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ORIGINAL ARTICLE

Disentangling the practice of landscape approaches: a Q-method analysis on experiences in socio-ecological production landscapes and seascapes

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Abstract

Landscape approaches are gaining momentum in both scientific and policy agendas. However, landscape approaches comprise a multitude of concepts, approaches and principles, which are in part similar, in some parts different or even contradictory. In this paper, we used a Q-method questionnaire to explore how landscape approaches are understood and employed in 45 case studies of socio-ecological production landscapes and seascapes derived from the International Partnership for the Satoyama Initiative (IPSI), as well as the motivations for employing them. Our analysis revealed that all landscape approaches pursued very similar goals, namely to ensure that local communities as landscape stewards have the capacity to preserve context-specific values in the face of socio-economic and environmental changes. The tools for reaching such goals are built upon people and nature feedback dynamics that crystalize in rich biodiversity and local ecological knowledge. However, our analysis also showed that the means to reach those goals differed depending on many contextual factors, such as the dominant ecosystems and socio-economic activities in the landscape, the constellation of actors or the most relevant drivers of change affecting the social–ecological system. In particular, we identified four distinct lenses in which landscapes approaches are applied in practice to landscape sustainability: (1) for the preservation of natural values, (2) for the preservation of socio-cultural values, (3) for the promotion of social justice and participatory governance, and (4) for securing food security and local livelihoods. Our results showed an association between the choice of a lens and the value types motivating the use of a landscape approach. Relational values were associated with a focus on landscape conservation and safeguard of social–ecological values. Our study highlights the relevant and beneficial role of landscape approaches as a boundary concept and emphasizes the need for transdisciplinary and participatory methods within landscape research and practice to navigate the context-specific options for implementation of landscape approaches.

Keywords Landscape sustainability · SEPLS · Q-sorts · Integrated landscape management

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Introduction

Throughout history, society and environment have progressively shaped each other in close interactions that often resulted in landscapes and land use systems of high natural and cultural value (Schaich et al. 2010). In the era of the Anthropocene, however, rapid environmental and socio-economic changes are leading to dramatic changes in human-dominated landscapes worldwide (Tilman et al. 2011). The consequences of the changes in the way societies relate to landscapes (e.g., over-exploitation of natural resources, landscape homogenization) are hard to reverse and include severe drops in biodiversity levels, degradation of ecosystems and their capacity to provide ecosystem services, as well as the substantial erosion of local ecological knowledge (Plieninger et al. 2014; Riechers et al. 2020).

The limited success of conventional efforts to halt biodiversity loss and ecosystems degradation has led to a surge of landscape approaches, which could be defined as a framework that integrates policy and practice to address the multi-scalar pressures on social–ecological systems and to reconcile economic development with the conservation of natural and social values (Arts et al. 2017). Landscape approaches distinctively focus on a territorial scale for capturing the interaction between human and natural dimensions and on inter- and transdisciplinary methods and perspectives to consider and integrate the multi-faceted complex nature of social–ecological systems (Sayer et al. 2013). Landscape approaches characteristically consider the context-specificity of social–ecological systems to promote landscape sustainability, which could be defined as the capacity of a landscape to consistently provide ecosystem services for the well-being of local communities and to advance social–ecological systems toward reducing vulnerability and boosting resilience toward environmental and socio-cultural changes (Wu 2013).

Landscape approaches have in a relatively short time successfully permeated the academic and policy arenas, and some elements of them have been taken up for example in the UNESCO World Heritage Convention, the Convention on Biological Diversity, the FAO Globally Important Agricultural Heritage Systems or the UNESCO Man and Biosphere Programme. The development and implementation of landscape approaches have been accompanied and complemented by epistemological advances to define a theoretical framework for landscape sustainability (Wu 2013; Opdam 2018; Liao et al. 2020). However, whereas the use of landscape approaches to advance landscape sustainability remains a relatively agreed-upon overall objective, the terms comprise a multitude of concepts and principles which are in part similar, and in some parts different or even contradictory. In practice, what landscape sustainability really means in each specific context can greatly differ (Wu 2013; Zhou et al. 2019). Depending on the specific needs of a region and the constellation of social–ecological factors in any given landscape, some sustainability dimensions are prioritized over others. When using landscape approaches, it is rare to achieve situations of absolute win–wins (Howe et al. 2014; Turkelboom et al. 2018). Rather, the promotion of any specific set of ecosystem services or values will necessarily come at the expense of others, generating trade-offs and mismatches that need to be managed (Turkelboom et al. 2018; Qiu et al. 2018).

Landscape approaches have been developed and implemented in a multitude of ways. In many cases, landscape sustainability was pursued by capitalizing on local practices and knowledge to adapt to the current cultural and socio-economic context (Fischer et al. 2012; Takeuchi et al. 2016). On some occasions, landscape approaches are articulated around specific landscape products, which are products deeply linked to the local identity and landscape character, typically part of a "quality turn" in food consumption (García-Martín et al. 2020). On other occasions, the recognition of the natural and cultural values associated with landscapes enabled its support by all actors in the landscape, either by generating an added value in specific goods (e.g., certification mechanisms) or services (e.g., tourism or new forms of agri-environmental use) (Woestenburg 2018; Flinzberger et al. 2020; Plieninger et al. 2020).

In every specific landscape setting, the local social–ecological context and the specific visions, priorities and aspirations of the groups of actors interacting in the landscape determine the answer to key questions such as: What are the specific objectives of the landscape approach? Who benefits from the landscape approach? How are competing needs and goals balanced? How are inevitable trade-offs navigated (Wiens 2013; Torralba et al. 2018)? By assessing and comparing different visions and understandings of cases implementing landscape approaches, what was prioritized in each case, and what was won and lost in the process, different strategies can be identified that serve as inspiration for similar contexts of landscape governance (Liao et al. 2020; Lam et al. 2020). Furthermore, by looking into the actual application of the principles of landscape approaches, we can advance on bridging the gap between science, policy and practice.

Many landscapes worldwide have over time developed strategies to conserve their integrity, maintain their multiple social–ecological values, and support the well-being of local communities against substantial environmental and socio-economic pressures (Takeuchi 2010; LPFN 2012). There is a high potential for learning valuable lessons from such individual contexts (Bennett et al. 2016), particularly from

time-tested landscape approaches that have been proved successful in navigating multidimensional drivers of change. The International Partnership for the Satoyama Initiative (IPSI) offers a unique repertory of such practical cases, where different communities worldwide have developed strategies to sustainably manage their landscapes (López-Casero et al. 2015). Aiming to build on mutually beneficial human–nature relationships, the Initiative promotes "Socio-Ecological Production Landscapes and Seascapes" (SEPLS), areas where production activities help maintain biodiversity and ecosystem services in various forms while sustainably supporting the livelihoods and well-being of local communities (Gu and Subramanian 2014; Takeuchi et al. 2016).

By exploring how the principles of landscape approaches apply to IPSI cases, the main objective of this study is to identify the different landscape sustainability lenses employed in the SEPLS. By "lens", we refer to an epistemological approach that differs from other cases' understanding of landscape sustainability in practice. Additionally, we aim to assess how the different lenses and strategies vary depending on the social–ecological context and what value types are underpinning the motivations to preserve and manage these landscapes. To do so, we use the Q-method, a semi-quantitative technique that provides a structured way to uncover different perspectives on complex issues and concepts.

Methodology

Case studies

To meet the study's goals, we made use of the global network of 229 case studies (as of March 2021) that are at the core of the International Partnership of the Satoyama Initiative (IPSI). IPSI is a network that was established and recognized during the tenth meeting of the Conference of the Parties to the Convention on Biological Diversity, held in Nagoya, Japan in 2010 (CBD COP 10). IPSI's purpose is to connect various member organizations dedicated to collaboration with local stakeholders and to realize "societies in harmony with nature" (Takeuchi 2010). The IPSI cases studies are very diverse and represent some of the most archetypical examples of cultural landscapes around the world. They are all characterized by long-term profound interactions between people and nature, which have generated over time a multifunctional landscape that maintains or enhances biodiversity while sustaining the human well-being of the local community. Some examples of IPSI cases would include satoyama landscapes in Japan or the traditional fruit-tree orchard meadows in Germany (Fig. 1). The network includes national and local governments, intergovernmental organizations, NGOs, the private sector, indigenous peoples, local communities and academic institutes. Upon becoming part of the network, each IPSI member is expected to submit at least one case study where landscape approaches are being used to reconcile production and economic development with the conservation of social–ecological values.

SEPLS case studies are publicly available as structured reports on the IPSI website (IPSI 2021). Based on the availability as well as the agreement on sharing the contact information, focal points from 139 of the initially contacted 229 SEPLS cases were invited to the Q-method survey for this research. Focal points for each of the SEPLS cases were single individuals who represented at least one of the member organizations, and who had deep knowledge and first-hand personal experience in the landscape approach implemented. We included only those SEPLS case studies that employ a landscape approach. In some cases, the case studies consisted of multiple landscapes across different regions. In those cases, we asked those focal points to respond to the survey based on just one of the landscapes. In total, 45

Fig. 1 Examples of socio-ecological production landscapes and seascapes. **A** Satoyama landscape, **B** German orchard meadow

SEPLS focal contacts among the IPSI member organizations agreed to participate in the study (32% response rate). In addition to the Q-method interviews, we reviewed the structured reports from each case study, as these documents provide complementary information for the characterization of the landscape approaches and the subsequent analysis of the contextual factors potentially influencing the association between SEPLS cases and a particular landscape sustainability lens.

Q-method

Q-method is a semi-quantitative technique to explore different human perspectives over complex and multi-layered topics (Watts and Stenner 2005). In recent years, it has gained relevance in sustainability and conservation science as a way to capture and integrate inter-related views and perspectives related to sustainability (Sandbrook et al. 2010; Milcu et al. 2014; Zabala et al. 2018). In this case, we applied the Q-method to assess what aspects of landscape sustainability have been directly and indirectly promoted in the IPSI cases studies.

Respondents were asked to allocate a total of 36 statements (Q-set), each referring to a single possible landscape sustainability dimension that can be strengthened or enhanced through landscape approaches, along a ranking grid depending on their importance and relevance to the case study (Appendix S1). Specifically, the instructions given to the participants were: "In relation to the context of the case study that you led/collaborated as part of the IPSI, organize the following landscape sustainability aspects according to how much they (directly or indirectly) represent, relate and connect with the objectives of the case study". The ranking grid was laid out in a forced quasi-normal distribution of 10 categories that ranged from − 2 (least relevant) to + 2 (most relevant).

The list of aspects to be ranked in the Q-set (Table 1, Appendix S1) was designed to synthesize the diverse principles and objectives pursued by international programs such as the Sustainable Development Goals (UN General Assembly 2015), the Aichi Biodiversity Targets (SCBD 2010) and the "Paris Declaration on the Satoyama Initiative", recognized in the 10th Meeting of the Conference of the Parties to the Committee on Biological Diversity (CBD/COP 10) in Nagoya (2010). It also integrated the core guiding principles defining landscape sustainability (Wu 2013), including the inter-generational perspective (WCED 1987), reduction of vulnerability (Turner et al. 2003), self-regenerative capacity (Selman 2008), landscape resilience (Cumming 2011), reduction of liabilities (Haines-Young 2000) and landscape multifunctionality (Musacchio 2009).

The data collection was carried out in February 2021. The survey was created and distributed online using the software Q-sortware (Pruneddu 2013). Responding to the survey took on average 40 min per respondent. An individual link was sent to each of the focal contacts, together with an introduction to the study and an invitation to participate in it. The survey could only be started after the participant had read and accepted a note of consent, which explained how their responses were going to be used and stored. Once the respondents ranked the 36 statements, some qualitative data were collected for the interpretation of the factors. For those four statements with the most extreme values (those assigned to have the maximum and minimum relevance), respondents were asked to explain their choices. Additionally, respondents were asked in a series of open questions for additional insights on the case study and their relationship with the study area. Finally, to explore the motivations for the conservation of the landscapes, respondents were asked to respond, in relation to the case study they represented: "Why do you think it is important to conserve this landscape?" The answers to this last question were coded into instrumental, intrinsic and relational value-dimensions, following the plural valuation framework (Chan et al. 2016; Arias-Arévalo et al. 2018). Instrumental values represent the importance of nature as a means to achieve human ends or satisfy human needs, interests or preferences; intrinsic values refer to the inherent worth of nature as an end in itself, regardless of any human interest; and relational values refer to those concerns related to the meaningfulness of relationships, such as those between nature and people and among people within nature or fostered by nature (Pascual et al. 2017). Respondents could provide several reasons to answer this question, so more than one value type could be assigned to each respondent. The coding of the responses were done by four co-authors of the study, while the first author checked the consistency of all codes and adjusted them when necessary.

Characterization of the socio-ecological production landscapes and seascapes

In parallel to the Q-method survey, a review of the SEPLS case studies reports was performed to characterize the contextual factors of each SEPLS and the landscape approaches employed. For each case study, we extracted information about (1) dominant ecosystems (forest, grassland, agricultural, inland water, coastal, dryland, mountain, urban/peri-urban); (2) the scale of the actions carried out (local, regional, national); (3) the dominant uses and socio-economic activities (cropland, animal husbandry, agroforestry, fishery, forestry, tourism, nature conservation, environmental education, wild products harvesting, hunting, industry); (4) the relevant actors interacting in the landscape (national government, local government, international NGO, local-regional NGO, academic institution, local communities,

Table 1 Numerical representations of factors using the z-scores and normalized Q-scores for each statement in the Q set across the four lenses of sustainable landscape management

Statement	F1–LS for the preservation of natural values		F2–LS for the preservation of socio-cultural values		F3–LS for social justice and participatory governance		F4–LS for securing food security and local livelihoods		Dist./Cons./relevance[a]
	Norm	*Z*	Norm	*Z*	Norm	*Z*	Norm	*Z*	
1. Prevention and eradication of pests and/or invasive species	− 3	− 1.96	− 3	− 1.28	− 1	− 0.67	2	1.23	ALL
2. Restoration of a degraded landscape	3	1.82	− 1	− 1.00	2	1.28	0	0.03	ALL
3. Generation of mechanisms and instruments, which allow the local community to participate in decision-making and governance	− 2	− 1.33	1	1.03	2	1.03	− 1	− 0.86	F1, F4
4. Improvement of food security in the local communities	− 1	− 0.39	− 2	− 1.06	0	0.37	3	1.78	ALL
5. Coordination and cooperation across administrative levels (e.g., local, national, international) and sectors (e.g., environment, education, industry, tourism)	− 1	− 0.78	1	0.71	2	1.18	− 2	− 1.27	ALL
6. Promotion and/or preservation of traditional structures and features (e.g., agricultural terraces, irrigation systems)	0	0.34	2	1.10	− 2	− 1.08	− 2	− 1.27	F1, F2
7. Enhancement of the local identity and place attachment across the members of the community	0	− 0.20	2	1.25	− 2	− 1.14	− 2	− 1.14	F1, F2
8. Conservation of the local cultural heritage and traditions	1	0.51	3	1.64	− 1	− 0.56	− 1	− 0.55	F1, F2
9. Development of strategies for environmental education	1	0.66	1	0.68	− 3	− 1.42	− 1	− 0.74	F3, F4
10. Stimulation of economic growth of the local community	− 2	− 1.67	0	0.13	0	0.13	1	0.74	F1, F4
11. Increase of the quality, recognition and/or marketing of specific products produced in the case study	− 2	− 1.10	− 2	− 1.06	− 2	− 0.85	1	0.88	F4
12. Promotion of sustainable agricultural/forest management practices with positive social and environmental impacts	2	1.78	1	1.09	3	1.58	0	− 0.27	F2, F4, +
13. Improvement of the quality of the soil, air and/or water	1	1.08	− 1	− 0.99	1	0.48	1	0.80	F2
14. Creation of employment opportunities for the local community	0	− 0.32	− 1	− 0.59	1	0.65	2	1.27	F3, F4
15. Mitigation and/or alleviation of the effects of climate change	2	1.23	− 1	− 0.54	− 1	− 0.64	0	0.11	F1, F4
16. Promotion of the connectedness and linkages between nature and the local community	1	0.48	2	1.19	− 1	− 0.72	2	0.91	F3
17. Promotion of strategies for the sustainable extraction of natural resources (e.g., reduction of social and environmental impacts, focus on renewal energy)	1	0.40	− 2	− 1.23	0	0.12	− 1	− 1.04	ALL
18. Strengthen and empowerment of the local community as natural resource stewards	0	− 0.10	3	1.73	2	1.11	1	0.80	F1, F2, +
19. Support and promotion of local industries that are compatible with the sustainable use of the natural resources	− 2	− 1.02	− 1	− 0.61	− 1	− 0.48	1	0.74	F1, F4
20. Increased awareness of the social, environmental and economic values existing in the landscape and/or the threats affecting them	0	0.22	1	0.51	0	− 0.01	2	1.65	F4, +
21. Enablement of spaces and strategies for dialog and solution of conflicts among actors in the case study	− 1	− 0.95	0	0.05	− 1	− 0.75	− 3	− 1.72	F2, F4
22. Development of strategies for equal access to opportunities by vulnerable actors in the community	− 1	− 0.60	− 1	− 0.77	0	0.07	− 2	− 1.67	F3, F4
23. Integration of innovations and new technological developments to improve the efficiency of the system	0	− 0.18	− 2	− 1.19	0	− 0.34	0	0.43	F2, F4
24. Generation of new knowledge through research activities	− 1	− 0.38	− 1	− 0.76	1	0.58	− 1	− 0.62	F3
25. Maintenance of important ecosystem functions such as pollination and nutrient cycling	1	0.82	0	− 0.41	0	0.18	− 1	− 0.42	F1, F3
26. Conservation of plant and/or animal biodiversity	3	1.82	1	0.94	3	2.33	3	1.86	F2, +
27. Generation of attractive opportunities for the tourism and recreation sector in the landscape	0	− 0.35	0	− 0.25	− 2	− 1.38	0	− 0.23	F3
28. Conservation and promotion of local ecological knowledge	2	1.10	1	0.99	0	0.15	0	0.08	ALL

Table 1 (continued)

Statement	F1–LS for the preservation of natural values		F2–LS for the preservation of socio-cultural values		F3–LS for social justice and participatory governance		F4–LS for securing food security and local livelihoods		Dist./ Cons./ relevance[a]
	Norm	*Z*	Norm	*Z*	Norm	*Z*	Norm	*Z*	
29. Stabilization and ensure of demographic stability in the case study	− 3	− 1.69	− 3	− 2.30	− 3	− 2.86	− 3	− 1.87	F3, −
30. Empowerment of women in the community	0	− 0.20	0	− 0.20	1	0.74	0	− 0.39	F3
31. Maintenance of the ecosystems (and its functions) for future generations	1	1.07	0	− 0.01	1	0.51	1	0.61	F4
32. Prevention and/or mitigation of the effects of natural hazards such as flooding, droughts or wildfires	0	0.06	0	− 0.41	1	0.60	0	− 0.01	F3
33. Preservation and conservation of the integrity and wholeness of the landscape	2	1.18	2	1.61	1	0.93	1	0.70	F2, +
34. Creation of spaces for knowledge exchange and co-learning	− 1	− 0.36	0	0.45	0	− 0.04	0	− 0.12	F2
35. Safeguard of standard of living and quality of life in the community	− 1	− 0.84	0	− 0.40	− 1	− 0.74	− 1	− 0.42	CONS, -
36. Generation of a proactive approach to the management of the landscape to anticipate potential future risks	0	− 0.12	0	− 0.06	0	− 0.34	0	− 0.03	CONS

Statements are ordered in the table from most distinctive (top) to consensus (bottom), based on Z-score differences. Respondent were asked to rank the statements based on how each of them directly related to the landscape approach developed in the SEPL they represent

[a]"Cons." indicates consensus statements, otherwise indicates distinguishing ("Dist.") at $p < 0.05$, and for which factor. Those statements with a + were considered as relevant for all the lenses. Those statements with a – were considered as not relevant by any lens

local producers); and (5) the most relevant drivers of change (urban and infrastructure development, natural resource extraction intensification, land abandonment, political and institutional policies, economic, cultural and demographic, technological, environmental). The extraction for the characterization of the case studies was performed by four co-authors using a structured protocol. Multiple categories were applicable for all variables.

Data analysis

We conducted a principal component analysis using the varimax rotation to analyze the Q-sorts. We also elicited the normalized Q scores for each factor using the weighted representation of the sorts of those cases that were significantly associated with that factor ($p < 0.05$). There is no blueprint for how many factors should be extracted in a Q-method analysis (Webler et al. 2009). For aspects related to clarity (respondents associated to not more than one factor), distinctness (looking for low correlation between factors), and stability (stable groups of respondents) we settled on four factors, each corresponding with a different landscape sustainability lens. We qualitatively interpreted the meaning of the four factors using the salience and level of agreement of the different statements for each factor (Table 1), and nuanced the interpretation with the additional qualitative information elicited in the survey. To do so, we looked into the case studies that were significantly associated with each of the factors ($p < 0.05$) (See Appendix S2). We used the qmethod package (Zabala 2014) in R environment (R Development Core Team 2011) for all the Q-method calculations.

To explore the variation of the social–ecological context across the different landscape sustainability lenses, we ranked the parameters characterizing the case studies based on their occurrence frequency within each factor (previously standardized in percentages based on the number of cases associated with every factor). Subsequently, we ran a nonparametric Spearman's correlation test to assess which parameters characterizing the case studies were significantly associated with every factor, both negatively and positively ($p < 0.05$). To assess the values attributed by each respondent to the landscapes in which they operated, we assessed the differences in the frequencies of mentioned values (instrumental, intrinsic and relational) across the identified factors using Kruskal–Wallis test.

Results

The representation of SEPLS cases analyzed spanned over all continents, but a majority of the cases were located in Asia (36%) or Africa (29%) (Fig. 2). Most of the cases were characterized by mixed landscapes of agricultural land (89% of the cases), grassland (76%) and forest (76%).

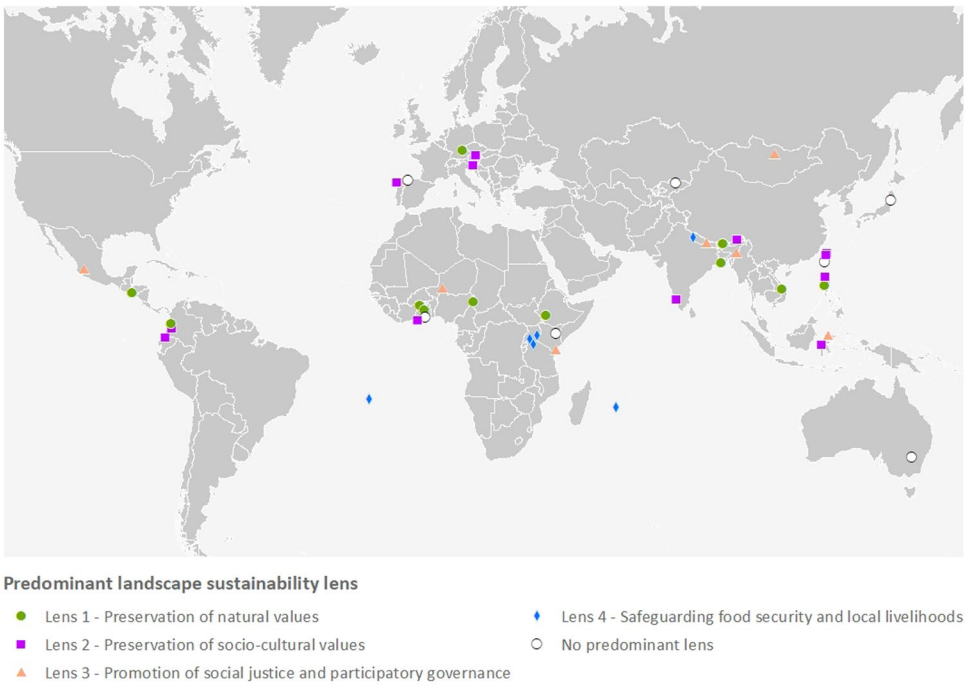

Fig. 2 Distribution of the SEPL cases included in the study

Accordingly, the main land uses and socio-economic activities were crop production (80% of the cases), followed by animal husbandry (53%) and forestry (40%). More than half of the landscapes were formally protected partially or entirely (56%), while the most commonly mentioned driver of change was land use intensification (64% of the cases), followed by economic (41%) and demographic transformations (41%). More detailed information on the characteristics of the case studies can be found in Appendix S2.

The Q-method analysis revealed four distinct predominant landscape sustainability lenses, each with a different focus on the landscape approach strategy (Table 1, Fig. 2): (1) landscape sustainability for the preservation of natural values, which was the dominant sustainability lens in 12 landscapes; (2) landscape sustainability for the preservation of socio-cultural values, which prevailed in 12 other landscapes; (3) landscape sustainability for the promotion of social justice and participatory governance, emphasized in 7 landscapes; and (4) landscape sustainability for safeguarding food security and local livelihoods, expressed in 7 landscapes. Seven landscapes were not aligned with any dominant lens and instead were related similarly to at least two lenses.

Lens 1: landscape sustainability for the preservation of natural values

The first landscape approach lens primarily focused on the ecological dimension of the landscape. The conservation or restoration of (agro-)biodiversity and ecosystem functions was at the core of this lens. In the face of a fluctuating environmental and socio-economic context, respondents associated with this lens considered that landscape approaches should be aligned to the capacity of the landscape to deliver regulating services. Thus, there was a strong emphasis on promoting the environmental resilience of the landscape. This was expressed by many respondents, with statements like: "In many production landscapes, resilience has been eroded with increased intensity of cultivation, poor soil management, loss of vegetative cover, and the increased use of mono-cropping, pesticides, and other practices that harm biodiversity and disrupt ecosystem functioning".

In this lens, there was a strong link between the landscape approach, land management and natural values. As synthetized by one participant: "The landscapes of the projects are inhabited by endangered species that are ultimately dependent on cattle grazing and other practices". As such, case studies where this lens was dominant made use of instruments and methodologies rooted in agricultural and forestry sciences, capitalizing on local ecological knowledge and high nature value farming practices like agricultural terraces or agroforestry practices to preserve (agro-)biodiversity and ecosystem services.

Through this lens, sustainability aspects related to the well-being of local communities were targeted indirectly. The social dimension of the landscape was relevant, but not the immediate focus of the landscape approach. Instead, the local community's well-being would be organically improved along with the preservation of the ecological dimension of the landscape. This was expressed

by several participants with statements like: "conservation of the landscape is equal to conserving the local people"; "restoration and conservation is key to our lives"; or "The growth in the local economy, although necessary was not the prime focus as this growth comes when the basic needs of the people have been met".

The cases associated with this landscape lens were very heterogeneous and diverse in relation to the ecosystems and actors in the landscape, as well as in the variety of drivers of change exerting pressure on the social–ecological system (Table 2). In terms of socio-economic activities, those related to the management of natural resources (cropland, animal husbandry, fishery, and agroforestry) were dominant.

Lens 2—landscape sustainability for the preservation of socio-cultural values

Lens 2 focused on the socio-cultural values of the landscape, mainly referring to the conservation and preservation of shared local identity, culture and traditions. In these landscapes, the main threat to sustainability was perceived to be the disruption and deterioration of human-nature interconnectedness, which is fully embedded in the cultural dimension of the landscape. This perspective was expressed by several respondents, like: "The recognition of local inhabitants as direct actors for ecosystem conservation could exemplify new ways of relation between societies and nature".

Landscapes within this lens considered local actors as landscape stewards, and focused on their empowerment on the one hand, and on the valuation of traditional management practices and structures on the other hand. This was indicated in responses such as: "The case study shows the significant contribution of traditional and local-based management to the ecological integrity of [the] local landscape", or "Connectivity between nature and local communities as well as empowering governance and decision-making of local communities are an essential part of the efforts".

A common instrument highlighted in this lens are protected areas, which would cover the entire landscape (Table 2), in many cases under designations such as World Heritage site or Biosphere Reserve. In the case studies where this lens was dominant, biodiversity conservation and ecosystem services would not be the direct targets of landscape approaches, as they would automatically benefit from strengthening socio-cultural values. This was synthetized by one participant who answered: "By conserving local cultural heritage and traditions, the identity and integrity of the local community are preserved and kept. Local traditions are also closely linked with traditional practices that help conserve nature".

Lens 3: landscape sustainability for the promotion of social justice and participatory governance

Lens 3 focuses on the political and governance structures of the landscape, which would enhance landscape sustainability by shaping the relationships between people and the environment. As such, the views expressed in this lens prioritized participation and inclusivity in decision making. According to this view, reducing existing inequalities and empowering vulnerable actors is the necessary first step for achieving landscape sustainability. One participant categorically illustrated this need by writing: "without local decision-making it is impossible [to] create long-lasting processes of ecosystem restoration and management".

This lens resonated particularly on case studies characterized by inland water and coastal landscapes and seascapes (Table 2). These case studies expressed the vulnerability of local communities in the face of sustainability challenges like pollution, food security and over-fishing, or toward entrenched asymmetric power relationships that make inter-territorial management and environmental monitoring difficult.

Lens 4: landscape sustainability for securing food security and local livelihoods

Lens 4 centered landscape approaches on the improvement of human well-being, particularly material living, health and employment. In these case studies, covering basic needs such as food security in the community was the first and main objective of landscape management, and considered as an imperative baseline beyond which more nuanced sustainability objectives can be set. As expressed by one participant: "food is life, therefore food security gets priority in landscape management. Without food, we are unable to work on our landscapes. Whatever we are doing must lead to food security first and then we address other issues".

In the landscapes where this lens was dominant, landscape approaches are applied along with instruments that focus on the capitalization and valorization of local values as a means to safeguard livelihood without depleting local resources. This was synthetized by a participant who stated: "Landscape restoration is directly linked to alternative and added income based on tourism and recreation, thus reducing the pressure on fishing resources for livelihood". This lens was echoed in cases where the relationships between the local communities and ecosystems were severely degraded due to socio-economic transformations. As such, those operating within this lens considered strategies to restore the connection between people and nature, often by applying new management paradigms or governance frameworks. Some respondents indicated that these types of strategies are potentially important going forward, for example:

Table 2 Characteristics of the cases studies associated with each landscape sustainability lens

Landscape sustainability lens	Most frequent ecosystems	Main uses and socio-economic activities	Main actors in the landscape	Drivers of change	Scale of the case study	Protected status	Categories correlated with the lens
Lens 1—preservation of natural values ($n=12$)	**Agriculture; forest;** in-land water; mountain	**Cropland;** animal husbandry; fishery; agroforestry	**Local communities;** local government; local producers	**Land use intensification;** economic; cultural, demographic, environmental	Regional	Partially protected	Tourism (–)
Lens 2—preservation of socio-cultural values ($n=12$)	**Agriculture; forest;** mountain	**Cropland;** animal husbandry; forestry; tourism; nature conservation; wild products harvesting	**Local communities;** local producers; academic institutions; local government; local NGOs	Land use intensification; economic; cultural and demographic	Regional	Entirely protected	Entirely protected (+); local communities (+)
Lens 3—promotion of social justice and participatory governance ($n=7$)	**Agriculture; forest;** in-land water; mountain	**Cropland; animal husbandry;** forestry; tourism; fishery	**Local communities; local producers; local government;** international NGOs	**Land use intensification;** economic; environmental	Regional; local	Partially protected	Coastal (+); fishery (+)
Lens 4—safeguarding food security and local livelihoods ($n=7$)	Agriculture; forest	Cropland; fishery	Local communities; local producers	Land use intensification	Regional; local	Not protected	National scale (+); local communities (–)

Categories are displayed for every Q-factor from higher to lower frequency values in percentages. Only categories displaying frequencies higher or equal to 40% are included. Bold fonts indicate categories with frequencies higher or equal to 70. Positive significant correlations are indicated with (+), negative significant correlations are indicated with (–). A detail account of these results can be found in Appendix S2

"sustainable livelihoods are critical to the sustainability of local communities and indigenous peoples. New bottom-up ownership, cooperation and consultation frameworks are essential for sustainable landscape management".

Similarities and differences across lenses

The four identified lenses shared some characteristics (Table 1). There were five core principles that were positively considered as a priority in landscape approaches for all the identified lenses: conservation of biodiversity, preservation of local ecological knowledge and practices, awareness of the social–ecological landscape values, empowerment of local community as resource stewards, and conservation of the integrity and wholeness of the landscape. There were also two principles that were not considered a priority by any of the lenses: promotion of demographic stability and safeguarding the standard of living (Table 1). In relation to the case studies associated with each of the lenses, we observed similarities and differences for all contextual factors, specially related to the dominant land uses and socio-economic activities, drivers of change and actors (Table 2, Appendix S3).

In relation to the question "Why is it important to conserve these landscapes?" our results show that participants attributed a wide diversity of value types to the landscapes (Fig. 3). Values in the domain of instrumental values were the most frequently mentioned (60%), followed by intrinsic (51%) and relational values (49%). The importance of the different value domains was different across the different lenses. Landscape lenses 3 (promotion of social justice and participatory governance) and 4 (securing food security and livelihoods) were negatively correlated to the relational value domain, and positively correlated to the instrumental value domain. In contrast, landscape lens 2 (preservation of socio-cultural values) was positively correlated to the relational domain and negatively to the instrumental value domain. We found statistically significant differences in the frequency for which the instrumental value domain was mentioned by focal points associated with the different lenses ($p = 0.038$; Appendix S4).

Discussion

Through our Q-method of the landscape approaches carried out in 45 socio-ecological production landscapes and seascapes, we have identified and characterized four distinct landscape lenses. Each of these lenses refers to a shared understanding on the objectives of landscape approaches and pathways necessary to find a balance between conservation and development that benefits both the social–ecological values of landscape and the well-being of the communities in it.

By looking into the shared elements that were positively considered across the four landscape lenses, we can identify some principles that collectively conform a consensus about what landscape approaches pursue and what landscape sustainability is (Table 1). In all four lenses, landscape sustainability would be fostered by empowering local communities as landscape stewards. The approaches would have the goal to preserve the context-specific values in the face of socio-economic and environmental changes, and to build upon people and nature feedback dynamics that crystalize in rich biodiversity and local ecological knowledge (Table 2). This consensus resonates with the majority of the concepts that are present in the more relevant definitions of landscape sustainability (Opdam et al. 2018; Wu and Wu 2021), particularly on key points such as the context specificity of social–ecological values, resilience and vulnerability. In addition, our analysis reveals the central role of local actors as part of the landscape, not simply as beneficiaries from landscape sustainability, but as inherent parts of the landscape. As such, local communities are directly responsible for co-producing long-term, landscape-specific ecosystem services. This resonates well with empirical and conceptual studies on integrated landscape approaches, which point to multi-level, or polycentric, governance structures as key factors for success (Reed et al. 2017; Sayer et al. 2017).

While the objectives of landscape approaches across all the lenses look similar, the pathways and strategies to reach those objectives differ starkly. The lenses concentrate on reinforcing, respectively, natural values; socio-cultural values; spaces for participation and reduction of vulnerability; and food security and sustainable management of local

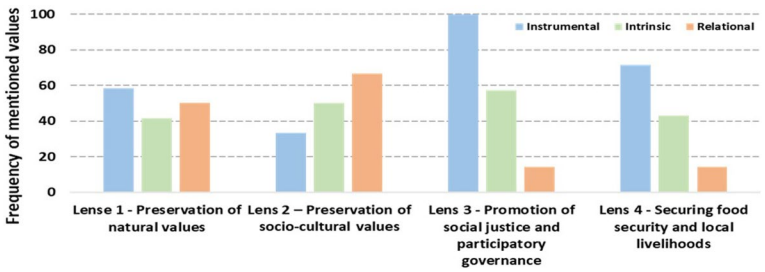

Fig. 3 Frequency (%) of the mention of value domains by the respondents belonging to the four landscape sustainability lenses. Blue: instrumental values, green: intrinsic values, red: relational values

resources. Whereas each of the four lenses focuses primarily on one specific set of elements, this does not mean that the less prioritized targets are deemed irrelevant. Instead, it is considered that they would be organically promoted alongside those selected as central in the landscape approach. This synergistic effect is very well illustrated in landscape lenses 1 and 2. Through lens 1, socio-cultural values are promoted by protecting natural values such as agrobiodiversity (as stated by one participant associated with lens 1: "In the landscape our communities are at the base of agriculture (…). Therefore, conservation of agrobiodiversity to which they are more accustomed is the most important for these communities"). Lens 2 expresses the opposite, as natural values are assumed to emerge from upholding socio-cultural values (as stated by one participant associated with lens 2: "Preserving local traditions is important because [of] the mutual relationship between the local inhabitants and their activities and the conservation of the structure, function and dynamics of their ecosystems"). Our results suggest that for a landscape approach to be meaningful for the local communities, a preliminary phase must precede any landscape intervention, where those involved consider which elements of the social–ecological system demand more attention. Such a preliminary phase would require considering the landscape's social and natural capital (Huntsinger 2016; Spake et al. 2019; Garau et al. 2021), the current social–ecological dynamics (Levin et al. 2013), as well as landscape legacies from the past (Tappeiner et al. 2021).

To some extent, the different lenses replicate the sustainability trade-offs between preservation and transformation (Oldekop et al. 2010). Lenses 1 and 2 emphasize the preservation side, but differ on the particular set of landscape values to be protected. In contrast, lenses 3 and 4 highlight transformation, building lens 3 on inclusiveness and participation (in bottom-up initiatives), and lens 4 on material well-being (in top-down processes). Although our study cannot reveal how a particular landscape approach resolves such tradeoffs, it provides some general insights. First, in areas where landscapes are more degraded and communities are more marginalized, landscape approaches are more likely to opt for transformation as the means to generate a shift in the social–ecological system toward sustainable management of the landscape. Second, there is a relation between how coupled communities and ecosystems are, and the choice of a particular landscape approach. In those areas where close nature–people feedbacks are clearly recognizable, landscape approaches are more likely to be associated with preservation lenses than in those areas where these nature–people relations are fuzzier. This is clearly reflected in the value types assigned to the landscapes (Fig. 3). Participants from lenses 1 and 2 more often expressed the importance of people and nature connection through relational values (Chan and Gould 2018), emphasizing multiple benefits such as high biodiversity levels or rich traditions and socio-cultural elements (e.g., "These landscapes reflect the history of the interactions between humans and nature through the centuries"). In contrast, relational values were expressed less frequently by participants associated with lenses 3 and 4, who were often representing landscapes with a legacy of social–ecological pressures resulting in landscape degradation and loss of human–nature relationships (e.g., "Restoration of degraded landscapes is imperative and timely (…) especially in landscapes drenched in chemical fertilizers and pesticides, which are close to becoming wastelands"). Similar to some studies looking into the linkages between landscape simplification and the erosion of human–nature connectedness (Riechers et al. 2022), we found associations between landscape degradation due to resource use intensification with the declining importance of relational values. As such, participants associated to lenses 3 and 4 typically expressed the need to develop new strategies that foster reconnecting society and ecosystems, while highlighting the current importance of the instrumental value domain (e.g., "A new management system that takes into consideration social, ecological and economic aspects of the SEPLS is needed and timely") (Fig. 3). In practice, we observe this dichotomy in the ways landscape approaches are implemented worldwide. On the one hand, several landscape initiatives rely on time-tested uses and experiences, where the role of traditional local ecological knowledge underpins an integrative landscape approach (Plieninger et al. 2006). On the other hand, some landscape approaches focus on landscape transformation, where innovative ecosystems thinking is used to support sustainability transitions (Pigford et al. 2018).

Our application of the Q-method had some limitations. By limiting our scope to SEPLS within IPSI network our analysis and results should be carefully extrapolated to the application of landscape approaches elsewhere. In addition, our recruitment strategy could generate some potential self-selection bias among the participants in the study. To control that potential negative impact we maintained a fluid communication with the SEPLS case studies, endorsed by the IPSI directorate along the whole study. In addition, the design of our Q-method allowed different levels of engagement depending on the interests of the focal points and degree of motivation. Finally, another limitation is that the communication with the participants in the survey was in English, which in many cases was not the focal points' native language. To some extent that could have complicated the understanding of some of the statements. We mitigated this potential impact with a fluid communication prior to and following the survey. Focal points would self-evaluate the comprehension of the statements. In case there was any problem, the meaning of the statements was clarified.

Conclusions

Our study highlights the relevant and beneficial role of landscape approaches as a boundary concept: while some core principles about what a landscape approach entail are shared (social–ecological perspective, landscape resilience, knowledge integration and landscape stewardship), these principles are assembled in many different ways. As such, landscape approaches facilitate communication across disciplinary borders while the application differs in each particular situation. In every case, the chosen approach for a landscape initiative would depend, on the one hand, on local contextual factors and, on the other hand, on what the local community considers most pressing. For landscape approaches to become relevant, they must put local actors at the forefront. To do so, they need to embrace solution-oriented transdisciplinary scientific and participatory methods to achieve a shared understanding of what landscape sustainability means and how to work toward it in each particular context.

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Data availability The data that support the findings of this study are available on request from the corresponding author, MT. The raw data are not publicly available as it contains information that could compromise the privacy of research participants.

Declarations

Conflict of interest The present work has not been published before. The work does not contain any conflicts of interests and financial support has been properly stated in the acknowledgements of the manuscript.

References

Arias-Arévalo P, Gómez-Baggethun E, Martín-López B, Pérez-Rincón M (2018) Widening the evaluative space for ecosystem services: a taxonomy of plural values and valuation methods. Environ Values 27:29–53. https://doi.org/10.3197/096327118X15144698637513

Arts B, Buizer M, Horlings L et al (2017) Landscape approaches: a state-of-the-art review. Annu Rev Environ Resour 42:439–463. https://doi.org/10.1146/ANNUREV-ENVIRON-102016-060932

Bennett EM, Solan M, Biggs R et al (2016) Bright spots: seeds of a good Anthropocene. Front Ecol Environ 14:441–448. https://doi.org/10.1002/FEE.1309

Chan KM, Gould RK (2018) Editorial overview: relational values: what are they, and what's the fuss about? Curr Opin Environ Sustain 35:A1–A7. https://doi.org/10.1016/J.COSUST.2018.11.003

Chan KMA, Balvanera P, Benessaiah K et al (2016) Why protect nature? Rethinking Values Environ 113:1462–1465. https://doi.org/10.1073/pnas.1525002113

Cumming GS (2011) Spatial resilience: integrating landscape ecology, resilience, and sustainability. Landsc Ecol 26:899–909. https://doi.org/10.1007/s10980-011-9623-1

Fischer J, Hartel T, Kuemmerle T (2012) Conservation policy in traditional farming landscapes. Conserv Lett 5:167–175. https://doi.org/10.1111/j.1755-263X.2012.00227.x

Flinzberger L, Zinngrebe Y, Plieninger T (2020) Labelling in Mediterranean agroforestry landscapes: a Delphi study on relevant sustainability indicators. Sustain Sci 15:1369–1382. https://doi.org/10.1007/S11625-020-00800-2/FIGURES/2

Garau E, Torralba M, Pueyo-Ros J (2021) What is a river basin? Assessing and understanding the sociocultural mental constructs of landscapes from different stakeholders across a river basin. Landsc Urban Plan 214:104192. https://doi.org/10.1016/J.LANDURBPLAN.2021.104192

García-Martín M, Torralba M, Quintas-Soriano C et al (2020) Linking food systems and landscape sustainability in the Mediterranean region. Landsc Ecol. https://doi.org/10.1007/s10980-020-01168-5

Gu H, Subramanian SM (2014) Drivers of change in socio-ecological production landscapes: implications for better management. Ecol Soc 19:41. https://doi.org/10.5751/ES-06283-190141

Haines-Young RH (2000) Sustainable development and sustainable landscapes: defining a new paradigm for landscape ecology. Fennia 178:7–14

Howe C, Suich H, Vira B, Mace GM (2014) Creating win-wins from trade-offs? Ecosystem services for human well-being: a meta-analysis of ecosystem service trade-offs and synergies in the real world. Glob Environ Chang 28:263–275. https://doi.org/10.1016/j.gloenvcha.2014.07.005

Huntsinger L (2016) Enabling sustainable pastoral landscapes: building social capital to restore natural capital. Options Méditerranéennes Série a, Séminaires Méditerranéens 116:315–325

IPSI (2021) International Partnership for the Satoyama Initiative. https://satoyamainitiative.org/. Accessed 21 Mar 2021

Lam DPM, Martín-López B, Wiek A et al (2020) Scaling the impact of sustainability initiatives: a typology of amplification processes. Urban Transform 2:3. https://doi.org/10.1186/s42854-020-00007-9

Levin S, Xepapadeas T, Crépin AS et al (2013) Social–ecological systems as complex adaptive systems: modeling and policy implications. Environ Dev Econ 18:111–132. https://doi.org/10.1017/S1355770X12000460

Liao C, Qiu J, Chen B et al (2020) Advancing landscape sustainability science: theoretical foundation and synergies with innovations in methodology, design, and application. Landsc Ecol 35:1–9. https://doi.org/10.1007/s10980-020-00967-0

López-Casero F, Michaelis C, Okayasu S, et al (2015) IPSI case study review: a review of 80 case studies under the International Partnership for the Satoyama Initiative (IPSI). Tokyo, Japan

LPFN (2012) Landscapes for people, food and nature initiative: action and advocacy strategy 2012–2014. LPFN, Washington

Milcu AI, Sherren K, Hanspach J et al (2014) Navigating conflicting landscape aspirations: application of a photo-based Q-method in Transylvania (Central Romania). Land Use Policy 41:408–422. https://doi.org/10.1016/j.landusepol.2014.06.019

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. https://doi.org/10.1007/s10980-009-9396-y

Oldekop JA, Bebbington AJ, Brockington D, Preziosi RF (2010) Understanding the lessons and limitations of conservation and development. Conserv Biol 24:461–469. https://doi.org/10.1111/j.1523-1739.2010.01456.x

Opdam P (2018) Exploring the role of science in sustainable landscape management. An introduction to the special issue. Sustainability 10:331. https://doi.org/10.3390/su10020331

Opdam P, Luque S, Nassauer J et al (2018) How can landscape ecology contribute to sustainability science? Landsc Ecol 33:1–7. https://doi.org/10.1007/s10980-018-0610-7

Pascual U, Balvanera P, Díaz S et al (2017) Valuing nature's contributions to people: the IPBES approach. Curr Opin Environ Sustain 26–27:7–16

Pigford AAE, Hickey GM, Klerkx L (2018) Beyond agricultural innovation systems? Exploring an agricultural innovation ecosystems approach for niche design and development in sustainability transitions. Agric Syst 164:116–121. https://doi.org/10.1016/J.AGSY.2018.04.007

Plieninger T, Höchtl F, Spek T (2006) Traditional land-use and nature conservation in European rural landscapes. Environ Sci Policy 9:317–321. https://doi.org/10.1016/J.ENVSCI.2006.03.001

Plieninger T, van der Horst D, Schleyer C, Bieling C (2014) Sustaining ecosystem services in cultural landscapes. Ecol Soc 19:59. https://doi.org/10.5751/ES-06159-190259

Plieninger T, Muñoz-Rojas J, Buck LE, Scherr SJ (2020) Agroforestry for sustainable landscape management. Sustain Sci 15:1255–1266. https://doi.org/10.1007/s11625-020-00836-4

Pruneddu A (2013) Implicit person theories and Q-sort: personality change in emerging adults. University of York, York

Qiu J, Carpenter SR, Booth EG et al (2018) Understanding relationships among ecosystem services across spatial scales and over time. Environ Res Lett 13:054020. https://doi.org/10.1088/1748-9326/aabb87

R Development Core Team R (2011) R: a language and environment for statistical computing. R Found Stat Comput 1:409

Reed J, van Vianen J, Barlow J, Sunderland T (2017) Have integrated landscape approaches reconciled societal and environmental issues in the tropics? Land Use Policy 63:481–492. https://doi.org/10.1016/J.LANDUSEPOL.2017.02.021

Riechers M, Balázsi Á, Betz L et al (2020) The erosion of relational values resulting from landscape simplification. Landsc Ecol 35:2601–2612. https://doi.org/10.1007/S10980-020-01012-W/TABLES/1

Riechers M, Martín-López B, Fischer J (2022) Human–nature connectedness and other relational values are negatively affected by landscape simplification: insights from Lower Saxony, Germany. Sustain Sci 17:865–877. https://doi.org/10.1007/S11625-021-00928-9/FIGURES/2

Sandbrook C, Scales IR, Vira B, Adams WM (2010) Value plurality among conservation professionals. Conserv Biol 25:285–294. https://doi.org/10.1111/j.1523-1739.2010.01592.x

Sayer J, Sunderland T, Ghazoul J et al (2013) Ten principles for a landscape approach to reconciling agriculture, conservation, and other competing land uses. Proc Natl Acad Sci USA 110:8349–8356. https://doi.org/10.1073/pnas.1210595110

Sayer JA, Margules C, Boedhihartono AK et al (2017) Measuring the effectiveness of landscape approaches to conservation and development. Sustain Sci 12:465–476. https://doi.org/10.1007/S11625-016-0415-Z/FIGURES/2

SCBD (2010) Decision adopted by the Conference of the Parties to the Convention on Biological Diversity at its tenth meeting. X/2. The Strategic Plan for Biodiversity 2011–2020 and the Aichi Biodiversity Targets

Schaich H, Bieling C, Plieninger T (2010) Linking ecosystem services with cultural landscape research. GAIA Ecol Perspect Sci Soc 19:269–277. https://doi.org/10.14512/gaia.19.4.9

Selman P (2008) What do we mean by sustainable landscape? Sustain Sci Pract Policy 4:23–28. https://doi.org/10.1080/15487733.2008.11908019

Spake R, Bellamy C, Graham LJ et al (2019) An analytical framework for spatially targeted management of natural capital. Nat Sustain 2:90–97. https://doi.org/10.1038/s41893-019-0223-4

Takeuchi K (2010) Rebuilding the relationship between people and nature: the Satoyama Initiative. Ecol Res 25:891–897. https://doi.org/10.1007/s11284-010-0745-8

Takeuchi K, Ichikawa K, Elmqvist T (2016) Satoyama landscape as social–ecological system: historical changes and future perspective. Curr Opin Environ Sustain 19:30–39. https://doi.org/10.1016/j.cosust.2015.11.001

Tappeiner U, Leitinger G, Zariņa A, Bürgi M (2021) How to consider history in landscape ecology: patterns, processes, and pathways. Landsc Ecol 36:2317–2328. https://doi.org/10.1007/S10980-020-01163-W/FIGURES/1

Tilman D, Balzer C, Hill J, Befort BL (2011) Global food demand and the sustainable intensification of agriculture. Proc Natl Acad Sci USA 108:20260–20264. https://doi.org/10.1073/pnas.1116437108

Torralba M, Fagerholm N, Hartel T et al (2018) A social–ecological analysis of ecosystem services supply and trade-offs in European wood-pastures. Sci Adv 4:eaar2176. https://doi.org/10.1126/sciadv.aar2176

Turkelboom F, Leone M, Jacobs S et al (2018) When we cannot have it all: ecosystem services trade-offs in the context of spatial planning. Ecosyst Serv 29:566–578. https://doi.org/10.1016/J.ECOSER.2017.10.011

Turner BL, Kasperson RE, Matsone PA et al (2003) A framework for vulnerability analysis in sustainability science. Proc Natl Acad Sci USA 100:8074–8079. https://doi.org/10.1073/pnas.1231335100

UN General Assembly (2015) UN General Assembly, transforming our world: the 2030 Agenda for Sustainable Development, 21 October 2015, A/RES/70/1

Watts S, Stenner P (2005) Doing Q methodology: theory, method and interpretation. Qual Res Psychol 2:67–91. https://doi.org/10.1191/1478088705qp022oa

WCED (1987) Our common future. Oxford University Press, New York

Webler T, Danielson S, Tuler S (2009) Using Q method to reveal social perspectives in environmental research. Social and Environmental Research Institute, Greenfield

Wiens JA (2013) Is landscape sustainability a useful concept in a changing world? Landsc Ecol 28:1047–1052. https://doi.org/10.1007/s10980-012-9801-9

Woestenburg M (2018) Heathland farm as a new commons? Landsc Res 43:1045–1055. https://doi.org/10.1080/01426397.2018.1503236

Wu J (2013) Landscape sustainability science: ecosystem services and human well-being in changing landscapes. Landsc Ecol 28:999–1023. https://doi.org/10.1007/s10980-013-9894-9

Wu J, Wu J (2021) Landscape sustainability science (II): core questions and key approaches. Landsc Ecol 368(36):2453–2485. https://doi.org/10.1007/S10980-021-01245-3

Zabala A (2014) qmethod: a package to explore human perspectives using Q-methodology. R J 6:163–173

Zabala A, Sandbrook C, Mukherjee N (2018) When and how to use Q-methodology to understand perspectives in conservation research. Conserv Biol 32:1185–1194. https://doi.org/10.1111/cobi.13123

Zhou BB, Wu J, Anderies JM (2019) Sustainable landscapes and landscape sustainability: a tale of two concepts. Landsc Urban Plan 189:274–284. https://doi.org/10.1016/j.landurbplan.2019.05.005