence on the system and was at the same time considerably affected by other system factors (Fig. 5). Furthermore, local identity was the most important factor in the system because it had the highest total rank. The system grid illustrates the relative importance of impact factors within the coupled HES. As can be inferred from Figure 5, not only human factors, such as spatial planning and budget, are important for the further development of the HES, but also environmental factors, such as environmental quality, play a decisive role.

Multiscale scenarios

Two scenarios reflected rather surprising, innovative, or critical development trajectories for the Visp region. The first scenario (Table 3), termed "clumping risks in a neoliberal world," was the combination of the scenarios "growth and convergence" (context) and "clumping risks" (the Visp region). The Visp region was hit hard by several detrimental national and international developments, leading to decreased gains in tourism and a decrease in employment in agriculture. In addition, Lonza, the biggest industrial employer in the region, followed the national trend and abandoned its location city of Visp to move to lowland agglomerations, which resulted in the emigration of many well-educated people.

The second scenario (Table 4), termed "realize potentials based on green growth," combined the "green growth" (context) and "think big" (the Visp region) scenarios. A joint destination management institution in the region took up the international trend for recreational and weekend tourism, glacier experiences, and sustainable tourism in the Alps, and favored big labels and innovative concepts, e.g., "Upper Valais: Matter/Saas-valley," "highest vineyard in Europe," and stronger links to agrotourism. This resulted in rising attendances and gains in winter and summer tourism.

DISCUSSION

The set of multiscale scenarios has been developed based on a transdisciplinary and mutual learning processes between science and practice. Thus, it covers scientific and practical epistemic values. We did not scientifically assess the societal impact of our study, as for instance, was done in Walter et al. (2007), but we still generated insights rated important by the stakeholders involved. In general, transdisciplinary processes can build capacity, consensus, analytic mediation, and legitimization (Scholz 2011).

The stakeholders had intermediate to strong problem awareness concerning the impacts of climate/global change and local challenges (Lang et al. 2012). The research objective was commonly defined and conceptualized in the first workshop by the joint identification of impact factors. There was some underrepresentation of relevant actor groups, such as hotel owners and industry representatives, even though they were invited to the workshops. All stakeholders agreed with the use of the FSA as a method for integration. However, an FSA only takes into account, to a certain degree, the complexity of an HES. For instance, the number of impact factors that can be integrated in the study is reasonably limited to 20. There was some discontinuous participation of stakeholders in the workshops. However, at least six representatives came to all of the workshops and provided some continuity. Concerning the transferability of our results, we suggested that the results were, at first, only useful for the Visp region. However, Visp is a typical European alpine region with typical challenges, and thus, we argue that the results could easily be compared to similar studies in other regions. With respect to its societal impact, there was some friction between the results of our study and political processes. This gap could have been bridged by a stronger involvement of policy and decision makers from the very beginning. However, results will be transferred to stakeholders in the form of a report that is easily accessible. In general, in transdisciplinary research, societal impact is generated by an ongoing learning process between science and practice. This replaces the direct impact from "truth" to "power," as well as centralized steering ideas (Scholz 2011, Lang et al. 2012).

In addition, trust and consensus building was successfully achieved during the stakeholder workshops. This can be

illustrated through our observation of a change from a rather skeptical view on the planned scenarios prevalent in the first workshop, toward an enthusiastic discussion of future trajectories and also of critical and surprising issues, such as the decline in top destination tourism, shrinkage of industry, and the cooperation of the tourism department of Matter Valley, a further important destination for winter tourism and a current rival. The discussions of the critical and surprising topics are illustrated in the two multiscale scenarios "clumping risks in a neoliberal world" and "realize potentials based on green growth," (Table 3, 4). These extreme risks or courageous steps were not considered by the stakeholders in the beginning. Instead, the discussions avoided the critical combination of climatic and economic risks in the region. In our view, one basic purpose of the scenarios was to consider unwanted but possible futures instead of wishful thinking. Considering a more systemic and realistic picture was a valuable asset for the stakeholders and the scientists.

We consequently arrived at six multiscale scenarios that cover the global, the Swiss, and the regional levels. The scenarios represent illustrations of how to approach a systemic picture of the study region, anticipate possible futures, and point to strategies to cope with local and global challenges. Our study adds an alpine example to the multiscale scenarios already developed in other contexts, such as Europe, Africa, Canada, Latin America, and the Caribbean (Kok et al. 2006*a*, 2006*b*, 2007, Wiek et al. 2006, Biggs et al. 2007, Shaw et al. 2009, Özkaynak and Rodriguez-Labajos 2010, Saner et al. 2011). Vivid discussions exist on how scenarios can be linked across the various scales (Biggs et al. 2007, Kok et al. 2007, Zurek and Henrichs 2007). Zurek and Henrichs (2007) point out the difference between: (1) coupling the scenario building processes, and (2) linking the scenario elements and outcomes.

The method we used to link the scenarios across the scales, external consistency analysis, assessed the consistency among the future states of the specific scenarios according to an ordinal scale (Wiek et al. 2001, Dürr 2006). The advantage of using this method was that it allowed us to couple the scenario building process, e.g., by adjusting the selection of impact factors, and to subsequently link the scenario outcomes by an external consistency analysis. We are aware that our study is limited to some extent because a few steps of the analysis, for example, the consistency analysis and the external consistency analysis, would have profited from a consultative or collaborative mode of stakeholder involvement. This was omitted because of time constraints and the limited availability of stakeholders.

In addition, the qualitative system analysis and the resulting system grid displayed in Figure 5 show that local identity, defined rather broadly as the importance of the region, its products, and its traditions in the everyday lives of its residents, is the most important system element. It plays a crucial but unpredictable role in the future development of the Visp region. The regional population has repeatedly proven to be rather enduring, given that their traditional values and identities are still intact (Senglet 1991). This would help in overcoming new crises. The importance of local identity came as a surprise because it is a cultural factor. Moreover, it is "soft" compared to community budget and spatial planning. The importance of local identity for sound adaptation strategies in the alpine regions is supported by the results of Loibl and Walz (2010) for Davos, and Zanon and Geneletti (2011) for Trentino. In addition, Hirschi (2010) and Ingold et al. (2010) point out the importance of the additional soft factors of regional cohesion and collaborative networks.

CONCLUSION

From the HES perspective, it is important to take into account the social and environmental aspects, as well as their interplay, when considering the future developments of mountain regions that are facing global change. In MOUNTLAND, the project that frames this study (Huber et al. 2013*b*), environmental expertise has been abundant. However, regional knowledge was a subject that required investigation through the transdisciplinary stakeholder process. It was necessary to gain more insight into the complex dynamics of the Visp region today and historically to make claims for potential future strategies. The combination of regional knowledge gained through an FSA with stakeholders from different domains, and expert-based knowledge, in the form of context scenarios, to arrive at plausible multiscale scenarios forms a potentially successful template, which may also be useful for other contexts. For projects facing a limited budget and time constraints regarding interaction with stakeholders, the FSA and the functional-dynamic approach to stakeholder involvement are efficient means for advancing regional scenarios.

We combined the FSA with an HES perspective and a functional-dynamic concept of stakeholder involvement to link the scenarios across the scales. Consequently, the study contributes to the ongoing discussion on how to arrive at multiscale scenarios (Biggs et al. 2007, Kok et al. 2007, Zurek and Henrichs 2007). It also suggests a method that allows the coupling of both the scenario building process and the scenarios as such. We asked how the process of stakeholder involvement in the research practice could contribute to a better understanding of the challenges and future development of mountain regions that are facing global change. We showed that the place-based knowledge and values of stakeholders were very important elements in broadening perspectives and in developing strategies that were geared toward more desirable states. In addition, a transdisciplinary approach makes sure that scientists focus on problems that are really relevant for the people in the study regions.

Our research is only one step on the way toward method-guided, HES-based, transdisciplinary processes (Scholz 2011). Sustainability science needs to systematically analyze the complexity of a coupled HES, with support from adequate forms of theory-practice cooperation and integrative methods, such as FSA, system dynamics, or multiagent modeling (Scholz 2011). This would allow the building of socially robust orientations for transitions toward sustainability.

Responses to this article can be read online at:
http://www.ecologyandsociety.org/issues/responses.php/4972

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Appendix 1

	Impact Factors	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**Sum**
1	Damage through natural hazards and extreme natural events		2	1	2	2	1	0	0	2	-1	-1	-2	0	-1	0	0	-1	0	0	1	**5**
2	Environmental Quality	0		0	0	0	2	1	1	1	0	0	1	0	0	0	0	2	1	2	0	**11**
3	Construction activities and quality of built environment	1	-1		0	1	-2	0	-1	-1	-1	1	0	1	1	0	1	0	1	1	0	**2**
4	Hazard protection measures	-2	0	2		2	-1	0	0	2	0	1	0	0	-1	0	1	2	2	1	0	**9**
5	Spatial Planning	-1	2	2	1		2	2	2	0	1	1	1	1	1	2	1	2	2	2	0	**24**
6	Nature protection measures	0	2	-1	1	1		0	1	1	-1	-1	1	1	-1	0	0	1	0	1	0	**6**
7	Support of enterprises for local goods	0	1	0	0	1	0		2	2	0	0	1	2	1	0	0	1	0	2	0	**13**
8	Type of agricultural management	0	2	-1	0	0	1	2		0	0	0	1	2	1	0	0	1	0	2	0	**11**
9	Type of forest management	-2	2	-1	1	0	1	2	0		0	0	1	2	1	0	0	1	0	2	0	**10**
10	Renewable energy management	0	0	1	0	1	-1	0	1	1		0	0	2	1	0	0	1	0	0	0	**7**
11	Touristic infrastructure: strategy and investment	1	2	-1	-1	-1	-1	0	0	0	0		1	2	2	0	1	0	0	-1	0	**4**
12	Destination management	0	0	0	1	0	0	1	1	0	0	0		1	1	0	0	0	0	2	0	**7**
13	Development of economic sectors	0	0	0	0	1	1	0	0	0	0	0	1		2	0	0	0	1	2	0	**8**
14	Budget of municipalities	0	1	1	0	2	1	2	0	0	1	1	2	0		2	0	2	2	1	0	**18**
15	Strategies for business support	0	1	0	1	0	0	2	1	1	2	2	0	1	-1		1	0	-1	1	0	**11**
16	Population change & composition	0	0	2	0	1	0	0	0	0	0	0	1	0	2	1		0	1	2	0	**10**
17	Quality of life: basic needs and recreation	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1		0	0	0	**3**
18	Strategies for social and economic conditions for inhabitants	0	0	1	0	1	0	0	0	0	0	0	0	0	-1	1	2	2		2	0	**8**
19	Local identity	0	0	1	0	1	2	1	2	2	1	-1	2	0	0	0	1	2	2		1	**17**
20	Cooperation of communities and institutions	0	0	1	0	1	0	0	0	0	1	1	2	0	0	0	0	1	0	1		**8**
	Sum	**-3**	**14**	**8**	**6**	**14**	**6**	**13**	**10**	**11**	**3**	**4**	**14**	**15**	**8**	**7**	**9**	**17**	**11**	**23**	**2**	

Appendix 2. Consistency matrix; Legend: -2: the occurrence of one future level would make the occurrence of the other impossible (inconsistent), -1: the occurrence of one future level would hinder the occurrence of the other (hindering), 0: the occurrence of one future level would not affect the occurrence of the other (uncorrelated), 1: the occurrence of one future level would support the occurrence of the other (supporting), 2: the occurrence of one future level would require or cause the occurrence of the other (inducing)

Please click here to download file 'appendix2.pdf'.

Appendix 3

Context: regional centres
Global Trends: A2
Climate: A2
Population CH: 7.5 Mio
Migration within CH: Regional Centres
Accessibility of mountain regions: High Increase
Tourism Development: Exploitive
Natural Resource Management: Exploitive
Environmental Awareness: No Interest
Consumption Patterns: Regional Products
Economic Growth: Moderate Increase
Agricultural Markets: High Increase in Prices
Wood Prices : Stable Prices
Energy Consumption: Rising Consumptions
Technol. Innovation in Agriculture: Low Innovation Rate
Energy Policy: Business As Usual
Nature Conservation : Reduction
Climate Policy: Low Reduction
Spat Planning Policy: Laisser-Faire
Agricultural Policy: Protection
The Visp region: backwards development
Medium local consequences of climate change
Reduced environmental quality
Urban sprawl and homogenization
Low level protection policy
‘Laissez-faire’ planning and zoning activities
Reduction of nature protection measures
Strong support of enterprises for local goods
Intensification of agriculture
Difficult management of forests
Increase of renewables
Structural change caused by climate change and low investment
Expansion of the destination management
Structural change of third sector (services)
Higher budget
Care for locational advantage
Large inflows of non-residents (more than 15%)
Reduced quality of life
Increasing attractiveness for residents
Low importance of local identity
High degree of coherence among municipalities

Storyline – regionalized backwards development

The unabated climate change in Switzerland has resulted to a temperature increase of +2.0 °C in winter and +2.5 °C in summer. It has also resulted to a change in precipitation by +2.9 mm in winter und -6.6 mm in summer. The impact of climate change on the region is strong, causing glaciers to melt by 75%. It has also caused a decrease in weather conditions that are snow-secure and a higher frequency of extreme events, such as heat waves and fires (+13%) in summer and floods and landslides in winter. Apart from the forests, touristic infrastructure, such as mountain railways located in areas with low elevation, have also been highly affected, making some of them unfit for use. In addition, the strong competition among skiing regions, most of which are investing in top destination tourism, have lead to the decrease of customers and profits among the entire tourism sector. To solve the problem of declining tourism, the region tries to tap the services of established companies from the service sector, such as the call centers, energy providers and IT companies. This strategy partly fails and the region tends to set back into the first and second sectors of the economy. For example, the value chain in agriculture grows, the construction industry increases its benefits and other industry companies, such as Lonza, stay in the region. This "backwards development" has been faced by the region and transferred further to a planned development, which secures a positive economic development. In general, regional centers in mountain regions gain importance all over Switzerland. Correspondingly, the Visp region benefits from this development and there is a strong influx of people, which are foreign to the region. In agriculture, the innovation rate remains low but the prices for agricultural products rise due to the protective Swiss federal policy. Switzerland follows a laissez faire-like spatial planning policy that is mirrored in the region. This results to unplanned settlement, homogeneous land-use, and low interest in nature conservation and construction quality. The high degree of unplanned settlement is decelerated by the decrease in tourism. However, the tourism-related buildings remain intact and are used for alternative purposes only in rare cases. The region benefits through the enlarged investments in infrastructure for basic services, culture and sports. In the long term, however, the quality of life shrinks due to the loss of landscape beauty and recreation quality.

Appendix 4

Context: local sustainability
Global Trends: B2
Climate: B1*
Population CH: 7.5 Mio
Migration within CH: Regional Centres
Accessibility of mountain regions: No Increase
Tourism Development: Sustainable
Natural Resource Management: Sustainable
Environmental Awareness: Low-Tech Solutions
Consumption Patterns: Regional Products
Economic Growth: Moderate Increase
Agricultural Markets: High Increase in prices
Wood Prices : Increase in Prices
Energy Consumption: Stable Consumption
Technol. Innovation in Agriculture: Low Innovation Rate
Energy Policy: 2000-Watt Society
Nature Conservation : Extension
Climate Policy: Strong Reduction
Spat Planning Policy: Restrictive
Agricultural Policy: Greening
The Visp region: retirement residence
Low local consequences of climate change
High environmental quality
Boom in second homes in Saas-Fee and Saas-Valley
High level protection policy
Very restrictive planning and zoning activities
Extension of nature protection measures
No support of enterprises for local goods
Integrated agriculture
Integrated forest management
Status quo of renewables
Moderate change and investment
Stagnation of destination management
Governed shrinking of third sector (winter tourism)
Higher budget
Loss of locational advantages
Large inflows of non-residents (more than 15%)
Improve the quality of life
Increasing attractiveness for residents
Low importance of local identity
Fusion of the communities Visp, Baltschieder and Visperterminen

Storyline – retirement residence and environmental sustainability

Climate change is appropriately addressed by both mitigation strategies at an international level and by adequate regional, anticipatory adaptation strategies and is a rather minor problem for the Visp region. Due to still rising temperatures (globally: +1.4 – 3.8 °C) and high competition with other skiing areas, the region has decided to reduce the offers for winter tourism in a planned manner, such as by using compensations for the abandonments of skiing areas in lower elevations. Following the general trend in Switzerland, a regionally typical, ecologically sustainable solution is aimed for. The new strategy is characterized by: (i) the diversification of offerings in tourism, such as sustainable tourism, agrotourism, mountain-biking, hiking, summer tourism, alpine wellness and cultural tourism, as well as (ii) the settlement of pensioners, like in Florida in the USA. Encouraged by the greening of federal policy, the regional spatial planning and policy fully acknowledges landscape beauty, ecologically oriented agriculture/forestry and recreation quality. This strategy helps in increasing the number of tourists and I augmenting the economic revenue. To satisfy the need for different activities that may enhance the capabilities and health of the pensioners and to offer services for elderly care and assisted accommodation, the region invests in suitable infrastructure. In addition, the contingent for secondary homes is softened to meet the high demand e.g. in Saas-Fee. Therefore, a large number of holiday homes is built. This results in an increase in real estate prices and higher revenue in the building industry. Federal agriculture policy is greening, but the innovation rate remains low. Agriculture primarily serves the maintenance of the cultural landscape and a partnership with agrotourism is enforced. The merging of the city of Visp, Baltschieder and Visperterminen helps in securing the financial margin of the communities.

Appendix 5

Context: local sustainability
Global Trends: A1B
Climate: A1B
Population CH: 9.5 Mio
Migration within CH: Migration to Agglomeration
Accessibility of mountain regions: High Increase
Tourism Development: Exploitive
Natural Resource Management: Exploitive
Environmental Awareness: Technical Solutions
Consumption Patterns: Global Production
Economic Growth: High Increase
Agricultural Markets: Decline in prices
Wood Prices : Stable Prices
Energy Consumption: Stable Consumption
Technol. Innovation in Agriculture: High Innovation Rate
Energy Policy: New Priorities
Nature Conservation : Reduction
Climate Policy: Low Emission Reduction Aims
Spat Planning Policy: Laisser-Faire
Agricultural Policy: Liberalisation
The Visp region: export product ‚Energy Upper Valais'
Marked local consequences of climate change
High environmental quality
Increase in regionally specific construction and settlement quality
High level protection policy
Very restrictive planning and zoning activities
Extension of nature protection measures
Strong support of enterprises for local goods
Integrated agriculture
Integrated forest management
Increase of renewables
Moderate change and investment
Expansion of the destination management
Governed shrinking of third sector (winter tourism)
Higher budget
Care for locational advantage
Small demographic fluctuations (increase or decrease by up to 15%)
Improved quality of life
Increasing attractiveness for residents
Medium importance of local identity
High degree of coherence among municipalities

Storyline – export product 'Energy Upper Valais' and environmental sustainability

Although the international climate policy responds adequately to massive climate change and emissions are widely reduced, the impact of unavoidable climate change (global warming: +1.4 - 3.8 ° C) is still heavily felt in the region. The glacier decline has reached 90%, rock falls and landslides are increasing and the mountain railways are heavily affected, due to the thawing of permafrost. Maintenance of winter tourism is made even more difficult by the strong and tough competition with other resorts, resulting in the decrease of margins. In response to this development, the region decided in great unity to push forward two strategies. The first strategy is to establish a fund that will compensate entrepreneurs when ski lifts are voluntarily abandoned. The second strategy is to use the national trend towards a 2000-watt society, where renewable energies are strongly supported. The region invests in the further development of hydropower. In addition, solar farms are built on land that is not used for tourism, such as steep slopes tht are suffering from the effects of drought. Agriculture builds partnership for renewable energy production, such as biomass and area for solar installations. In accordance with national policies, scenic beauty, recreational quality, agro-tourism and sustainable forestry is promoted, providing momentum to summer tourism. The rise in the prices of agricultural and forestry products facilitate integrated forest management and a locally typical type of agriculture and agro-tourism.

Appendix 6

Context: green growth
Global Trends: A1B
Climate: A1B
Population CH: 9.5 Mio
Migration within CH: Migration to Agglomeration
Accessibility of mountain regions: High Increase
Tourism Development: Exploitive
Natural Resource Management: Exploitive
Environmental Awareness: Technical Solutions
Consumption Patterns: Global Production
Economic Growth: High Increase
Agricultural Markets: Decline in prices
Wood Prices : Stable Prices
Energy Consumption: Stable Consumption
Technol. Innovation in Agriculture: High Innovation Rate
Energy Policy: New Priorities
Nature Conservation : Reduction
Climate Policy: Low Emission Reduction Aims
Spat Planning Policy: Laisser-Faire
Agricultural Policy: Liberalization
The Visp region: take the reins
Marked local consequences of climate change
Preserved environmental quality
Increase in regionally specific construction and settlement quality
High level protection policy
Moderate restrictive planning and zoning activities
Extension of nature protection measures
Strong support of enterprises for local goods
Intensification of agriculture
Intensification of forestry
Increase of renewables
Structural change in tourism and high investment
Expansion of the destination management
Governed shrinking of third sector (winter tourism)
Higher budget
Care for locational advantage
Small demographic fluctuations (increase or decrease by up to 15%)
Improved quality of life
Increasing attractiveness for residents
High importance of local identity
Fusion of the communities Visp, Baltschieder and Visperterminen

Storyline– take the rains and green growth

The international climate policy is committed to strict reduction efforts. Nevertheless, the consequences of the unavoidable global climate change in the Visp region are strong, since climate change at the cantonal and community levels is not a priority. This results in a large glacier reduction, an increased frequency of rock falls and landslides, heavy precipitation in winter and heat waves, drought and fire (+10%) in summer. Despite these adverse conditions, the Visp region takes the reins on the future development and initiates several positive developments. First, in response to the strong demand for sustainable tourism in Switzerland, the region diversifies its strategy and develops alongside its strong top destination tourism in Saas-Fee several forms of summer tourism, such as sustainable tourism and agrotourism, with rigorous quality standards. The climate advantage compared to other Alpine regions pays out and favors the top destination tourism with its unique glacier experiences. This allows the preservation of the visitor numbers and the tax revenue. Second, the region promotes the renewable energy industry and invests heavily in the further development of hydropower and solar systems. Third, in agriculture and forestry attempts are pushed forward to couple national and local subsidies to expand the value chain and produce marketable products. This is facilitated by higher world prices for agricultural and forestry products. The cooperation between and within the communities and the residents' identification with the region are very high. This allows smaller communities to pool their existing strengths; the municipalities of the city of Visp, Baltschieder and Visperterminen are merged. The population leaves small side valleys as the risk of natural disasters is too high. As a consequence, population pressure intensifies in the main valley and small fluctuations in population occur.