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Application of a vision in the Lake District of Salzburg

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ABSTRACT

Understanding the complexity of landscapes is an essential prerequisite to propose strategies for landscape development in the mid future, to predict long-term effects of landscape change, and assess future demands on landscape resources. In order to be able to direct today's landscapes to a possible future state (German: Leitbild), landscape planning must include socio-cultural, economic and political considerations in addition to ecological aspects of the landscape. In response to this challenge, this paper unifies the Leitbild concept with a spatial explicit planning procedure and introduces a case study application for describing and classifying landscape visions based on a transdisciplinary, holistic concept.

The general assessment system of planning a vision is adapted to the natural, cultural, political and economic conditions of the given case study area in the Federal States Upper Austria and Salzburg (Austria). The assessment system includes exercises that identify the assets of the planning procedure and encourage stakeholders, scientist and local people to collaborate in planning and implementation processes. This paper provides an overview of planning procedures from the Leitbild perspective, outlines problems encountered in the case study, and compares them to the findings of other scholars.

1. Introduction

Humans are anxious about economic and ecological sustainability and about the goods and services provided by nature, given the rapid rate of change and the shortened time horizons for reaction [1,2]. Humans want to react, regulate or destine future developments. Hence this paper aims to improve the understanding of the complex interdisciplinary system of landscape planning to allow for a consistent planning procedure which is necessary to react upon the needs from society. In case those needs are too urgent, it might be already too late to react pro-actively rather than re-actively. Thus, ideas about possible future scenarios formulated as achievable visions are needed to avoid being constantly forced to manage emergencies on a short term response basis [3].

In recent years, much has been written about scenario modelling [4–8], forecasting [9–11], strategic planning [12], future uncertainty and probabilities [13]. Among these papers there are some aiming at visioning towards an aspired future state using methodologies such as La Prospective [3]. However, while many of the above mentioned publications refer to institutional or organisational developments, little has been written about landscape planning approaches as such. Thus, based on Potschin et al. [14] we introduce a planning methodology similar to La Prospective – namely the Leitbild development – and combine this Leitbild approach with a consistent planning procedure. In a brief definition, the Leitbild concept can be regarded as a holistic and transdisciplinary elaborated summary statement, describing a desired and releasable future state for a specific issue, problem or spatial unit. For this, all present knowledge is used to chart various

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pathways into the future considering the constraints and demands from society. In a final step the aspired future spatial structure, distribution, utilisation, condition and development with a concise action plan is jointly developed and agreed upon. This novel approach combining the Leitbild approach with a reliable planning procedure aims at transdisciplinary planning propositions which may contribute to generating visions and are conducive to subsequent discussion and reasoning processes.

In accordance with Balsiger [15], Giri [16], Lawrence and Despres [17], Pohl [18], Wickson, Carew and Russel [19], Tress et al. [20] and others, there is a strong need for inter- and transdisciplinary concepts in landscape development. The question is "How to tackle this planning process?" and to investigate if a guideline already exists [21,22]. As a more general idea, Haber [23] and Jessel [24] posed the question, if it is generally possible to mastermind landscapes or "programme" landscapes with the help of computers using semi-operational programming routines to develop an aspired future state. Ever growing urban settlements, infrastructure enlargement, the increase of new recreation demands and many other influences on landscapes, however, clearly demonstrate that landscape planning is urgently needed on a broad basis. Visioning in this sense means to define subjects and areas of prime or inferior importance related to many interdisciplinary claims concerning natural resources, environmental protection and others in a "multiple perspectives approach" [25]. The assessment of how to use a specific spatial unit in a multifunctional way [26] has to be done through reasonable justification based on the right arguments and in consideration of ecosystem goods and services [27] – their utilization in interference with the landscape – and societal norms and values.

As landscape development is target driven, there is not *one* and only one holistic preferable concept to plan landscapes [28]. It has been argued among numerous authors that single disciplines cannot provide necessary knowledge to understand or solve these social, economic and ecological constraints [29–32]. Up to now, only partial attempts have been made to combine natural and societal perspectives [33,34,26,35]. However, there is a strong need for integrating socially, economically and ecologically sound planning procedures considering the complexity of landscapes [36–42], combined with the strength and weaknesses in participatory visioning approaches [43,44], while offering a conceptually coherent and operationalising "border-work" of different disciplines [43].

A variety of planning approaches exist, which aim at developing the landscape of tomorrow in a sustainable way [31]. During the last decades, process-driven deductions of priority areas based on qualified ecological expert opinions [45], landscape development based on the historical origin of a landscape [46,47], a functional approach to the ecosystem [27] or the world ecosystem goods and services using the natural capital approach [1,48,49] have been introduced and developed. Traditionally, landscape was "evaluated" through Environmental Impact Assessments [50–52]. This was followed by the Social Impact Assessment and even later the Strategic Impact Assessment and the Sustainable Impact Assessment or the Strategic Environment Assessment [53–55]. Potschin and Haines-Young have already compared those to the "Quality of Life – Capital approach" which tries to capture the gaps of the holistic transdisciplinary approach.

Having explored the different views on landscapes raises the question: "Which method is the most appropriate and leads to the best future state of landscape?" From these controversial discussions on how to develop *optimal* future states [56–58], it becomes apparent that it is necessary to come to a common agreement on the functions; whereby the primary importance is to provide certain goods and services that best satisfy human needs. However, "from a risk management perspective, the aim is not to seek the optimal future, but one that best delivers the desired outcomes at acceptable levels of risk" [9]. Furthermore, one must be encouraged to search for a path along which the development can take place [59], the capacity to identify a future that is desirable within a number of possible contexts and to be able to mediate between desired and undesired futures and the requirements set forth by different stakeholders. In order to agree on an achievable future, decision support is needed. Backcasting tools provide a good basis for policy makers as backcasts incorporate possible future visions which are necessary for opinion forming and decision-making [60]. However, the main intent of this backcasting is to build new knowledge, identify possible new development options and to analyse the feasibility and consequences of those options.

In Austria, Leitbilder (plural of Leitbild) have the role of referencing a certain status or condition based on benchmarking and evaluation of present situations and new developments. Officially, there is no Leitbild procedure foreseen in the planning process. According to the Austrian Spatial Planning Conference (ÖROK – Österreichische Raumordnungskonferenz), the Austrian National Strategic Plan (STRAT – Nationaler Strategischer Rahmenplan Österreichs) is setting the framework for the current planning period 2007–2013. Nevertheless, establishing an official Leitbild – even more a spatially explicit one – is not required by law. There are, however, numerous publications considering Leitbilder as a common planning basis in Austria. These publications deal with Leitbilder on a national [61,62] and regional scale [63], considering different administrative [64], natural [65] or content boundaries [66,67] for different planning inputs. This diversity results from the different legislations responsible for spatially planning in each of the nine Federal States of Austria.

The Regional Planning Act [68] of the Federal State of Salzburg obliges defined regions to establish a "Regional Planning and Development Programme" determining the spatial regional development in the medium term [69]. The draft of the programme is evaluated in a formal hearing procedure, approved by the regional municipality alliance and finally enacted by the government of Salzburg [70].

Despite the fact that the Regional Planning and Development Programme is legally non-binding, Leitbilder have been developed for some Austrian states [64]. Some regions have developed integrated, consolidated and holistic visions thereof [69] or they have derived a special focus such as on energy, water or tourism [71–73] from it. However, there is a lack in the planning literature considering a holistic and spatially explicit landscape planning approach as a problem solving strategy. How this can be done is demonstrated on behalf of the Mondsee catchment in Austria.

2. The regional case study area Mondsee

The area around the Austrian City of Salzburg, capital of the Federal State of Salzburg, comprises about a dozen medium-sized lakes (plus a large number of small ones), embedded in a landscape of Flysch hills in the Northern and Western parts, and Alpine mountains in the Southern and Eastern parts [74]. Although the Lake District can be regarded as one natural entity once created by glacial forces, the lakes are situated in different administrative regions: some in the Federal State of Salzburg, some in the so-called "Salzkammergut" mainly belonging to the Federal State of Upper Austria. This has implications for environmental planning and public action, which require collaboration across states. Accordingly, different parts of the Lake District are subject to different legislative constraints regarding the building regulations, the use of lake shore areas, (waste) water management, environmental protection, and preservation of nature.

Wide areas of the Lake District (Fig. 1) – especially the Fuschlsee and Irrsee belonging to the Mondsee catchment – have been favourite sites for holiday and leisure activities for many decades, implying an intensive use of certain lake shore areas particularly during the summer months and on weekends.

It is not only the high seasons and space related intensity of tourist use that put substantial pressure on the ecosystems of the lakes; the areas around some of the Northern lakes have also been subject to intensive agricultural use for decades. The use of fertilizers results in high amount of nutrients being washed into the lakes by rain and thus contributes substantially to the eutrophication of surface water bodies [75,76]. The increasing phosphorus discharge to surface waters and resulting eutrophication of lakes put substantial pressure on the ecosystem and the distribution and diversity of indigenous species. The pressure is caused by the development of phytoplankton and algae – especially the blue algae – which are also characterized by their toxic properties that may affect humans as well.

3. Combining social challenges with landscape planning

A key question for politicians and decision makers is how to provide the right framework to overcome present problems and how to face the challenge of various future demands. The Leitbild concept as discussed by Potschin et al. [14] may provide a useful instrument in helping decision makers to chart environmental, economic and social strategies.

To add the spatial perspective to the Leitbild concept, the methodology combines a consistent planning procedure with advanced GIS (Geographical Information Systems) and remote sensing technology. Tools to assess the present ecological and economic conditions, as well as the consequences of the proposed land use change options have been designed and implemented in a visioning and spatially explicit approach. Comparing, discussing and working out these visions lead to the

Fig. 1. The location of the case study area.

construction of a commonly accepted action plan, which most of the stakeholders from the water authority, farm advisory service and the farmers themselves agreed upon (for further details on the stakeholders see Table 1).

The remaining questions are "How to tackle this planning process?" and "Are there any standard solutions?" The first question addresses human interaction through participation, which should assist and support the ecologically driven planning process. The second question addresses the issue of how to build consensus out of dissimilar visions, demands and requirements from stakeholders towards a commonly agreed aspired future state.

For the Mondsee catchment it is hypothesized that an amalgamation of the Leitbild concept and a spatial planning procedure can help (1) to reduce the diffuse nutrient discharge to surface water, (2) to study possible, desirable and necessary changes to achieve this reduction, (3) to prepare an action plan (pre-activity), and (4) initiate and implement desirable changes (pro-activity). These tasks result in a dichotomy of missions, the parallel exploration of present conditions and preparation of a course for action. Following the strategic approach from Giget [77] in Godet [12], there is a need to respond to the following issues: (1) What can and might happen while implementing a certain countermeasure? (2) What can we do to reduce phosphorus non-point source discharge? and finally (3) How are we really going to do it?

However, further tasks to analyse the economic situation in the case study area need to be accomplished: (1) establish a spatially explicit economic system based on parcel and farm level in order to capture the incomes, expenditures and the resulting balance according to von Thünen [78] and (2) prepare and compare visions resulting from decreased or changing subsidy payments to farmers. The driving questions are (1) To what extent are farmers in the Mondsee catchment dependent on (inter-) national subsidy payments? and (2) To what extent is the income of farmers affected when changing present funding strategies?

In a complementary use of both ecological and economic analyses one would like to reach at a conclusion regarding the question "To what extent is a farmer's budget affected when implementing certain land use change countermeasures in order to reduce nutrient discharge to surface waters?"

Since it is not possible to give answers to all of those questions in detail, this paper serves a few important purposes: (1) as a suggestion for the conceptual link between visioning the future using the Leitbild concept, spatial planning and decision-making, (2) as a case study research, and (3) as a guideline for landscape planning in action. This paper will hopefully be a good starting point for those who must deal with complex planning procedures in a transdisciplinary way.

4. Eight steps towards purposeful landscape development

The process of finding a Leitbild includes the following steps: (1) landscape analysis, (2) landscape diagnosis, (3) landscape evaluation, (4) landscape prognosis, (5) landscape planning, (6) landscape treatment (with a spatially explicit action plan), (7) landscape monitoring [79–81]; and finally (8) documentation. Fig. 2 is visualising these eight stages after Klug [82].

4.1. Landscape analysis

The initial stage of the first step (landscape analysis) involves the identification and definition of planning objectives, breaking down the problems into measurable criteria and asking the question "What is the goal?" and "Why do I want to reach this goal?"

In order to design a process, aiming to meet the objectives and challenges already outlined in the previous chapters, people and organisations that posses a key role in the catchment have been brought together to collaborate on economic, social and civic interests. These key people include decision makers from the water authority, farm advisory service, researchers from soil science, agricultural science, hydrology, landscape ecology, GIS and remote sensing (Table 1). Reviewing the characteristics and perspectives of each group participating in the project helps understanding the values and attitudes characteristic for the region. As outlined by Gertler and Wolfe [83] this group description is an essential step and one of the most important element of transdisciplinary analysis. It is the starting point for a collaborative work, finding appropriate mechanisms to engage key stakeholders for a joint cooperation with synergetic effects.

According to the findings of Coates [25] the participants of the project listed in Table 1 fall into three broad categories. The first group (mainly 3 and 6) are participants who are associated with the government, Federal State agencies and/or regulating authorities. A second group (1, 2, 4, and 7) is contributing to technical implementations, such as field measurements, soil samples and driving the visioning processes. The third group encompass those who have a personal stake in the situation (5, 6, and 8). They are likely to be directly affected by the implementation of countermeasures to prevent nutrient runoff or by changing subsidy payments.

Landscape analysis itself results in an inventory of geospatially and non-spatially datasets incorporating the social, economic and environmental characteristics of the problem under consideration. Dealing with complex multi-dimensional and multi-scale problems, data assembling is the most critical and often the most time consuming part of a GIS project. However, data collection is ultimately doing the "fact finding" [84] and is the most important step involving also the research design and the experiments foreseen. Further tasks are:

- to break down and describe reality in a model,
- to define what information is needed and who is providing this information,

Table 1
The participants of the Interreg project "SeenLandWirtschaft".

No	Participant group	Description of representant	Websites for further information on main objectives and interests	Main data and information provided	Constraints and synergies with others
1	Federal Research and Education Centre Raumberg-Gumpenstein (HBLFA)	As the biggest agency of the Life Ministry of Austria it is the centre for agricultural research.	http://www.raumberg-gumpenstein.at http://www.lebensministerium.at	Analysis of chemical properties of soil samples taken on the field from collaborating farmers.	As a scientific institute on agriculture strong cooperation with the FAS and water authorities.
2	Agency for Water Management (Austria)	Authority examining properties, distribution, and circulation of water on and below the earth's surface.	http://www.baw.at	Provision of point measurement from field campaigns and other water related datasets.	Water quality issues related to agriculture
	Institute for water ecology, fishing biology and limnology (Upper Austria)	The Water Advisory Service is an organisation mainly advising farmers to safeguard water quality.	http://www.baw-igf.at/cms		
	Water Advisory Service (Upper Austria)		http://www.baw-ikt.at/cms http://www.ooe-wsb.at		
3	Federal state administration from Upper Austria and Salzburg	In the framework of this project they provide money to perform the project.	http://www.land-oberoesterreich.gv.at www.salzburg.gv.at	From the Salzburg Geographical Information System (SAGIS) as well as from Upper Austrian information system DORIS numerous spatially datasets have been provided.	Collaboration on federal state level with all organisations.
4	Purification Association Mondsee	The participating organisation is responsible for the waste water treatment in the Mondsee catchment	http://www.rhv-moir.at	Information on the release of phosphorus to the Mondsee.	Working in close collaboration with the water authorities and providing model input data.
5	Association for regional development in the Mondsee region	The aim of the association is to give impulse to innovative projects in the framework of agriculture, tourism, culture and economy)	http://www.dasmondseeland.at	no special contribution	In this case only passive contribution to the project.
6	Federal state chamber of agriculture (Upper Austria)	The chambers and the FAS provide progressive commercial advice to the farmers who have the freedom to consult any member of the team on their particular problem.	http://www.lk-salzburg.at	Land use data (meadows, crop fields, areas with orchards, etc.)	Minor constraints with the drinking water industry and water authorities.
	Chamber for Agriculture and Forestry (Salzburg)	A farmer is a person who is engaged in agrarian business by using land in different respect such as orchards, meadows, pastures, field crops.		Strategy on further farming business considering present and upcoming legislation and regulations	
	Farm Advisory Service (FAS) with the farmers			Returned questionnaires from farmers	
7	Centre for Geoinformatics (Z_GIS)	The Centre for Geoinformatics (Z_GIS) is a research organisation at Salzburg University providing spatially planning concepts.	www.uni-salzburg.at/zgis/research	Z_GIS is collecting spatially relevant information and is modelling the spatially explicit distribution of the phenomena under consideration.	Collaboration with the data providers to get input data for modelling. Modelling output provided to the FAS.
8	EuRegio Salzburg – Berchtesgadener Land – Traunstein	Organisation of cross-border collaborating municipalities from Bavaria and Salzburg state	http://www.euregio.sbg.at	no special contribution	Synergistic collaboration with all participants with no special constraints.

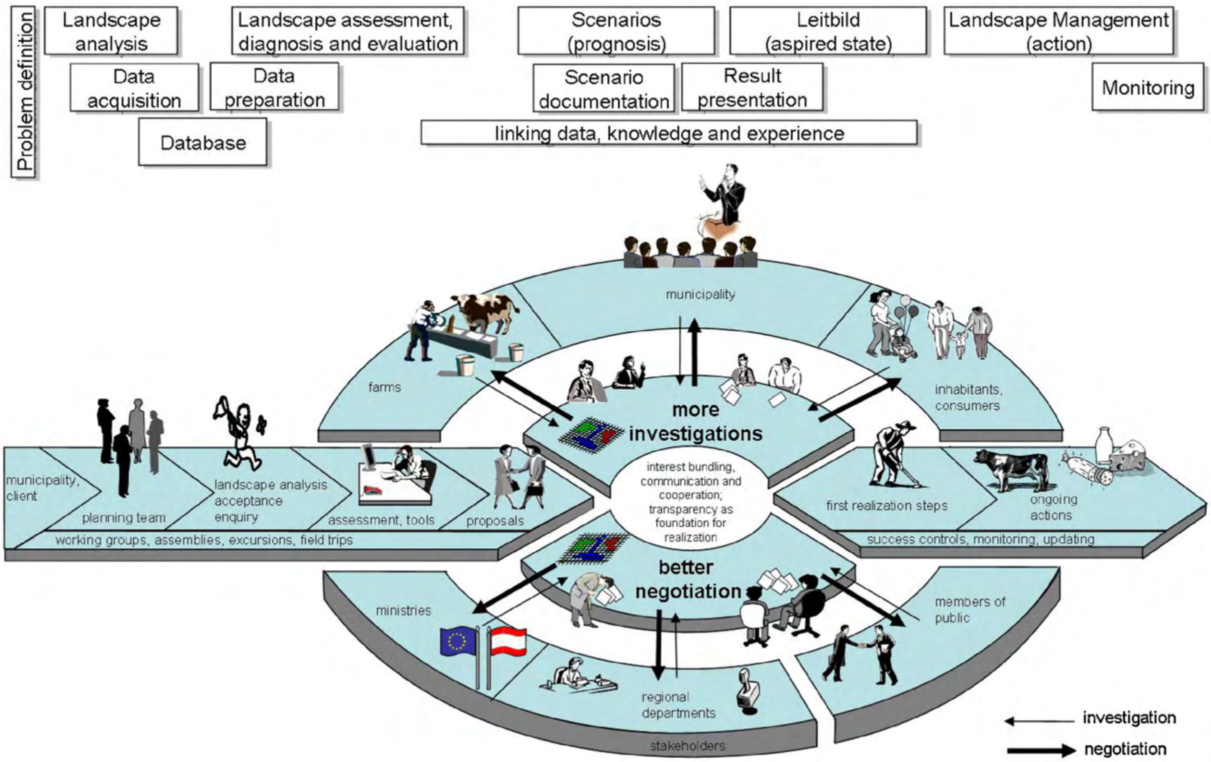

Fig. 2. Landscape planning in action. Modified according to Klug [82].

- to compile statistical characteristics,
- to develop methods to pre- and post-process data sets (e.g. plausibility examinations),
- to define methods used (definition of the toolbox with special concern on objectivity, neutrality, and independency).
- to observe the legal basis,
- to provide appropriate time and financial management,
- to define datasets needed and outline data requirements (accuracy, completeness, actuality, correctness, availability, condition, originality) and establish a mode of data collection and acquisition (field work, questionnaires, modelling).

Complex transdisciplinary projects have shown that collecting the necessary spatially datasets from numerous data providers as well as the pre- and post-processing of datasets is an approximately 1 year full time job, but crucial for the development of visions. The most fundamental tasks of pre- and post-processing are:

- organisation of datasets in a working environment (workspace/geodatabase) including the definition of input source, output source, intermediate and temporary datasets,
- defining conventions of datasets (report on the philosophy of the convention definitions and introduction of a "data dictionary"),
- data management (combine, extract, create data or new attributes, conversion to a common format and coordinate system, convert source datasets and tables to a geodatabase, clip, merge, etc. procedures),
- error propagation using plausibility examinations (data corrections, consistency analysis, validation, robustness),
- decoding of keys into analyzable entities,
- clustering of data towards new datasets, and
- building new toolboxes to handle the models.

4.2. Landscape diagnosis

Based on the landscape analysis, landscape diagnosis is the disclosure of datasets needed and already available for this study and is determining the utilisation capability and capacity of the landscape to meet the various ecological, economic and social demands and requirements from society in a systematical assessment. Therefore, landscape diagnosis is fundamental for the improvement of the present situation, for the implementation of change, and the consequent maintenance.

4.3. Landscape evaluation

Landscape evaluation can be defined as a structured method of landscape assessment, linking landscape analysis and landscape diagnosis with evaluation procedures providing an integrated meta-disciplinary framework within which decisions on landscape management can be discussed.

4.4. Landscape prognosis

The implementation of measures is based upon the decided strategies and is answering the question ‘‘What kind of strategies, instruments and options do I need in order to reach my objectives?’’ Therefore, landscape prognosis deals with the construction of possible alternative solutions, giving an answer to the questions ‘‘How and in which sequence do I reach my goals?’’ and ‘‘What kind of financial resources are needed?’’ Scenario planning is needed to describe the ‘‘big picture’’ of the process and plausible alternative future environments. These environments are used for learning, changing ideas or for testing executive decisions [7].

4.5. Landscape planning

The previous stages from landscape analysis to landscape prognosis determined the practical procedures of spatial explicit landscape planning. Therefore, landscape planning is coupled with *landscape care* (German: Landschaftspflege) and nature protection. The planning of measures and actions involves maintaining, changing, enhancing, and securing the development of landscapes and its natural balance as well as the provision of ecosystem goods and services from landscape resources. This stage is dedicated to clearly outline the action items played out and tested in the landscape prognosis stage.

The action carried out in the following step ‘‘Landscape treatment’’ needs a shared, commonly accepted and jointly agreed upon basis. This is reached by a cause-feedback dialogue resulting from the visions established in the previous stages.

4.6. Landscape treatment

Action is required regarding the decisions made in order to further develop the landscape. Hence, the action-science approach advocated by Argyris [85] suggests that the project participants design the action and employ self-monitoring methods to evaluate their actions. ‘‘Designing action requires that agents construct a simplified representation of the environment and a manageable set of causal theories that prescribe how to achieve the intended consequences’’ [85].

4.7. Landscape monitoring

The final stage involves landscape monitoring, a success control check of measurements implemented and a method ‘‘to track the reliability of the plan or the forces and factors that may be influencing choices implicit or explicit to the plan’’ [25]. The monitoring method and the indicators and parameters used should give answers to the questions ‘‘What kinds of countermeasures were needed to reach my given objectives? What is my accuracy level?’’ At the same time the present state is compared with the one after countermeasures have been implemented (ex ante and ex post comparison). Subsequent consequences need to be studied and analysed accordingly.

4.8. Documentation

Usually, the most neglected part of any planning project is documentation. Documentation, however, plays a critical role in the application, implementation and calibration traceability and hence the transparency of the visions derived. The following substantial information should be included in a report:

- metadata information according to the ISO 19115 standard [86],
- information on the quality of datasets,
- information on the procedures of data acquisition and pre-/post-processing,
- evolution of the data manipulation to derive additional values resulting from two or more datasets.

5. Scenario analysis

A core challenge in landscape planning is building the evidence base using theories able to predict the occurrence of various spatial phenomena or even to understand the underlying processes of change. At this point one may think it is not necessary to base future predictions on a solid theory since several authors stressed that the future is completely unknown [87]. However, considering the very plausible examples from the authors mentioned in van’t Klooster and van Asselt [87], it is evident that we need to establish a sound and transparent theory to cope with demands from society in the next decades. Hence, the problem agenda has identified the following issues as of primary importance for management: distribution structure of phosphorus loads to surface waters and the agricultural economy having influence on landscape development.

5.1. Modelling the distribution of diffuse phosphorus discharge

A nutrient modelling approach has been developed for the Lake District in the north-eastern part of the city of Salzburg [88]. The model serves as a basis to analyse possible scenarios to prevent the lakes of the Mondsee catchment from being further polluted. Environmental perspectives, specifically process-driven methodologies were introduced to assess the spatially explicit potential of phosphorus discharge to surface waters based on surface runoff, drainage runoff, soil erosion, interflow, and groundwater recharge (Fig. 3). As water is the main distribution agent for phosphorus, climatic models including precipitation and transpiration have been developed to assist the model framework. Although geoprocessing in GIS environments is not new, the idea to initially build a framework based on a combination of these ecological perspectives and spatially information is not common in the ArcGIS 9 software.

The challenge and flexibility of the GIS approach lies in the semi-operational rulesets related to specific assumptions and regional settings. We seek to embrace the challenges of different approaches in watershed estimations and have tested different ways to decompose complex natural environments into focal units. These units result from processes and functions provided by nature utilizing topological relations in order to be able to achieve the best environmental objectives.

We use the model to predict changes in phosphorus discharge by defining land-use alterations that need to take place in order to prepare a future landscape for closed substance cycles. The model is used to demonstrate possible perspectives for landscape planning practices using scenario techniques. The case study presents the implementation of the methodology in practice and its benefits, e.g., the improvement of planning based delineation of the landscape units derived from their inherent pattern, structure and potential.

5.2. The economic landscape management system

Since the farming system in Austria is not financially sustainable any more by its own, key subsidy payments are necessary. A key question for policy and decision makers at local and regional level is how these subsidy payments from EU as well as national and regional funding bodies can be sustained in a time of a decreasing budget. Scenario exercises at parcel and farm level may provide a useful instrument in helping define the farmer's economic–political strategies. The critical question is whether the conditions that influence the development of regional agricultural subsidies can be altered by direct intervention. If direct interventions are possible, what mechanisms can be used to address changes supporting and maintaining the regional agriculture?

These scenarios at parcel and farm level (described in detail in Klug and Jenewein [89]) assess the economic, social and environmental impact of the present Rural Development Programme 2007–2013 and its effects on possible landscape changes caused by the altered (inter-)national agricultural funding bodies. The planned decrease of subsidies, as outlined in the Rural Development Programme 2007–2013 and further in the draft of the following period 2013–2019, causes possible future changes of land use and hence possible changes in environmental quality. The reduction in funding substantially decreases the incomes of farmers, which are today strongly dependent on public subsidies. Thus, with decreasing funding,

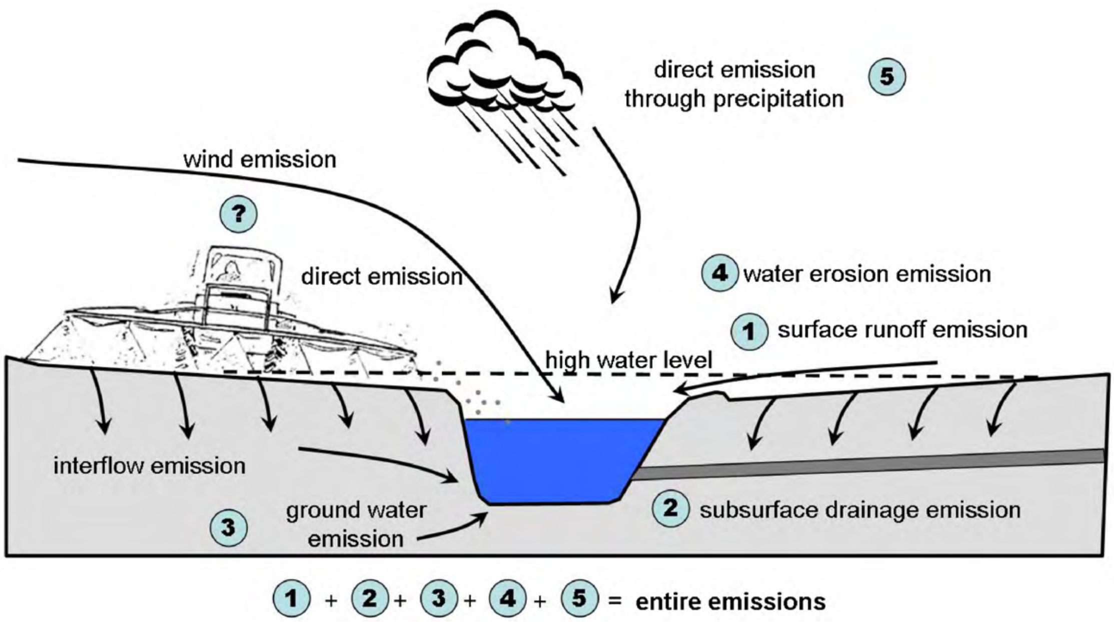

Fig. 3. The model of phosphorus non-point source pollution.

farming is not profitable any more. This causes either a reduction of work labour in farming, thus forcing the farmer to take on a second job, surrender farming or finally retire. Particularly parcels in remote areas and barren land with partly steep slopes are at risk to loose their cultural landscape characteristics which in turn has consequences for the tourism industry and the biodiversity of flora and fauna.

The study refers to present political and economic frameworks in Europe, Austria and the Federal States of Salzburg and Upper Austria. Therefore it is based on the newest agrarian funding regulations, considering payments according to the Common Agricultural Policy (CAP) as well as the Austrian Agri-Environmental Programme (ÖPUL) and regionalised subsidy agreements in the Mondsee catchment.

In a first step we analysed the income (e.g. subsidies, yield) and expenditures (e.g. fuel, work labour, seeds) at farm and single parcel level (see Fig. 4) based on a model integrating the funding schemes, estimated yield, and respective salary. In a second step we compared the modelled farm balances with the actual payments the farmers receive, using the spatially explicit datasets from IACS (Integrated Administration Control System). IACS is employed by the AMA Company, which is legally obliged to promote agricultural marketing and thereby coordinate the funding payment in Austria.

To gain an idea what might happen in the near and mid future, we employed possible short term scenarios as outlined by the Austrian Environment minister Josef Pröll. The minister sees, e.g., a strong reduction in the subsidy payment to maintain an open cultural landscape, especially on steep slopes. With a reduction to this extent, we see that the annual balance for some parcels will definitely be negative in the case study area. The farmers' expenditures are higher than their income. Non-profitability can cause the abandonment of farming and ultimately the abandonment of land.

To conclude, this model serves as a decision-making tool for policy makers. They are able to predict the consequences of reduced subsidies for certain areas and hence can assess whether the instruments used and the policies implemented for rural development have an efficient and effective impact on the rural areas in Europe. Consequences include considerations on the competitiveness of the agricultural sector, knowledge transfer and innovation, biodiversity and preservation of high nature value farming, water and climate change, the creation of employment opportunities in the fields of diversification and quality of life, improving governance and mobilising the indigenous development potential of rural areas.

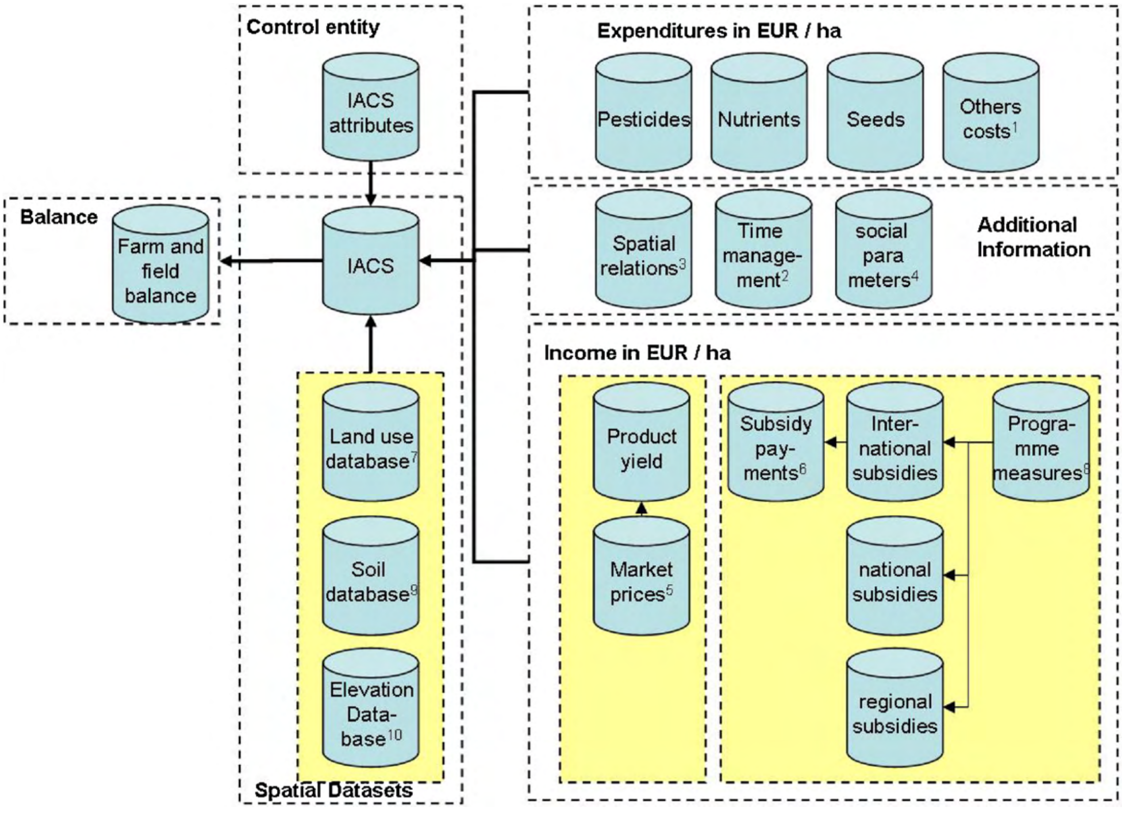

Fig. 4. The economic model. [1]Insurance, rent costs, fuel, machines, transport, tax on land. [2]Hours per work unit. [3]Area, distances, farm/parcel relation. [4]Demography of farmer, farm successor. [5]Market price table of farming products. [6]Subsidy payments result from cross-compliance and ÖPUL. [7]Land use derived from multi-temporal satellite imageries and IACS (Integrated Administration Control System). [8]The programmes are defining the measures available and the financial payments in EUR/ha. [9]Soil properties for various purposes (e.g. estimation of agricultural yield potential, etc.). [10]Derivation of aspect and slope (e.g. to derive areas suitable for steep slope farming funding).

Additionally, this model serves also as a tool for farmers and the farm advisory service. Applying this model can supply farmers with information regarding land use strategies that are financially feasible. Hence, this paper contributes to the development of tools supporting policy makers and farm advisory services in the implementation of Strategic Guidelines for Rural Development Policies.

5.3. Integrating scenarios for strategy planning

According to Malczewski and Ogryczak [90] scenario planning exercises are based on the exchange of information between decision makers and computer interfaces. While, e.g., Ive and Cocks [91], Fischer and Makowski [92], Suhaedi et al. [93] and Lu et al. [94] applied an interactive multiple-goal linear programming method (IMGLP) for land use planning purposes. De Wit et al. [95] did so with the analysis of agricultural development policies. Borrowing parts from both concepts, the optimisation of one or more functions to a series of constraints intended to explore future land use options and their impact is thought for [96]. The objectives of the model combination are to achieve public participation using interactive techniques [95] that facilitate consensus building between the groups of Table 1.

In the presently realised scenarios, empirical facts (how things are) are combined with normative objectives (how things ought to be) in a strategic analysis (how things can become) [97,98]. A first attempt is made towards the integration of both natural scientific and economic analysis. We use both models for the following reasons: the economic model shows the present balance concerning income and expenditures per parcel while the phosphorus model represents the spatially explicit danger of phosphorus discharge to surface waters. As a consequence, areas at high phosphorus emission risk need some countermeasures to prevent nutrients from discharge to affect surface waters and thereby cause eutrophication. Together, both models allow the simulation of proposed countermeasures and their consequences in nutrient discharge as well as related changes to the financial balance due to certain management restrictions (e.g. for establishment and maintenance of buffer strips or riparian forest alongside the rivers). They also allow for calculating follow-up costs resulting from compensation payments to the farmers due to, e.g. yield reduction or higher work loads resulting from the rededication of land. Therefore, the model provides us with information about the economic balance of the farmer and subsidies to be paid to the farmers when applying the proposed countermeasures.

6. Results

This unified Leitbild and spatial planning exercise helped to identify a number of different and innovative management implications not previously considered. The results can be grouped into three parts: (1) results related to the problems encountered in the case study area, (2) lessons learned from the project implementation and (3) results gained from the methods used.

6.1. Results relating to the problem encountered in the case study area

The model calculating the distribution of diffuse phosphorus discharge results in an identification of spatial explicit units with quantitative phosphorus discharge. The results show an annual entry of 17 tons of phosphorus into the Mondsee, 3 tons emitting into the Irrsee and 1 ton into the Fuschlsee. Very high phosphorus emissions take place in the north of the Irrsee, on the plateau between Irrsee and Mondsee, in the east of the Mondsee along the Wangauer Ache (river) and in the west of the Mondsee along the Fuschlerache. While the average phosphorus emission in the entire catchment is about 0.8 kg/ha total P per year, 44% of the modelled surface (248 km^2) showed a discharge below 0.2 kg/ha total P per year. Emissions of more than 3.2 kg/ha total P and year occur only on 1% of the surface area. A comparison of the average annual phosphorus emissions from the individual 98 subcatchment areas disclose values between 0.31 kg/ha total P year in the south of the Mondsee and 2.07 kg/ha total P per year in the south of the Irrsee. However, the average value is approximately 1 kg/ha total P per year.

Comparing the model results (17 tons per year into the Mondsee) to in situ water measurements reveal that the modelled phosphorus is 1.5 times higher than the water measurements showed (12 tons per year) [99]. These differences can be explained by the two different methodologies used in the study [88]. Nevertheless, in those parts of the catchment where the annual rate of phosphorus discharge surpasses 0,5 kg/ha, immediate action is required to keep the oligotrophic status of the Mondsee in balance. Hence, changing the model parameters such as land use or on site management actions serves as a basis for scenario modelling aiming at a reduction of nutrient discharges into the water.

Additionally, a map displaying the annual phosphorus emissions serves as a tool for the farm advisory service when consulting the farmers in the area. An action plan including management guidelines and land use change (e.g. implementation of buffer stripe areas) is based on the scenario modelling results of those high risk areas [100]. Finally this action plan was put into practice at the end of the year 2007.

Using the economic model we were able to map the annual financial situation of the farmers on a parcel and farm level. Altering the present situation by implementing the proposed land use and management guidelines, which are necessary to prevent a nutrient surplus at the surface water level, enables us to communicate economic and environmental changes to farmers.

6.2. Lessons learned from the project implementation

Since the project progress is strongly depending on its setting, I would like to critically review the lessons learned during the project implementation in comparison to the findings of others.

The characteristic basis of this planning approach is an early-stage of participatory landscape development with all its benefits and limitations but also with all its potentials. The exchange of factual arguments from the very beginning reveals what participants consider as key success or failures in their own working environment. It is a good starting point of a promising interdisciplinary landscape development.

The identification of collaborating key actors constructing the scenario together allows not only the exchange of constructive criticism, but also of assumptions related to the model building. This debate triggers communication which leads to clarification on one or the other topic. Heated debates might also need mediation between conflicting parties.

Furthermore, the work was jeopardised by difficulties that arose from working with a large and heterogeneous group of partners with different interests and power relations. Political power struggles, influences on decision-making processes and institutional differences regarding research methods made project progress difficult. This is well described and defined by Macgill and Siu [101] as "self believability", with one being very certain about the truth and therefore certain about what needs to be done (firm assent and accountability). The result is that decision makers, particularly senior executives, have a natural impatience with analysis and a tendency of feeling an urge to "cut to the chase" [102]. Expressions such as "we know our business" could indicate either total confidence in their business or identify a major deficiency in meta-disciplinary management and was therefore stated as a defence mechanism [5]. Having integrated a number of partners with a high "certitude" might be a basis for social conflict, especially when having certitudes on competing positions and resources. Stickiness – referring to the difficulty in information transfer between and among people – and friction as the "nuances and double checks that occur in the social interaction among humans in work processes" [7] might be the prime driving force to impede new and unfamiliar approaches when looking at landscapes. The initial lack of mutual understanding and trust between the participants might have its origin in the fact that the approach adopted in envisioning the future is new, uncommon and/or not of major importance in the respective disciplines of the individual entities.

In the beginning of the project progress was limited. A possible explanation of the delayed project start might be the organisational reluctance in sharing information, perhaps out of fear. The discovery of a not intended and unwanted reality by scientists might have internal political and personal consequences in the eyes of politicians. These consequences "can be highly political and personal as careers are seen to be at stake" [103], especially in times before elections. The election period of the Chamber for Agriculture and Forestry in Salzburg was in February 2005 in the middle of the project. Political sensitivity and the non-predictable outcome of the project analysis might be the main reason for the delayed start of the project. Furthermore, Godet [12] reported on a risk inherent in the start-up phase due to team members or even the team leader changing as the study progresses. In the case study project both the team leader and – especially in the beginning – project participants changed often.

Not being aware of forces working against immediate and open communication [5], the action plan countering the phosphorus emissions from non-point source pollution was already defined before the scenarios themselves had been established. The full spectrum and real benefits of exploring possible change using scenarios could not be realised since a few organisations had a non-unequivocal willingness to change the present situation. This "willingness must be clear from top down and continually reiterated and reinforced by management behaviour" [25]. Since we could not solve this problem we failed to implement one of the key goals of planning—to alter the mental maps of participants. This means we failed – as required by Chermack [8] – to link vision planning with theory building.

Still, having developed a model for estimating the non-point source emission of phosphorus to surface waters, there was some criticism regarding the high level of model integration. Decision makers found it hard to cope with. Criticism was also earned in relation to the apparently inadequate incorporation of the local scale and the non-sufficient match of the model results with the water measurements from the field. The author agrees with both lines of criticisms. However, not having adequate spatial datasets at hand we were not able to scale down the present situation and visions from a regional to local scale. Only rough estimations on the phosphorus soil content of the top layer were available. Only at the end of the project additional data exposing the animal units per farm made it possible to estimate the amount of manure placed to the respective farm parcels. Thus, for each project it is strongly necessary to clarify the expectations of results giving special consideration to the spatial and temporal scale.

6.3. Results of the methods used

From the very start of the project it was clear that the scenarios had to be flexible and evolving around a common achievable future state including a certain land use pattern. Each individual scenario has the potential of becoming the Leitbild for the future. This requires that the participants of the project agree on an equal denominator, which unfortunately was not always the case in this research study.

Despite the partly tremendous obstacles faced during the project implementation, unifying the Leitbild concept with a spatial planning guideline was successful. In a participative environment, the various participants listed in Table 1 expressed the problems from their point of perspective first while the end of the project foresees an action plan promoted by the farm advisory service and implemented by the farmers. Spatial planning helped us to focus on areas at high risk and to identify strategies to solve the problem of increased phosphorus discharge to surface waters.

7. Discussion

Since scenario modelling and strategic thinking is not new [4–8,12], this case study research has shown that spatially explicit Leitbild development can provide a basis for more sophisticated promising future landscapes that will go beyond the mere ecological deduction of ecological *optimal* states as done by, e.g. Grabaum and Meyer [58], Sarapatka and Sterba [56] and Seppelt and Voinov [57]. As Yankelovich [104] already stated, effective ways to start a dialogue between the participants is to present complex issues that are solved in a number of visions. It clearly uncovers conflicts and inconsistencies of opinions, demands, and requirements from society. Nevertheless, goal setting and constructive discussion as proposed within the Leitbild concept is regarded as extremely important and very often a neglected skill in our society [105]. Creating a shared vision is therefore the most effective engine for change in the desired direction without extrapolating past trends but rather realistic scenarios based on present and future demands and requirements from society. Nevertheless, for a systematic analysis of ecological consequences of management, respective optimization models still have their value. Participatory analysis of future visions can help to both design future landscape patterns and its underlying land use demands, and maximise the chances of realizing it. Constructing a procurable landscape means to move change in a particular direction, which is shared by all members of the planning group. It is essential since the results of the discussions reveal that the connections in the case study area are becoming more and more intertwined. Everything seems to be interrelated and decisions and actions affect everything and everyone. Thus, bridging the gap between experts and peoples' demands should be based on consciousness-raising, awareness generation, and mutual understanding. It is the main challenge of interdisciplinary projects we are facing if we want to be able to allocate both marketable and non-marketable resources such as ecosystem services.

8. Conclusion

To sum up, this approach does not reject traditional or complementary approaches; it rather incorporates a more holistic means of inquiry. This study shows ideas of stakeholder participation not precluding science in general; rather they change the way in which science is brought into practice. With support of the growing body of literature in sustainability science as summarized, e.g. in Potschin and Haines-Young [31], this unification of the Leitbild approach and spatial planning provides some added value to research activities. It gives an insight into perceptions, attitudes, mutual relations and behaviour of stakeholders, and adds knowledge in understanding not only conflict (re)solution mechanisms but also preferences in decision-making, rather than modelling causes and consequences to achieve optimal states.

This approach is firmly grounded in transdisciplinary approaches where stakeholders, decision makers and scientists are involved in the definition of the concept as well as evaluation of proposed countermeasures. These tools are regarded as useful for comparing choices, but cannot replace freedom of choice. What we have learned in this case study research is that scientists can dream of constructing rational tools linking computer models and acknowledged methodologies with visions, but it is hard to encounter resistance and "natural rejection from flesh-and-blood people driven by passion who certainly have no intention of being subjected to machines" [12].

In order to ensure an adequate working environment in future projects this research provides new arguments on strength and weaknesses of an applied participatory approach, not clearly mentioned in other papers dealing with the Leitbild concept or transdisciplinary projects. Hence, this paper will hopefully help and guide readers to overcome interpersonal problems encountered and to realise their projects making better use of the potential the spatial explicit visioning approach holds.

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