Landscape concepts and approaches foster learning about ecosystem services

Per Angelstam · José Munoz-Rojas · Teresa Pinto-Correia

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Abstract The ecosystem services framework aims to encourage ecological sustainability through political-economic decisions. However, it fails to capture the complexity of social–ecological interactions. This is an obstacle for coping with current grand challenges through integrative knowledge production and collaborative learning. Landscape concepts and approaches, which emphasize human–environment interactions, governance and stewardship, can help overcome this obstacle. In particular, landscape concepts and approaches can help resolve the integrative and operational gaps encountered in the ecosystem services framework as a means of communicating evidence-based knowledge about the state and trends of ecosystems. The goal of this Special Issue is to address how different interpretations of landscape can support knowledge production about ES, and how

applying landscape approaches on the ground can encourage more collaborative and sustainable land management alternatives. The effectiveness of the ecosystem services framework can be improved by (1) the use of landscape concepts to build bridges to different disciplines, arts and practice, as well as to build SMART sustainability indicators, and (2) the application of holistic landscape approaches for place-based knowledge co-production and collaborative learning across multiple governance levels. This forms the base for a research infrastructure integrating methods from the natural and social sciences through macroecology, comparative politics, and regional studies. While place-based research using landscape concepts can help develop more sustainable alternatives for land management, scaling up landscape approach initiatives towards landscape stewardship and fostering collaborations among initiatives are paramount challenges.

P. Angelstam (✉)
School for Forest Management, Faculty of Forest
Sciences, Swedish University of Agricultural Sciences
(SLU), PO Box 43, SE-73921 Skinnkatteberg, Sweden
e-mail: per.angelstam@slu.se

J. Munoz-Rojas · T. Pinto-Correia
ICAAM – Instituto de Ciências Agrárias e Ambientais
Mediterrânicas, Instituto de Investigação e Formação
Avançada, Universidade de Évora, Pólo da Mitra, Ap. 94,
7006-554 Évora, Portugal
e-mail: jmrojas@uevora.pt

T. Pinto-Correia
e-mail: mtpc@uevora.pt

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Background

Ecosystem services are defined as the benefits people obtain from ecosystems (MEA 2005; Braat and de

Groot 2012). This framework aims at and has the potential to drive a paradigmatic shift in land-use decision making via relevant governance, management and planning (Albert et al. 2014; Förster et al. 2015). Ecosystem services are nowadays considered as a key framework to encourage ecological sustainability through political-economic decisions (Saarikoski et al. 2018). However, this concept has already been challenged by critiques of scientific, operational and ideological nature (Norgaard 2010; Hauck et al. 2013; Jax et al. 2013). Key critiques include the decoupling of the ecological and social system dimensions of land-use (Schröter et al. 2014), and the neglect of landscape stewardship challenges inherent to application of the ecosystem services framework (Bieling and Plieninger 2017). Despite this critique, the concept of Ecosystem Services has gained a strong position in the scientific sphere, linking to the policy making arena, as it allows for assessment and measurements which were not done before. In addition, the concept has increased considerable attention among scientists as a way to communicate societal dependence on ecological life-support systems that integrates perspectives from both the natural and social sciences (Quintas-Soriano et al. 2018). We therefore choose to ground our analysis on this concept to develop a basis for comparison between different approaches.

Despite claims of the ecosystem services framework being able to trigger a paradigmatic shift by placing ecological challenges at the core of human decision-making (Gómez-Baggethun et al. 2010; Gómez-Baggethun and Ruiz-Pérez 2011), there have been many other previous attempts to highlight the heavy human footprint on the environment. Indeed, concerns about negative effects of human footprints on the environment and subsequently on human well-being are ancient. These concerns are the subject of taboos and cultures of local holistic knowledge production and have been embedded in traditional land use systems (Berkes et al. 1994; Primdahl et al. 2018). However, the industrial revolution triggered the rapid evolution of intensified agriculture and forestry (von Carlowitz 1713; Myrdal and Morell 2011), at the expense of other landscape benefits. A. Von Humboldt's *Cosmos* (Kwa 2007) was at the forefront of highlighting this problem, which originally evolved using the lens of landscapes as diagnostic tool for human impact on environments (Vanderburgh 2012).

George Perkins Marsh's (1864) book "Man and Nature" is a key step to systematically document negative effects of human action on the environment in general. Thomas' (1956) comprehensive report from the seminal symposium "Man's role in changing the face of the earth" is another milestone of holistic research that addresses the human footprint on landscapes and regions. Indeed, the plea for integrated studies of social-ecological system is not new either: E.P. Odum's (1959) 2nd edition of "Fundamentals of ecology" concludes "*a lot of diligent study of man and nature (as a unit, not separately) is in order before we can even begin to entertain the idea that we are masters of our destiny*". Since then the world has entered the Anthropocene, and climate change is here with extremely perilous scenarios (Wallace-Wells 2017). The diagnosis of our Planet is clear: it's not healthy. Consequently, there is a need both to define planetary boundaries within which we expect that humanity can operate safely (Rockström et al. 2009), and to encourage approaches to planetary stewardship towards increased ecological, economic and social sustainability (Steffen et al. 2011).

The challenge to translate knowledge to action that allows mitigation and adaptation to local to global challenges is immense, and requires multi-level governance based on knowledge co-production and learning in concrete coupled human-nature systems (i.e. landscapes) (e.g., Matthews and Selman 2006; Angelstam et al. 2017). The term landscape approach captures this aspiration (e.g., Sayer et al. 2013, 2015, 2016; Freeman et al. 2015; Reed et al. 2017). Similarly, Bissonette and Storch's (2003) integrative and novel work focuses on integrating landscape ecology and resource management. At the outset they conclude that it is not necessarily ignorance that hampers conservation and sustainable use. Instead obstacles and challenges in the social system need to be placed at the forefront and better understood (e.g., Flyvbjerg 2001; Kates 2011). Inter- and trans-disciplinary efforts, raising conservation on political agendas, understanding influences of economics, culture and geographic context are all crucial steps. Indeed, to encourage holistic problem solving a plethora of international level meetings have been arranged, and new international public policy orientations have emerged. The 1972 Stockholm Conference on the Human–Environment was the starting point of a long sequence of conferences (e.g., in Rio de

Janeiro 1992), assessments (e.g., MEA 2005; IPBES 2019) and international goal setting (e.g., Millennium Development Goals (UNDESA 2006)), ultimately resulting in the recent approval and subsequent adoption of the United Nation’s Sustainable Development Goals (UN 2015). However, in spite of this long history of insight the human footprint on nature is still increasing (IPBES 2019). The challenges being faced to support implementation of the global discourse about sustainable development (SD) as a societal process, and sustainability as outcomes at the appropriate operational scales on the ground, is thus at the core of this Special Issue. The concerns about a heavy human footprint on the environment, and subsequent negative effects on human well-being, has triggered the creation of a bewildering range of new terms and concepts in policy, practice and research with short life spans.

To scan current approaches to use landscape concepts as theory, and landscape approach as practice, we as editors of this Special Issue, arranged in 2017 a session at IALE-Europe’s conference in Ghent (<https://iale-europe.eu/iale2017/ecosystem-services-framework-and-concept-landscape-towards-holistic-territorial-approaches>). After the meeting a total of 20 articles were gathered (Table 1; Fig. 1). First, we use the articles collected in this Special Issue to demonstrate how different landscape concepts can support the development of SMART indicators to measure states and trends of different sustainability dimensions. Second, we show how this can support more efficient solutions to multi-level governance and sustainable land use by applying landscape approach initiatives on the ground. We also address the need to build bridges among different types of landscape approach, and initiatives to implement them.

Coupling ecological and social systems

To sustain the provision of multiple ecosystem services in landscapes, solid empirical evidence about states and trends, and well-coordinated policies and plans across multiple and governance levels are required (Saarikoski et al. 2018). Already Troll (1950) indicated how landscape research “requires continuous and close contact with the large number of disciplines in the natural and the economic and social sciences”. The term landscape, as used in a wide range

of different disciplines, art and in practice (Fig. 2), captures this and provides interfaces to a wide range of disciplinary approaches and ways of knowledge production. Grodzynski (2005) in his comprehensive two volume book, and summarized by Angelstam et al. (2013), reviewed the landscape concepts’ natural, anthropocentric and intangible interpretations as defined in the wide range of landscape research schools that have emerged in North America, and especially in Europe’s East and the West (see also Mathews and Selman 2006; Pedrolí et al. 2006; Dyakonov et al. 2007). Landscape ecology is perhaps the most prominent one of these (Wu 2013), due to its clear ambitions to promote sustainability science (Kates 2011; Wiens 2013; Wu 2013).

Stressing that relevant knowledge about landscapes has complimentary roots, having been published in multiple languages and across a wide range of cultural contexts over the past century, Wiens et al. (2007) identified four cornerstone themes of landscape ecology:

1. A Russian/Soviet biophysical approach based on soil science, physical geography and geology, clustered under the concept of geo-systems and with applications in centralized top-down and technocratic planning systems (e.g., Berg 1915). This approach was adapted to governance systems in open societies of Western Europe by French geographers such as Tricart and Killian (1979) and Bertrand and Bertrand (2002), who set the base for ecologically-based decision-making systems in Western Europe for the past 50 years.
2. Rapid natural resource inventories based on physical geography in large countries such as Australia (e.g., Christian 1958).
3. Cultural and historic geography (e.g., Sauer 1925; Troll 1950), as an attempt to overcome ecological determinism, and move towards approaches where contingent causality prevails understanding of human-nature relationships
4. A biological approach within ecology (Watt 1947) with spatial patterns and processes at the forefront.

Furthermore, there is a growing current of landscape ecology grounded on human and social sciences approaches and dealing with people’s relation to the landscape and processes of decision making at multiple scales with direct or indirect consequences on the

Table 1 List of contributions focusing on measurement and assessment of different ecosystem services (ES) with authors, topics and geographical region; *LA* denotes a focus on landscape approach

#	Author	Topic	Region	
1	Aalders and Stanik	Measuring cultural ES	Scotland	ES
2	Angelstam et al.	Research infrastructure for landscape approach	Europe and the Mediterranean	LA
3	Aspinall and Staiano	Provisioning service dynamic	Scotland	ES
4	Burton et al.	Visions for woodland expansion	Scotland	LA
5	Cusser et al.	Bees benefit from semi-natural habitat fragments	US and Brazil	ES
6	Fagerholm et al.	Facilitating researcher-stakeholder integration	Tanzania	LA
7	Frolova	The geosystem paradigm for landscape assessment in USSR	Russia	ES
8	Herrero-Jáuregui et al.	Landscape structure and ES	Spain (Central)	ES
9	Lazdinis et al.	Developing regional solutions for sustainable forest management	European Union	LA
10	Palang et al.	Predicted and real landscape change	Estonia	ES
11	Pérez-Ramírez et al.	Sense of place across cultivated lands		ES
12	Plieninger et al.	Socio-cultural mapping of ES	European high nature value farmlands	ES
13	Quintas-Soriano et al.	Mediterranean ES	Spain (SE)	LA
14	Rodriguez Sousa et al.	Olive grove stewardship	Spain (Southern)	LA
15	Santos-Martin et al.	Integration of economic and ecological values	Spanish high nature value farmlands	ES
16	Sarkki et al.	What do social innovations deliver on the ground?	Ukraine	LA
17	Sijtsma et al.	Broadening stakeholder engagement through cultural ES	The Netherlands/Germany	ES
18	Spyra et al.	ES as communication “Esperanto”	European	LA
19	Vialatte et al.	ES governance	Conceptual framework	LA
20	Zimmerman-Teixeira et al.	Ecosystem disservices	France and Brazil	ES

landscape structure and functions (Primdahl and Swaffield 2010; Selman 2012).

Using landscape concepts to derive sustainability indicators

Across a wide array of different social-ecological contexts, a total of 11 of the 20 articles in this special issue focus on how to measure the state and trends of different ecosystem services. To illustrate the opportunity to shift between the ecosystem services framework and landscape concepts we characterise each article using both approaches (see Table 2 with ID numbers from Table 1), present summaries of them according to the main landscape dimension (ditto), and analysed texts of the abstracts (Fig. 3).

Biophysical dimensions

Cusser et al. (2019, #5) found that to sustain pollination provision it is crucial to maintain the abundance of semi-natural habitat in both tropical (Brazil) and temperate biomes (USA), a task for which planning and coordinated management at the landscape scale is fundamental. Frolova (2019, #7) described the conceptual origins of the geosystem approach to resource management in the former USSR, and concluded that this concept is complementary to ES, and can be considered being relevant for both conceptual and also operational frameworks.

Fig. 1 Landscape concepts and approaches are of relevance for contexts that differ in their biophysical, anthropogenic and intangible socio-cultural interpretations. The map shows the location of case studies in the 20 articles in this special issue.

The case studies reflect the multi-level, multi-scale, geographically encompassing and complex spatial nature of landscape concepts and approaches as a basis for knowledge production and collaborative learning about ecosystem services

Fig. 2 The “niche” of the landscape concept in human culture (after Grodzynski 2005)

Table 2 Classification of 11 of the 20 articles in this special issue that focus on landscape concepts (Grodzynski 2005) and ecosystem service groups (MEA 2005)

	Landscape concepts		
	Biophysical interpretations	Anthropogenic interpretations	Intangible interpretations
Ecosystem service group			
Regulating	Aspinall and Staiano (#3) Cusser et al. (#5) Quintas-Soriano (#13) Rodríguez Sousa (#14)	Burton et al. (#4)	Plieninger et al. (#12) Zimmerman-Teixeira et al. (#20)
Habitat	Cusser et al. (#5) Pérez-Ramírez et al. (#11) Herrero-Jáuregui et al. (#8) Quintas-Soriano (#13) Rodríguez Sousa (#14)	Burton et al. (#4) Herrero-Jáuregui et al. (#8) Santos-Martin (#15)	Fagerholm (#6) Pérez-Ramírez et al. (#11) Plieninger et al. (#12) Zimmerman-Teixeira et al. (#20)
Provisioning	Aspinall and Staiano (#3) Frolova (#7) Quintas-Soriano (#13) Rodríguez Sousa (#14)	Aspinall and Staiano (#3) Frolova (#6) Burton et al. (#7) Santos-Martin (#15)	Plieninger et al. (#12) Quintas-Soriano (#13) Zimmerman-Teixeira et al. (#20)
Cultural		Burton et al. (#4) Aalders and Stanik (#1) Quintas-Soriano (#13)	Fagerholm (#6) Sijtsma et al. (#17) Palang et al. (#10) Plieninger et al. (#12) Pérez-Ramírez et al. (#11) Quintas-Soriano (#13) Zimmerman-Teixeira et al. (#20)

Anthropogenic dimensions

Aspinall and Staiano (2019, #3) studied the dynamics of agricultural land use in Scotland 1940–2016 and the related provisioning ecosystem services. They found that energy and labour efficiency and production levels increased, as well as the necessary input to maintain this. Such holistic accounting can improve trade-offs between different ES. Herrero-Jáuregui et al. (#8) used proxies from socio-economic data and land use to assess cultural ES changes in a Spanish rural–urban gradient. Over a 20-year period agricultural and silvopastoral cultural landscapes degraded substantially. The challenge of more effective social-ecological land planning towards sustainability is stressed.

Intangible dimensions

Aalders and Stanik (2019, #1) compared the spatial distribution of indicators for cultural heritage and entertainment services as cultural ES at three spatial scales. They concluded that use of landscape units that reflect social-ecological systems would be ideal. Palang et al. (2019, #10) revisited a scenario study of trajectories of actual and desired land cover change nowadays and when Estonia was about to join the European Union. Three follow-up studies showed that caring for the visual landscape was one of the pillars of cultural landscape stewardship. Pérez-Ramírez et al. (2019, #11) stressed the need to include sense of place into assessment of cultural landscape values, with implications for governance systems and participatory planning. Plieninger et al. (2019, #12) stressed that socio-cultural mapping of ES is useful for

challenges in Spanish agro-ecosystems, and to assess the gap towards sustainable landscape management strategies. First, they quantified and mapped the importance of crop production in biophysical and monetary terms. Second, they mapped the ecological value of agro-ecosystems based on a “High Nature Value farming areas” index. Third, they explored the spatial correlations between economic and ecological values to identify major challenges related to agricultural land-use change and related ecosystem service delivery. Finally, they conducted a public consultation about the Spanish populations’ environmental concerns and the importance attributed towards ecosystem services. The results show that it is possible to balance the supply of ecological, economic, social values from agro-ecosystems, and that this helps identifying areas in Spain where action should be taken to enhance sustainable landscape programs. Quintas-Soriano et al. (2019, #13) developed an integrating spatial analysis of multiple ecosystem

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emerged in parallel in many contexts (Table 2). A total of nine articles in this special issue have the focus on integration, communication, stewardship and planning; a text analysis of these nine abstracts is found in Fig. 4.

To satisfy economic, ecological and socio-cultural dimensions of sustainability through the provisioning of multiple ecosystem services in any given area, the incorporation of the perceptions, attitudes and motivations of local public is essential (Quintas-Soriano et al. 2019, #13). Furthermore, participatory landscape planning using digital tools enhance the possibilities and target audiences for considering trade-offs in planning the delivery of multiple ecosystem services

2019; Zimmermann Teixeira et al. 2019). To do this, we introduced these texts into the tagcrowd software (<https://tagcrowd.com/>) and chose to proportionally represent the most commonly repeated 50 words. To focus on the most relevant issues at stake and avoid unnecessary noise in the result, we excluded from the analysis adverbs articles, prepositions and pronouns

in multi-functional landscapes (Fagerholm et al. 2019, #6). Although a landscape approach is widely embraced as a general concept for working with social-ecological systems towards sustainability (e.g., Sayer et al. 2013; Freeman et al. 2015; Angelstam et al. 2019a), there are many barriers for incorporating multi-level and multi-sectoral perspectives, especially in a rural areas (Blicharska et al. 2011; Elbakidze et al. 2015; Sayer et al. 2016; Reed et al. 2017; Bjärstig et al. 2018; Chiasson et al. 2019). Institutional and cultural barriers encountered include a general lack of staff and resources, low status of planning that limits stakeholder engagement and insufficient knowledge limits implementation.

Lazdinis et al. (2019, #9) highlight the application of place-based landscape approach to reflect the diversity of forest conditions and desired products among governance units in the European Union. A prerequisite is that residents, land owners and land users are involved throughout the process, which requires training and is time-consuming. Using a participatory GIS approach Fagerholm et al. (2019, #6) found that cultural landscape services showed clustering and small spatial extent, which allows for local-level, spatially specific discussions between stakeholders. Visual power of maps and satellite image are emphasized. They conclude that in data scarce contexts, participatory mapping of landscape services has potential to advance understanding of what values and benefits landscape has for the locals and how this information, when mapped spatially, can be integrated with planning practices. Sarkki et al. (2019, #16) evaluated the Swiss-funded development co-operation project FORZA that focuses on developing sustainable forest management in the Ukrainian Carpathians. Spyra et al. (2018, #18) focused on the use of participatory planning of ES. They argued that the ES approach can be viewed as an “Esperanto” that can support communication, use of local knowledge and integration of ES in existing legal documents, thus supporting more effective planning and management processes towards sustainability. These three last studies (Spyra et al. 2018, #18; Fagerholm et al. 2019, #6; Sarkki et al. 2019, #16) stress the need to combine quantitative and qualitative methods, bridge disciplinary barriers and work at different governance levels from the Pan-European to regional and local landscape.

Focusing on stakeholders’ feedback Burton et al. (2018, #4) found considerable consensus among stakeholder groups that woodland expansion in Scotland can offer valuable benefits. Long-term funding and landscape scale collaboration were favoured as solutions, both of which are highly aligned with the principles of landscape approach (Sayer et al. 2013). Rodríguez Sousa et al. (2019, #14) studied new forms of management of olive trees; the most rapidly expanding crop in the Mediterranean landscapes of the Iberian Peninsula. Novel forms of stewardship are needed to cope with both abandonment and intensification. Scenarios incorporating ecological management allowed the best economic and environmental balance. However, farmers need to be financially rewarded for landscape stewardship and direct environmental payments. Finally, due to interdependent ecological and social processes occurring at multiple space and time scales, Vialatte et al. (2019, #19) stress that operationalising the ES concept is challenging. Focusing on the landscape level allows integration of different ES and their underlying components i.e. ecological processes, management practices and social structures, and understanding of stakeholder interactions. The landscape level makes it possible to make the social choices among ES explicit.

Multiple landscapes as an integrative research infrastructure

The European Union’s Horizon 2020 funding for establishment of a research infrastructure based on Long-Term Social-Ecological Research (LTSER) platforms (Singh et al. 2013) is an attempt to create an international research infrastructure of landscapes (eLTER; see <http://www.lter-europe.net/elter>). The European Strategy Forum on Research Infrastructures (ESFRI 2016) is one option for improved cohesion among such place-based initiatives aimed at trans-disciplinary research. To facilitate initiatives towards better use and development of research infrastructures, ESFRI publishes roadmaps (ESFRI 2016). By putting eLTER on the ESFRI Roadmap in 2018, ESFRI has underpinned the importance of LTSER platforms as a part of a Research Infrastructure in terms of integrated ecosystem, critical zone and socio-ecological research.

Table 3 Landscapes provide a wide range of consumptive and non-consumptive benefits to people, firms and society. Landscapes' renewable natural resources and values therefore continue to be at the centre of many policies about forests, water, agriculture and rural development. This table from Angelstam et al. (2019a) presents four general criteria as a base

for learning through evaluation that combines landscape as space, infrastructure and Lee's (1993) idea of compass and gyroscope. These four criteria are then matched with three operational landscape approach concepts and two general frameworks for landscape approach.

Criterion (inspired by Lee 1993)	Model forest (IMFN 2008)	Biosphere reserve (UNESCO 2008)	LTSER platform (Grove et al. 2013; Singh et al. 2013; Angelstam et al. 2019b (#2)	General framework (Axelsson et al. 2011)	General framework (Sayer et al. 2013)
A. Landscape as space (area, region, catchment)	<ul style="list-style-type: none"> • Principle 1: Landscape. A large-scale biophysical area representing a broad range of landscape values, including social, cultural, economic, and environmental concerns 	<ul style="list-style-type: none"> • Biosphere reserves are organised into three management zones, known as core areas, buffer zones and transition areas 	<ul style="list-style-type: none"> • Siting in a large area relevant to both ecological and social system topics 	<ul style="list-style-type: none"> • Attribute 1: A sufficiently large area that matches management requirements and challenges to deliver desired goods, services and values 	<ul style="list-style-type: none"> • Principle 3: Multiple scales • Principle 4: Multifunctionality
B. Infrastructure	<ul style="list-style-type: none"> • Principle 6. Knowledge sharing and networking. Builds on stakeholder's capacity to engage in the sustainable management of natural resources, and collaborate and share results and lessons learned through networking 	<ul style="list-style-type: none"> • Logistical support for research, education, monitoring, etc. 	<ul style="list-style-type: none"> • Construction and maintenance of coordination capacity (data bases, laboratories, monitoring schemes such as sites for long-term monitoring) • Networking among initiatives 	<ul style="list-style-type: none"> • Attribute 4: Integrative knowledge production 	<ul style="list-style-type: none"> • Principle 1: Continual learning and adaptive management
C. Gyroscope (sustainable development as a societal process in a landscape as place)	<ul style="list-style-type: none"> • Principle 2. Partnership. A neutral forum that welcomes voluntary participation of representatives of stakeholder interests and values on the landscape • Principle 4. Governance. The process is representative, participatory, transparent and accountable, and promotes collaborative work among stakeholders • Principle 5. Program of activities. The activities are reflective of stakeholder needs, values and management challenges 	<ul style="list-style-type: none"> • Different stakeholders are informed, should participate on the procedure for the elaboration and review of integrated management policy • Environmental education: (1) respect natural and cultural heritage; (2) favour responsible relationships with the environment and better land management, (3) create citizens who are aware of their responsibilities to future generations • Institutional structure for local sustainable development 	<ul style="list-style-type: none"> • Stakeholder engagement for regional/local development involving decision-makers at different levels of governance, land use stakeholders, the public • Collaborative learning builds on both quantitative and qualitative research, and stakeholders' skills and experiences 	<ul style="list-style-type: none"> • Attribute 2: Multi-level and multi-sector stakeholder collaboration that promotes sustainable development as a social process • Attribute 5: Sharing of experience, results and information, to develop local tacit and general explicit knowledge 	<ul style="list-style-type: none"> • Principle 2: Common concern entry point • Principle 5: Multiple stakeholders • Principle 6: Negotiated and transparent change logic • Principle 7: Clarification of rights and responsibilities • Principle 9: Resilience • Principle 10: Strengthened stakeholder capacity

Table 3 continued

Criterion (inspired by Lee 1993)	Model forest (IMFN 2008)	Biosphere reserve (UNESCO 2008)	LTSER platform (Grove et al. 2013; Singh et al. 2013; Angelstam et al. 2019b (#2))	General framework (Axelsson et al. 2011)	General framework (Sayer et al. 2013)
D. Compass (states and trends of sustainability)	<ul style="list-style-type: none"> • Principle 3: Sustainability. Stakeholders are committed to the use, conservation and sustainable management of natural resources and the landscape 	<ul style="list-style-type: none"> • Development of integrated management policy • Conservation of biological diversity (genetic variation, species, ecosystems, landscapes) and sustainable use of natural resources 	<ul style="list-style-type: none"> • Long-term monitoring of social and ecological systems • Biological conservation and sustainable provision of ecosystem services to nature and people 	<ul style="list-style-type: none"> • Attribute 3: Commitment to and understanding of sustainability as an aim among stakeholders 	<ul style="list-style-type: none"> • Principle 8: Participatory and user-friendly monitoring

Additionally, several networks focus on landscape restoration (IUCN and WRI 2014) and on sustainable landscape management in the tropics (Denier et al. 2015). Other global level concepts and processes aiming at of landscape approach are UNESCO's Biosphere Reserves, the International Model Forest Network (www.imfn.net) and the Global Landscapes Forum (www.landscapes.org). There is thus potential for integration among different landscape approach concepts, and initiatives applying them, as a research infrastructure that can contribute to more sustainable models of practice and management that are effective on the ground. This is urgently required to address the interconnected wicked challenges of economic development, ecological integrity, and social justice that are essential components of human well-being through a stronger territorial basis (e.g., Duckett et al. 2016).

Assessing states and trends of sustainability, using ecosystem services, natural capital (Wackernagel et al. 1999), landscape services (Bastian et al. 2014) or nature's contribution to people (Pascual et al. 2017), involves challenges, which are both disciplinary and related to stakeholder engagement and participation. Efforts towards landscape stewardship require that individuals reconnect to the landscape as their place of living which they constantly influence (Selman 2012), and building trust and trustworthiness among both academic and non-academic participants in problem-solving at a local landscape scale (Von Wehrden et al. 2019; Pinto-Correia et al. 2018). In general, ecological research dominates the ES approach (e.g., Angelstam et al. 2019b, #2). To balance the ecological focus, social science also needs to contribute actively. In

response to this Flyvbjerg (2001:60) advocated a “phronetic (prudent) approach” and ... to carry out analyses and interpretations of the status of values and interests in society aimed at social commentary and social action, i.e. praxis...” Three key questions are: Where are we going? Is this desirable? What should be done? Horizon scanning for the future is an approach to address those questions. It is the formal process of gathering, processing and disseminating information to support decision-making in the future (e.g., Sutherland and Woodroof 2009; Shackleton et al. 2017). A horizon scanning is both an approach to begin the process of place-based knowledge production and learning with academic and non-academic stakeholder groups, and to interpret and discuss the results from research.

The interest in integrating both qualitative and quantitative approaches in research about landscapes is particularly promising when it comes to cultural ecosystem services (e.g., Plieninger et al. 2019, #12) and Fagerholm et al. (2019, #6)). Nevertheless, a social system perspective is urgently needed concerning different stakeholders' perspectives on what is service or a disservice (Zimmermann Teixeira et al. 2019, #20) and what are most relevant societal expectations and how different expectations are either conflicting or complementary (Pinto-Correia and Kristensen 2013).

The high-level praise of landscape approach as a practical tool (e.g., World Forestry Congress 2009; Sayer et al. 2013; Freeman et al. 2015) needs to be matched by assessments of place-based initiatives' performance. Comparative studies of different kinds of landscape approaches, and initiatives that apply

them, can enhance learning about how to implement policy aiming at sustainability in different contexts. However, this calls for a focused and pedagogic analytical framework for learning through evaluation that is generally applicable to existing landscape approach concepts, and which can be applied to any concept or initiative. Angelstam et al. (2019b, #2; see also Table 3) suggested four criteria, viz. (1) a concrete landscape representing both space and place, which is supported by (2) an appropriate administrative infrastructure, and combined with the use of Lee's (1993) idea of (3) compass (sustainability as consequences), and (4) gyroscope (sustainable development as a societal process). Supporting learning through evaluation, Angelstam et al. (2019b, #2) made an audit of all 67 registered European Long-Term Socio-Ecological Research (LTSER) platforms' level of compliance with the definition of the LTSER concept. The objective of that concept is to function as regional platforms for knowledge production and governance of multiple ecosystem services, and a place-based research infrastructure. This was generally satisfied but there is also room for improvement. Ideally, different landscape approach concepts should collaborate. However, barriers in terms of competition among concepts that focus only on their own version of what landscape approach means need to be bridged. We therefore encourage a wider use of systematic learning through evaluation of place-based applications of different types of landscape approach.

Conclusions

The papers in this Special Issue reveal the diversity of concepts that are applied when the goal is to understand and assess the benefits people derive from landscapes and their constituent ecological and social systems. These landscape concepts are first and foremost complementary. The complexity, both of landscape concepts and of disciplines that work with landscape analysis and landscape conservation, do not create the ground for a simple and unifying approach to assess these benefits. Therefore, accepting different approaches, grounded on natural or social sciences and the humanities, and defining bridges between them and the knowledge they produce, is the most enriching way forward. Additionally, in practice, these linkages require a common ground for problem-solving

transdisciplinarity. Place-based approaches allow for recognizing the role of each perspective, and to find ways for their integration. Furthermore, they require integrating many different forms of knowledge, both scientific and the practitioners'. Being able to handle the integration of natural and social science methods can be supported by the use of macroecology, comparative politics, human geography, land-use planning and regional studies. Finally, we encourage use of concrete landscapes for place-based collaborative learning at multiple levels using some form for internationally renowned landscape approach.

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