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SPECIAL FEATURE: CASE REPORT

Pathways towards sustainable landscapes

New approaches to support implementation of nature conservation, landscape management and cultural landscape development: experiences from Germany's southwest

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Abstract Worldwide natural landscapes are being replaced by human-dominated landscapes. A main feature is the human imprint that shapes and re-shapes these landscapes and reflects the socio-economic, political and cultural conditions as well as needs and values of a particular society at a given time. Some of these landscapes are considered cultural landscapes, in particular those that evolved over long periods of time and created biologically and culturally diverse landscapes with characteristic landscape elements. These cultural landscapes are considered worthy of protection. However, protecting or 'freezing' cultural landscapes at a particular point in time seems to be a contradictive goal since they have been continuously evolving based on their use and management. Therefore, maintaining and developing cultural landscapes or landscape elements in a way that they can contribute to their unique character whilst protecting internationally and nationally listed habitats and species appears to be a more sensible goal. We present Germany's southwest, the state of Baden-Württemberg as a case study. We discuss the wide range of instruments that have been put in place to maintain and develop Baden-Württemberg's cultural landscapes. We speculate about their future and argue that to maintain and develop these and other cultural landscapes around the globe require creative strategies that complement the conventional nature conservation and landscape management approaches. Although no panacea, regional development strategies that are developed from the bottom-up and are embedded in legal planning frameworks are likely to support management and development of cultural landscapes more effectively than any individual applications of the existing conventional approaches.

Keywords Landscape dynamics · Landscape governance · Landscape planning · Landscape ecology · Social-ecological systems · Co-management

> "Every landscape has its own soul, just like the people who live opposite you".
> Christian Morgenstern (1922).

Introduction

Human activities, mainly through the clearing of natural forests for settlement, resource extraction and agricultural use, have fundamentally altered almost every corner of the earth (Ellis and Ramankutty 2008), and replaced natural landscapes with human-dominated landscapes. Some of these landscapes are considered cultural landscapes (Farina 2000; Plieninger and Bieling 2013). The human imprint is a main feature of cultural landscapes, reflecting the socio-economic, political and cultural conditions as well as human needs and values of a particular society at a given time (Antrop 2006; Konold 2007). Like history books, cultural landscapes display complex and long-lasting land use histories. These land use histories created biologically and culturally diverse landscapes with characteristic and

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familiar landscape elements considered worthy of protection (Beaufoy and Marsden 2013; Koohafkan and Altieri 2011; Rössler 2006).

Today, management of cultural landscapes tends to 'freeze' them in a particular point in time. This seems to be contradictive goal, since they have been continuously evolving based on their use and management (Antrop 2006). However, given the rapid and fundamental changes across (agri)cultural landscapes (e.g. Meeus et al. 1990; Verburg et al. 2010) resulting not only in the replacement of traditional place-based land uses and management practices by standardized industrial ones, but also in the transformation of whole landscapes through processes such as urbanisation and globalisation, it is not surprising that efforts are being made to preserve regional diversity and values associated with cultural landscapes (Plieninger et al. 2014). These efforts are being supported at all levels of governance, for example, the Food and Agriculture Organisation of the United Nations (e.g. Koohafkan and Altieri 2011), the Convention on Biological Diversity (e.g. Takeuchi 2010), as well as other global (e.g. Brown et al. 2005; Louman et al. 2014), European (e.g. Council of Europe 2000), national and state wide nature conservation and rural development strategies which identify pathways towards more sustainable management and further development of cultural landscapes (e.g. Ministerium für ländlichen Raum und Verbraucherschutz Baden-Württemberg 2011a, b). More recently, proactive development through design is being advocated in Germany against the background of current change processes that transform cultural landscapes; for example, from agricultural landscapes to energy landscapes that are characterised by wind turbines and fields of solar panels, as a result of the change in energy policy (Bundesanstalt für Naturschutz und Bundesinstitut für Bau-, Stadt- und Raumforschung 2014).

Over the past decade, the development of sustainability science has contributed to the emerging agreement that sustainability challenges, such as the management and development of cultural landscapes, require new ways of knowledge production and decision making (Lang et al. 2012). The involvement of actors from outside academia in transdisciplinary research processes has been identified as critical to integrate the best available knowledge, reconcile values and preferences, as well as create ownership for problems and solution options. The growing popularity and acceptance of transdisciplinary approaches to address societal challenges related to sustainability present opportunities for landscape researchers to apply and learn from these transdisciplinary research processes (Lang et al. 2012). It also provides opportunities for landscape researchers to contribute to the solution-oriented research agenda of sustainability science. For example, landscape planners can address core questions related to "creating and pursuing desirable futures" (Miller et al. 2014, p. 243) in their work, by incorporating historic and valued landscape memory or 'pasts' as part of contemporary landscape aesthetics and use.

Using Germany's southwest as a case study, the objective of our paper is to provide a brief overview of the characteristics that shape cultural landscapes in the German state of Baden-Württemberg. We summarise the wide range of instruments that have been put in place to address environmental problems, and to maintain and develop these cultural landscapes. We then speculate about their future, considering current energy policies in Germany. We argue that to maintain and develop these and other cultural landscapes around the globe require creative strategies that complement the existing conventional approaches and add dynamism to nature conservation and landscape management. We conclude the paper by suggesting that well governed and implemented regional development strategies present promising and forward-looking models. Although no panacea, regional development strategies that are developed from the bottom-up and are embedded in legal landscape planning frameworks are likely to support management and development of cultural landscapes more effectively than any individual applications of the existing conventional approaches.

Cultural landscapes in the state of Baden-Württemberg, Germany

A great diversity of cultural landscapes with characteristic elements exists in Baden-Württemberg (Konold 2014b). Some commentators even suggest that Baden-Württemberg represents a miniature version of landscapes that can be found across Europe (Braun and Hutter 2014). However, unlike in other European countries such as the UK, where the concept of landscape character is well established and used to assess, map, and characterise (cultural) landscapes and landscape change (Swanwick and Land Use Consultants 2002), cultural landscapes have not been studied systematically in Baden-Württemberg. In the context of cultural landscapes though, important questions have been raised (Konold 2014a, b, c); one is addressed in this paper: what approaches or tools are needed to effectively manage and develop cultural landscapes?

The natural and cultural conditions, including geology, relief, altitude, soils, waters, climatic gradients, history and way of settlement, building types, land use history, religious differences and differences in mentality, are responsible for the diversity of cultural landscapes in Baden-Württemberg. Often several more or less faded 'cultural

layers' rest on top of each other. Next to the remains of natural or semi-natural habitats, it is primarily the cultural physical traces, such as stone walls, ditches, paths, trees, hedges, boundary stones, chapels and crosses that shape these cultural landscapes and provide their unique character (Konold 2014b).

Evolving cultural landscapes and landscape elements

From a historical perspective, until the beginning of the 19th century Germany's southwest was a patchwork stitched together of a large number of relatively small territories, including abbeys, counties, principalities, and duchies. Religion and sentiment have, among the more obvious natural factors such as relief, soil, and climatic conditions, profoundly shaped these territories and cultural landscapes. For example, pilgrimage sites, farm and field chapels as well as crosses in open fields are only found in catholic areas (Konold 2014b). Another example is the line of succession. Narrow strips of arable fields can be found on the Swabian Jura. These indicate that farms (houses and land) were divided between all siblings when they were inherited from one generation to the next, leading to narrower strips of arable fields every time. This line of succession is called *Realteilung* and differs from the so-called *Anerbenrecht* where farms are passed on to only one successor to avoid the splitting of farms and its land, such as commonly practiced in many parts of the Black Forest. However, in areas where agricultural land was consolidated to improve efficiency, characteristic landscape elements, such as the narrow arable fields, ditches, and other land considered 'unusable', have disappeared.

Despite land consolidations and adjustments in the use and management of the land, many cultural landscape elements, some of which appear to have, at first glance, no particular function, remain to the present day. Many of these cultural landscape elements are important biotopes for threatened or endangered plant or animal species and/or significantly contribute to the character of a particular landscape. In combination with these, non-humanist dispositions are more well-known characteristic landscape elements. These are common across many of the diverse cultural landscapes in Baden-Württemberg and include *Streuobstwiesen* (an agroforesty system with fruit trees and grasslands), heaths, hedges, historical road systems, ponds, stone walls and monasteries (Landespflege Freiburg und Landesanstalt für Umwelt, Messungen und Naturschutz Baden-Württemberg 2014). These landscape elements have been sustained in many cultural landscapes over a relatively long and complex history of settlement and land use.

Instruments for maintaining and developing cultural landscapes and landscape elements in Baden-Württemberg

Maintaining cultural landscapes has always been a major objective of nature conservation and landscape management in Baden-Württemberg (Höll 2014). The corresponding instruments have, along with the accumulation of new knowledge, evolved and increased over time, and are quite diverse. Table 1 presents an overview of the key instruments in place to address environmental problems, and to maintain and develop cultural landscapes and landscape elements. The two main types of conventional instruments include the protected site system, with several protected area categories, and the German-specific environmental planning instruments—landscape planning and the impact mitigation regulation. In addition to these, new instruments have been established—landscape management associations and PLENUM—mainly to complement and support implementation of the conventional instruments, i.e. to address the shortcomings of these instruments. The motto of these is "protection via use".

In the following section, each of the instruments is briefly introduced in the sequence of how nature conservation evolved through the protected area concept—from islands and networks to landscapes and social-ecological systems (Palomo et al. 2014)—and landscape management through the German-specific planning instruments (Luz 2000; von Haaren 2002; Wende et al. 2012). The section concludes with a description of the new instruments.

The conventional instruments provided for in German legislation include the establishment of protected sites to conserve nature and maintain cultural landscapes. Protected area categories include nature, biosphere and landscape reserves, national and nature parks, nature monuments, and legally protected biotopes. Besides these, protection of selected areas through designation in Natura 2000 sites is another important nature conservation instrument to maintain valuable cultural landscapes and landscape elements. However, Natura 2000 sites are, in legal terms, not a protected area category unlike the ones listed above. Rather, Natura 2000 is an ecological network of protected areas in the territory of the European Union. In 1992, the governments of the European Communities adopted legislation to protect the most seriously threatened habitats and species across Europe. This legislation is called the Habitats Directive and complements the Birds Directive which was adopted in 1979. These two directives form the basis of the creation of the Natura 2000 network of protected areas in Europe (European Commission 2014).

An overview of the protected area categories, number and size of protected areas in Baden-Württemberg is provided in Table 2, indicating that about half of the area of

Table 1 Overview of the key instruments to address environmental problems, and to maintain and develop cultural landscapes and landscape elements in Baden-Württemberg

Topic	Conventional instruments (established by German law in the 1970s)			New instruments (established early 2000s) Baden-Württemberg specific
	Protected site system including protected area categories		German-specific environmental planning	
Objectives	To conserve nature (nature reserves, national park, nature monuments, legally protected biotopes)	To maintain cultural landscapes and landscape elements (biosphere reserves, landscape reserves, nature parks)	To manage landscapes (landscape planning, impact mitigation regulation)	To conserve nature and develop cultural landscapes and landscape features (landscape maintenance associations, PLENUM)
Framework	Legal	Legal	Legal	Voluntary
Cover	Site-specific	Site-specific	Blanket cover/whole of landscape approach	Blanket cover—where landscape maintenance associations are established; site-specific and time-bound for PLENUM project-regions, includes non-site-specific projects
Main focus/task	Nature conservation	Cultural landscape management	Whole of landscape management	Nature conservation and cultural landscape development through utilisation
Approach	Top-down, sectoral	From top-down towards bottom-up approaches, multiple sectors	From top-down towards bottom-up approaches, multiple sectors	Bottom-up, integrated
Tool	Restrictive, static	From restrictive, static towards enabling, developing	Mitigates/compensates adverse environmental effects of development projects	Enabling, developing
Orientation	From fixed towards process	From fixed towards process	Process	Process
Involvement of sectors	One lead sector nature conservation (involves other sectors to achieve outcomes)	One lead sector—nature conservation (involves other sectors to achieve outcomes)	One lead sector—district/local government (involves other sectors to achieve outcomes)	Collaboration of multiple sectors—e.g. agriculture, forestry, marketing, producer associations, tourism groups, nature conservation, environmental education, local government, local community groups
Main partners	Authorities, individual land managers, shepherds, foresters	Authorities, tourism groups, individual land managers, shepherds, foresters	Authorities, individual land managers	Authorities, diverse business sectors, individual land managers, shepherds, foresters
Aims	Achievement of nature conservation and landscape management goals as defined in the German Nature Conservation Act	Achievement of nature conservation and landscape management goals as defined in the German Nature Conservation Act	Achievement of nature conservation and landscape management goals as defined in the German Nature Conservation Act, coordination of diverse tasks for implementation (e.g. NATURA 2000, climate change strategies)	Provision of added value for nature and people; development of regional economic cycles; establishment of local and regional networks

land in Baden-Württemberg is legally protected. Table 2 also points out that some protected area categories, i.e. the national park (established in 2014), the biosphere reserve (established in 2008), and the seven nature parks (established between 1972 and 2000) contribute to the establishment of *Grossschutzgebiete* (large conservation areas). These large conservation areas showcase Baden-Württemberg's diverse natural and cultural treasures and together cover about 35 % of the area of land, of which about 60 % is forests (Ministerium für Ländlichen Raum und Verbraucherschutz Baden-Württemberg 2011b). About 21 % of the area of land within the nature parks is

Table 2 Protected area categories, number, and size of protected areas in Baden-Württemberg, Germany

Protected area category	Number	Area in ha	Part of the land area in %
Nature reserves	1,025	86,813	2.43
Biosphere reserves	1	85,269	2.69
Landscape reserves	1,450	810,426	22.67
National park	1	10,062	0.18
Nature parks	7	1,147,496	32.10
Nature monuments	14,416	6,534	0.18
Legally protected biotopes	206,310	140,694	3.94

Note: Some protected area categories overlay each other, for example, the national park lies within a nature park. Natura 2000 sites are, in legal terms, not a protected area category and, therefore, have not been included (Source: based on Höll 2014 and Ministerium für Ländlichen Raum und Verbraucherschutz Baden-Württemberg 2014)

NATURA 2000 sites (Ministerium für Ländlichen Raum und Verbraucherschutz 2011a, b). Despite the fact that the national park, biosphere reserve and nature parks have different objectives and focal points for their work, overall these big conservation areas are aimed at fulfilling a wide range of important functions. These include protection of threatened habitats and species in NATURA 2000 sites, protection of legally protected biotopes, and maintenance of important cultural landscapes primarily through nature compatible tourism strategies.

Since the Nature Conservation Act in Baden-Württemberg came into force in 1975, the number and total area of landscape reserves have increased significantly from 540143 ha in 1975 to 810426 ha in 2012. This means that about 23 % of the area of land in Baden-Württemberg is protected as landscape reserve today. Similar to the large conservation areas, the larger landscape reserves are aimed at fulfilling important and diverse functions: firstly, to serve as buffer zones between intensively used areas and nature reserves and areas with a high concentration of legally protected biotopes (Höll 2014); secondly, to help prevent negative impacts on valued cultural landscapes, such as through urban sprawl, new roads, pipeline routes and the like, and contribute to the protection of relatively 'large areas' of extensively managed grasslands and *Streuobstwiesen*; thirdly, to contribute to the maintenance of diverse landscape 'images' and to the recreational potential offered by the most valued landscapes. Arguably, the protected area categories that support relatively large areas of land, i.e. *Grossschutzgebiete* and to some extent the larger landscape reserves appear to be more effective to sustain and develop cultural landscapes than smaller areas, since they tend to integrate a landscape ecological perspective (Wiens 2009).

In addition, the protected area system in Germany is complemented by the German-specific legal environmental planning instruments: landscape planning and the impact mitigation regulation (Marschall 2007). The goal of these instruments is to implement the objectives of nature conservation and landscape management and to provide the legal basis for sustainable landscape development (Bundesanstalt für Naturschutz 2008). Landscape planning is a comprehensive spatial environmental planning instrument that provides a "broad base of spatial information about ecological and social landscape functions, as well as prioritised landscape development goals, including local residents' preferences" (von Haaren and Bathke 2008 p 212). Landscape planning is carried out with blanket coverage at all levels and scales of spatial planning and zoning (for the state level in the scale of 1:200000–1:500000, for the region usually 1:50000 and for the municipality in 1:10000 or 1:5000; Wende et al. 2012) and provides for the acquisition and integration of the interests of nature conservation and landscape management into spatial planning (von Haaren and Bathke 2008). Landscape planning contributes to the assessment of the values of an area, the evaluation of potential impacts from development projects, and development of measures that result from the planned objectives. In this way, landscape planning also addresses the challenge of developing cultural landscapes through the process of understanding and directing the changing relationship between people and nature. It performs both problem management and long-term planning (von Haaren 2002). Part of the long-term planning is the definition of landscape visions and the use of landscape design, both of which are based on human values, preferences, creativity and societal ideas for sustainable landscape development (Jessel 2013; Potschin et al. 2010; von Haaren et al. 2014). Part of the problem management is the spatial management and development of alternatives to avoid and reduce impacts on landscapes. Where prevention of impacts, caused by specific projects, such as roads, wind energy plants, residential areas, is not possible, unavoidable deterioration requires mitigation and/or compensation according to the German Law. This is where the impact mitigation regulation comes into play.

The impact mitigation regulation, similar to landscape planning, is carried out with blanket coverage, i.e. both

inside and outside of protected areas. The impact mitigation regulation aims to prevent deterioration of the functional capacity of the natural environment and of the unique character, beauty of and scenic qualities of landscapes. This can be done by specific measures like river restoration, planting of hedges, establishment of *Streuobstwiesen*, conversion of intensively used and managed fields into extensively used and managed grasslands of high biodiversity value. Finding the appropriate measures and locations is done through 'eco-accounts', which many municipalities and government administrations have introduced. Eco-accounts provide a functional means to simplify and optimise the planning and realisation of mitigation and compensation measures (Küpfer 2012). The idea of the eco-account is to implement measures, such as the restoration of rivers and streams, as parts of natural landscapes and to re-establish cultural landscape elements such as hedges, heaths, and *Streuobstwiesen* (Küpfer and Röhl 2011). As a result, the ecological and (cultural) value of an area is enhanced through specific measures, evaluated through "eco points". Generally, an eco-account is developed out of a landscape plan at the municipal level (Küpfer 2012).

Since the beginning of the 21st century, the so-called 'soft', in terms of voluntary, instruments have been added to the list of conventional nature conservation and landscape management instruments that are part of German legislation. Funding programmes for regional nature conservation and landscape management have been put in place—through landscape maintenance associations called *Landschaftserhaltungsverbände*—and for cultural landscape development—through PLENUM, the strategy of the state of Baden-Württemberg for conservation and development of nature and the environment (Höll 2014).

Landscape maintenance associations were first established in 2011 (Ministerium für ländlichen Raum und Verbraucherschutz Baden-Württemberg 2011a). Their primary goal is to maintain cultural landscapes that play an important role in preserving biological diversity by, for example, keeping the landscape open, and contributing to the aesthetic qualities of the landscape. They work in close collaboration with authorities and land managers and offer tailored advice to regions. They organise practical implementation of landscape management actions with key partners—shepherds, farmers and foresters. The institutionalisation of the landscape maintenance associations as a regional actor seems of particular importance to achieve long-term landscape outcomes. The board of these associations comprises representatives from nature conservation, farming, forestry, and local government politics. The state of Baden-Württemberg, through its Ministry for Rural Areas and Consumer Protection, offers all administrative districts increased financial support to establish a landscape maintenance association (Höll 2014). However, in some districts—where landscape management associations have not been established (yet)—there is a sceptical attitude towards the landscape maintenance associations and questions have been raised whether this additional institution is needed to complement the conventional instruments to achieve long-term landscape outcomes.

PLENUM, the project of the state of Baden-Württemberg for conservation and development of nature and the environment in close collaboration with the general public, is based on the principle of the Rio conference in 1992 "think global—act local". PLENUM aims to develop characteristic and representative cultural landscapes in Baden-Württemberg for people and nature supporting a bottom-up and learning approach. This voluntary approach translates into regions having to draft a regional development concept to become an accepted PLEMUN project region for a specific time. The key overlaps or integrators between this and the conventional instruments appear to be (1) the drafting of a regional development concept that corresponds to the development of a landscape vision in the landscape planning process, and (2) the move from a site-specific instrument, that corresponds to the idea of large conservation areas, to a broader regional sustainable development concept, that corresponds to the whole of landscape approach taken in landscape planning. Hence, PLENUM is a bridging organisation that integrates nature conservation, landscape management and cultural landscape development by supporting sustainable regional development projects (Crona and Parker 2012).

A precondition for becoming a PLENUM project region is that the regional development concept needs to be supported by all political panels in the proposed project region. Projects in the following fields of activity are eligible for funding in the project regions: (1) landscape management via nature-compatible uses by agriculture and forestry; (2) marketing of regional and nature-compatible manufactured products; (3) 'soft' tourism based on quality, economic development and job creation; (4) environmental education; and (5) protection of nature through support of environmentally sensitive land use and management regimes (Landesanstalt für Umwelt, Messungen und Naturschutz Baden-Württemberg 2011).

The Ministry for Rural Areas and Consumer Protection in Baden-Württemberg who funds the establishment of a PLENUM project-region can also fund PLENUM projects. Currently, PLENUM projects are being implemented in five project regions covering 15.6 % of the land area of Baden-Württemberg. Projects are implemented over a fixed period of 10 years for which the regions receive the status of being a PLENUM region. Project funding can be extended for two additional years to consolidate and support sustainable development in these regions.

PLENUM takes a place based, integrated bottom-up, and 'use'-driven approach where in selected project-regions the protection of biological and development of cultural diversity is being advocated and supported by the local population and implemented by economic sectors (Landesanstalt für Umwelt Messungen und Naturschutz Baden-Württemberg 2011). The production and marketing of regional specific, in some cases almost forgotten, food have positive effects in and beyond the project regions (Gehrlein et al. 2013). Also, the initiation of projects by local people, in particular the collaboration of diverse sectors to support regional value chains, is regarded as a key success factor (Süß et al. 2011). In summary, PLENUM may be able to address some of the implementation challenges the conventional instruments are facing (von Haaren 2002).

Discussion

The introduction of voluntary instruments since the beginning of the 21st century indicates that the conventional instruments are not sufficient to conserve nature, manage landscapes and develop cultural landscapes in the long term. The new instruments differ in some important points when compared with the conventional instruments (Table 1). The landscape management associations and PLENUM serve as bridges between diverse actors and groups (Olsson et al. 2004; Hahn et al. 2006). In the case of the landscape management associations, it is a bridge between nature conservation bodies, farmers, foresters, and local government to better coordinate nature conservation and landscape management activities. In comparison, PLENUM is a more complex bridging organisation for cultural landscape development (Crona and Parker 2012). PLENUM proposes that nature conservation in cultural landscapes is only achievable in the long term through some form of utilisation and, therefore, focuses on an integrated regional development approach from the bottom-up.

PLENUM projects are either site specific with direct nature conservation outcomes, or support, for example, marketing of local produce, regional value chains, and learning about the complex relationships between nature, people, culture and place, which indirectly support nature conservation and cultural landscape development. The fact that PLENUM project regions are designated regions for only a fixed period of time suggests that PLENUM moves away from a site-based, nature conservation approach, towards a more holistic integrated and dynamic landscape approach at the regional scale. This is a major difference when compared with the conventional instruments. Although PLENUM project evaluations have shown positive results regarding the successful implementation of nature conservation goals (e.g. Demuth and Knebel 2007), on one hand, and socio-economic outcomes, on the other (e.g. Gehrlein et al. 2013) further evaluations will be needed to monitor trends, particularly after the time, when regions lose their PLENUM project region status.

Based on the experiences from the five project-regions to date, the following broad success factors have been identified: the (1) bottom-up approach that enables (2) integrated development of land-based projects that are supported by regional value chains, (3) networks between project partners and regions, and (4) improved acceptance of nature conservation through positive experiences with PLENUM (Landesanstalt für Umwelt Messungen und Naturschutz Baden-Württemberg 2011). However, a more nuanced and substantive analysis of these broad factors, in the context of the diverse projects carried out in each of the PLENUM project-regions, is required. In particular, it seems critical to explore how PLENUM, as a boundary organisation, manages power relations among diverse public and private sectors and actors with potentially different views, values, and visions for the project-regions. Further, it is important to investigate how PLENUM liaises and guides processes to ensure a balanced approach is taken that does not privilege regional entrepreneurs fulfilling their dreams about how to commodify every bit of the cultural landscape or local elites pursuing their private gains rather than the common good. Also, an in-depth analysis of the 'neutral' (or other) space PLENUM provides that fosters growth of networks and alignment of actor interests to support, for example, regional value chains, would provide important insights. Finally, how different types of knowledge are utilised by PLENUM, for example to improve acceptance of nature conservation, requires further exploration (Crona and Parker 2012). In summary, further investigations are needed to identify the contributions that PLENUM can make to adaptive governance theory and practice, and more broadly to cultural landscape development and sustainability science.

While PLENUM, as a relatively new instrument, may seem to provide a paradox, i.e. conservation via use, it corresponds to other global initiatives (e.g. Takeuchi 2010) that seek to maintain and re-establish biological and cultural diversity in landscapes by taking a social–ecological systems approach (e.g. Bohnet and Smith 2007; Palomo et al. 2014). For example, the Satoyama Initiative in Japan aims to rebuild a healthy relationship between people and nature through new and shared management systems—'new' commons for the Satoyama landscapes (Takeuchi 2010; Yokohari and Bolthouse 2011). Similar to the Satoyama Initiative, PLENUM is looking for new ways and partners to utilise the cultural landscapes in the PLENUM project regions and sees the redevelopment of 'working'

cultural landscapes as vital to their evolution (Landesanstalt für Umwelt, Messungen und Naturschutz Baden-Württemberg 2014).

Implementation of the German energy policy has led to the redevelopment of some cultural landscapes to include wind turbines, photovoltaic and biomass plants and to the transformation of some cultural landscapes from agricultural into energy landscapes that are now dominated by wind, photovoltaic and/or biomass parks (Bundesanstalt für Naturschutz und Bundesinstitut für Bau-, Stadt- und Raumforschung 2014). These change processes were neither projected nor envisaged, even two decades ago (Bruns et al. 2000). This indicates how difficult it is to anticipate the future (Konold 2014a). Those who anticipate the future, generally the planning profession, look at the past to comprehend what happened to project the future based on trends (Antrop 2005; Konold 2014a). Others work with scenarios and involve multiple sectors and local communities to envision a range of possible futures (e.g. Plieninger et al. 2013). These futures, developed via participatory processes, elucidate local values, needs and preferences, and stimulate learning and capacity building among participants. Ultimately these processes can support implementation of projects that contribute towards sustainable landscape development (e.g. Bohnet 2010; Bohnet et al. 2010, 2011; Albert et al. 2012).

Acknowledging that there is no clear reference point and an ever shifting baseline against which (cultural) landscapes will be assessed, transformational and other change processes in landscapes need to be guided by legal spatial environmental planning instruments, such as landscape planning and the impact mitigation regulation, which have their foundations in the German Environmental Law. Landscape planning, however, can be improved if it includes participation, communication, and co-design (Luz 2000; von Haaren 2002; von Haaren et al. 2014). In particular, landscape ecological co-design must play a vital role in guiding the transformations that are inevitable (e.g. infrastructure projects), while maintaining the diverse functions, values, and services that cultural landscapes provide (Bundesanstalt für Naturschutz und Bundesinstitut für Bau-, Stadt- und Raumforschung 2014; Konold 2014c).

Recent landscape change (since 1996) has been quantified in Germany considering where wind turbines, photovoltaic and biomass plants have been established, where maize has replaced grassland, and where change in forest and urban area cover occurred, and through accumulation transformed landscapes (Bundesanstalt für Naturschutz und Bundesinstitut für Bau-, Stadt- und Raumforschung 2014). How these changes together with future needs will affect and potentially transform or change the cultural landscapes in Baden-Württemberg remains unclear as yet. However, landscape planning and the impact mitigation regulation seem to be well suited, if applied, in finding the most suitable locations for energy projects and to compensate for significant adverse environmental effects of proposed projects.

However, in the interest of furthering sustainable cultural landscape development in Baden-Württemberg, it is important to address national challenges, such as nature conservation vs energy needs in Germany (Bundesanstalt für Naturschutz und Bundesinstitut für Bau-, Stadt- und Raumforschung 2014). It is also important to pay attention to the need for nature-compatible land uses and management practices, which address global challenges, such as food security issues, locally. Therefore, identification of spatially explicit locations suitable for agricultural, forestry, agroforestry, and livestock production systems under changing climatic conditions, as well as identification of spatially explicit locations for renewable energy parks, in areas of intensive and diverse cultural landscapes, is vital. Again, landscape planning, as a legal instrument, that assists in finding the most suitable locations for different land uses, based on sustainability principles (e.g. maintenance of groundwater recharge and retention), in combination with practical bottom-up projects, provides promise by developing (cultural) landscapes that accommodate new land uses and values as they emerge.

While careful co-design of (cultural) landscape change for landscape sustainability (Nassauer and Opdam 2008; Musacchio 2009; von Haaren et al. 2014), catalysed by regional development strategies, such as PLEMUM, is no panacea to reconcile all competing land uses and landscape values, there seem to be few alternatives to more effectively address landscape challenges. The protected site categories nature park and biosphere reserve, by taking bottom-up types of approaches, seem to follow the PLENUM strategy that appears to successfully lead the way in connecting scale and contemporary issues to the cultural landscapes of the past, and in a way that lets them develop into the future.

Sustainability science has contributed models, methods, case studies and principles (e.g. Lang et al. 2012; Wiek et al. 2012) to the emerging science of landscape sustainability (Wu 2006, 2013). It has supported ideas on how cultural landscapes can be maintained and developed by pointing out the need for cross-sectoral planning and decision making (e.g. Wiek and Walter 2009). How these ideas can be translated and applied in planning and development practice in regions where external pressures for economic growth and development prevail (e.g. Dale 2014; Pearson and Gorman 2010) requires further exploration. In particular, how regional development strategies can be put in place that are socially just based on democratic processes and embedded in broader legal landscape planning frameworks requires further research attention.

Conclusion

Using Germany's southwest as a case study, we explored how (cultural) landscapes have evolved over time and what the corresponding instruments are that have been put in place to maintain and develop them. Two main types of legal nature conservation and landscape management instruments safeguard cultural landscapes and landscape elements. These are the protected site system, including several protected area categories, and landscape management through landscape planning and the impact mitigation regulation. However, based on the recognition that cultural landscapes and landscapes elements can only be sustained and maintained as living cultural landscapes in the long term, if they are used and valued for the multiple functions and services they provide, new voluntary instruments have been introduced at the beginning of the 21st century.

The PLENUM strategy, one of the voluntary instruments that has been introduced in Baden-Württemberg to complement the legal instruments, has the potential to contribute to the sustainable development of cultural landscapes into the future by re-establishing traditional land uses, and accommodating new uses based on emerging needs. However, regional development strategies, such as PLENUM, if not well governed and implemented bear significant risks. They may advantage economic sectors, entrepreneurs and elites in pursuing their private gains rather than the common good. Therefore, we recommend that, although no panacea, regional development strategies need to be embedded in legal landscape planning frameworks. This means that cultural landscape development, whether in Germany, Europe or elsewhere, requires environmental legislation that restricts and compensates for adverse environmental effects from development projects, and genuine innovative strategies that support sustainable regional development from the bottom-up. PLENUM, as a project and governance approach, needs to prove itself as a genuine forward-looking model that achieves "protection via use". Application in diverse landscapes and legal contexts will contribute to this effort. The transdisciplinary approaches offered by sustainability science will, on one hand, inform and support such applications, and on the other hand, such applications will have the potential to contribute to the transformational agenda of sustainability science (Lang et al. 2012).

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References

Albert C, Zimmermann T, Knieling J, von Haaren C (2012) Social learning can benefit decision-making in landscape planning: Gartow case study on climate change adaptation, Elbe valley biosphere reserve. Landsc Urban Plan 105:347–360

Antrop M (2005) Why landscapes of the past are important for the future. Landsc Urban Plan 70:21–34

Antrop M (2006) Sustainable landscapes: contradiction, fiction or utopia? Landsc Urban Plan 75:187–197

Beaufoy G, Marsden K (2013) CAP reform 2013. Last chance to stop the decline of Europe's high nature value farming?. Hamsterley Vale, County Durham

Bohnet IC (2010) Integrating social and ecological knowledge for planning sustainable land- and sea-scapes: experiences from the Great Barrier Reef region, Australia. Landsc Ecol 25: 1201–1218

Bohnet I, Smith DM (2007) Planning future landscapes in the wet tropics of Australia: a social-ecological framework. Landsc Urban Plan 80:137–152

Bohnet IC, Gooch M, Hickey R (2010) Young people envision the future of their local area: an explorative study from the Wet Tropics, Australia. Appl Environ Educ Commun 9:185–197

Bohnet IC, Roebeling PC, Williams KJ, Holzworth D, van Grieken ME, Pert PL, Kroon FJ, Westcott DA, Brodie J (2011) Landscapes toolkit: an integrated modelling framework to assist stakeholders in exploring options for sustainable landscape development. Landsc Ecol 26:1179–1198

Braun A, Hutter CP (2014) Deutschlands wilder Süden—Naturerlebnisland Baden-Württemberg. Theiss, Stuttgart

Brown J, Mitchell N, Beresford M (2005) Protected landscapes: a conservation approach that links nature, culture and community. In: Brown J, Mitchell N, Beresford M (eds) The protected landscape approach: linking nature, culture and community. International Union for Conservation of Nature, Gland, p. 3–18. http://data.iucn.org/dbtw-wpd/edocs/2005-006.pdf

Bruns D, Ipsen D, Bohnet I (2000) Landscape dynamics in Germany. Landsc Urban Plan 47:143–158

Bundesanstalt für Naturschutz (2008) Landscape planning—the basis of sustainable landscape development. http://www.bfn.de/fileadmin/MDB/documents/themen/landschaftsplanung/landscapeplanning basis.pdf

Bundesanstalt für Naturschutz, Bundesinstitut für Bau-, Stadt- und Raumforschung (2014) Den Landschaftswandel gestalten! Potentiale der Landschafts-und Raumplanung zur modellhaften Entwicklung und Gestaltung von Kulturlandschaften vor dem Hintergrund aktueller Transformationsprozesse

Council of Europe (2000) European landscape convention—explanatory report. Strasbourg

Crona BI, Parker JN (2012) Learning in support of governance: theories, methods, and a framework to assess how bridging organizations contribute to adaptive resource governance. Ecol Soc 17(1):32. doi:10.5751/ES-04534-170132

Dale A (2014) Beyond the north-south culture wars, SpringerBriefs in geography. Springer

Demuth S, Knebel J (2007) Halbzeitevaluation von Projekten des PLENUM-Gebiets Heckengäu 2003-2006, Modul 3: Bewertung der Naturschutzwirkungen. Institut für Botanik und Landschaftskunde, Karlsruhe

Ellis EC, Ramankutty N (2008) Putting people in the map: anthropogenic biomes of the world. Front Ecol Environ 6:439–447

European Commission (2014) Natura 2000. European Commission, Brüssels. http://ec.europa.eu/environment/nature/natura2000/index_en.htm

Farina A (2000) The cultural landscape as a model for the integration of ecology and economics. Bioscience 50:313–320
Gehrlein U, Steil C, Demuth S (2013) Abschlussevaluation des PLENUM-Programms im Projektgebiet Schwäbische Alb. Institut für Ländliche Strukturforschung, Johann Wolfgang Goethe-Universität Frankfurt/Main
Hahn T, Olsson P, Folke C, Johansson K (2006) Trust-building, knowledge generation and organizational innovations: the role of a bridging organization for adaptive comanagement of a wetland landscape around Kristianstad, Sweden. Human Ecol 34:573–592
Höll N (2014) Instrumente zur Erhaltung der Kulturlandschaften. In: Landespflege Freiburg, Landesanstalt für Umwelt, Messungen und Naturschutz Baden-Württemberg (ed) Kulturlandschaften in Baden-Württemberg. G. Braun Buchverlag, Karlsruhe, Germany, pp 240–245
Jessel B (2013) 300 years of sustainability: an ancient concept remains useful. Gaia-Ecol Perspect Sci Soc 22(2):73
Konold W (2007) Dynamism and change of cultural landscapes. UNESCO Today. J German Comm UNESCO 2:18–21
Konold W (2014a) Der Schwarzwald 2064 - Kaum vorstellbar und doch sei ein Blick gewagt. Der Schwarzwald 2:6–8
Konold W (2014b) Kulturlandschaften - Landschaften der Kulturen?. In: Landespflege Freiburg, Landesanstalt für Umwelt, Messungen und Naturschutz Baden-Württemberg (ed) Kulturlandschaften in Baden-Württemberg. G. Braun Buchverlag, Karlsruhe, Germany, pp 10–21
Konold W (2014c) Kulturlandschaftsentwicklung - Kontinuitäten und Brüche. Schwäbische Heimat 3:245–252
Koohafkan P, Altieri MA (2011) Globally important agricultural heritage systems—a legacy for the future. Food and Agriculture Organization of the United Nations, Rome
Küpfer C (2012) Strengthening ecology in the landscape—the eco-account is an important instrument to stabilize ecological functions. In: ECLAS (ed) ECLAS conference "The power of landscape", Warsaw
Küpfer C, Röhl M (2011) Biotopverbund: Planung und Umsetzung aus deutscher Perspektive. Revue d'Allemagne 43:539–554
Landesanstalt für Umwelt Messungen und Naturschutz Baden-Württemberg (2011) PLENUM. Zukunft für Mensch und Natur—Natur schützen, Regionen stärken, Vielfalt erhalten. Stuttgart
Landesanstalt für Umwelt, Messungen und Naturschutz Baden-Württemberg (2014) PLENUM—Projekt des Landes zur Erhaltung und Entwicklung von Natur und Umwelt in enger Zusammenarbeit mit der Bevölkerung. Karlsruhe
Landespflege Freiburg, Landesanstalt für Umwelt, Messungen und Naturschutz Baden-Württemberg (2014) Kulturlandschaften in Baden-Württemberg. G. Braun Buchverlag, Karlsruhe, Germany
Lang DJ, Wiek A, Bergmann M, Stauffacher M, Martens P, Moll P, Swilling M, Thomas CJ (2012) Transdisciplinary research in sustainability science: practice, principles, and challenges. Sustain Sci Suppl 1:25–43
Louman B, Sunderland T, Reed J (2014) Implementation of integrated landscape aproaches. In: Forum GL (ed). http://www.landscapes.org/wp-content/uploads/2014/documents/GLF_Brief_05_landscapes.pdf
Luz F (2000) Participatory landscape ecology—a basis for acceptance and implementation. Landsc Urban Plan 50:157–166
Marschall I (2007) Der Landschaftsplan: Geschichte und Perspektiven eines Planungsinstruments. VDM Verlag Dr. Müller, Saarbrücken
Meeus JHA, Wijermans MP, Vroom MJ (1990) Agricultural landscapes in Europe and their transformation. Landsc Urban Plan 18:289–352
Miller TR, Wiek A, Sarewitz D, Robinson J, Olsson L, Kriebel D, Loorbach D (2014) The future of sustainability science: a solutions-oriented research agenda. Sustain Sci 9:239–246
Ministerium für ländlichen Raum und Verbraucherschutz Baden-Württemberg (2011a) Landschaftserhaltungsverbände in Baden-Württemberg. Brückenbauer zwischen Mensch und Natur. Stuttgart
Ministerium für Ländlichen Raum und Verbraucherschutz Baden-Württemberg (2011b) Nationale Naturlandschaften Baden-Württemberg. Ministerium für Ländlichen Raum und Verbraucherschutz, Schönaich
Ministerium für Ländlichen Raum und Verbraucherschutz Baden-Württemberg (2014) Der Nationalpark Schwarzwald. Ministerium für Ländlichen Raum und Verbraucherschutz Baden-Württemberg, Stuttgart
Morgenstern C (1922) Stufen. Eine Entwicklung in Aphorismen und Tagebuch-Notizen R. Pieper and Co. Verlag, München
Musacchio LR (2009) The scientific basis for the design of landscape sustainability: a conceptual framework for translational landscape research and practice of designed landscapes and the six Es of landscape sustainability. Landsc Ecol 24:993–1013
Nassauer JI, Opdam P (2008) Design in science: extending the landscape ecology paradigm. Landsc Ecol 23:633–644
Olsson P, Folke C, Hahn T (2004) Social-ecological transformation for ecosystem management: the development of adaptive co-management of a wetland landscape in southern Sweden. Ecol Soc 9:2
Palomo I, Montes C, Martin-Lopez B, Gonzalez JA, Garcia-Llorente M, Alcorlo P, Mora MRG (2014) Incorporating the social-ecological approach in protected areas in the Anthropocene. Bioscience 64:181–191
Pearson DM, Gorman JT (2010) Managing the landscapes of the Australian Northern territory for sustainability: visions, issues and strategies for successful planning. Futures 42:711–722
Plieninger T, Bieling C (2013) Resilience-based perspectives to guiding high-nature-value farmland through socioeconomic change. Ecol Soc 18
Plieninger T, Bieling C, Ohnesorge B, Schaich H, Schleyer C, Wolff F (2013) Exploring futures of ecosystem services in cultural landscapes through participatory scenario development in the Swabian Alb, Germany. Ecol Soc 18:39
Plieninger T, van der Horst D, Schleyer C, Bieling C (2014) Sustaining ecosystem services in cultural landscapes. Ecol Soc 19(2):59
Potschin MB, Klug H, Haines-Young RH (2010) From vision to action: framing the Leitbild concept in the context of landscape planning. Futures 42:656–667
Rössler M (2006) World heritage cultural landscapes: a UNESCO flagship programme 1992–2006. Landsc Res 31:333–353
Swanwick C, Land Use Consultants (2002) Landscape character assessment—guidance for England and Scotland. The Countryside Agency and Scottish Natural Heritage, Wetherby, West Yorkshire and Edinburgh
Takeuchi K (2010) Rebuilding the relationship between people and nature: the Satoyama initiative. Ecol Res 25:891–897
Verburg PH, van Berkel DB, van Doorn AM, van Eupen M, van den Heiligenberg HARM (2010) Trajectories of land use change in Europe: a model-based exploration of rural futures. Landsc Ecol 25:217–232
von Haaren C (2002) Landscape planning facing the challenge of the development of cultural landscapes. Landsc Urban Plan 60:73–80
von Haaren C, Bathke M (2008) Integrated landscape planning and remuneration of agri-environmental services Results of a case study in the Fuhrberg region of Germany. J Environ Manage 89:209–221
von Haaren C, Warren-Kretzschmar B, Milos C, Werthmann C (2014) Opportunities for design approaches in landscape planning. Landsc Urban Plan 130:159–170

Wende W, Wojtkiewicz W, Marschall I, Heiland S, Lipp T, Reinke M, Schaal P, Schmidt C (2012) Putting the plan into practice: implementation of proposals for measures of local landscape plans. Landsc Res 37:483–500

Wiek A, Walter AI (2009) A transdisciplinary approach for formalized integrated planning and decision-making in complex systems. Eur J Oper Res 197:360–370

Wiek A, Ness B, Schweizer-Ries P, Brand FS, Farioli F (2012) From complex systems analysis to transformational change: a comparative appraisal of sustainability science projects. Sustain Sci 7:5–24

Wiens JA (2009) Landscape ecology as a foundation for sustainable conservation. Landsc Ecol 24:1053–1065

Wu JG (2006) Landscape ecology, cross-disciplinarity, and sustainability science. Landsc Ecol 21:1–4

Wu JG (2013) Landscape sustainability science: ecosystem services and human well-being in changing landscapes. Landsc Ecol 28:999–1023

Süß P, Gehrlein U, Dehmuth S (2011) Abschlussevaluation des PLENUM-Programms im Projektgebiet Allgäu-Oberschwaben. Institut für Ländliche Strukturforschung, Johann Wolfgang Goethe-Universität, Frankfurt/Main

Yokohari M, Bolthouse J (2011) Keep it alive, don't freeze it: a conceptual perspective on the conservation of continuously evolving satoyama landscapes. Landsc Ecol Eng 7:207–216