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5

A LANDSCAPE APPROACH TO PLANETARY WELL-BEING

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Introduction: Landscapes as geographic interfaces between humans and nonhuman beings

Landscape as a place-based socio-ecological system

A landscape can be defined as a perceivable place of living for human and nonhuman beings. Organisms interact selectively with their surroundings, depending on their characteristics and behaviours. People's influence on nonhuman nature is most acute and prevalent on the landscape level, and landscapes also reciprocally affect human activities (Antrop, 2000). For this reason, landscapes provide a conceptual and actual space for human–nature interactions that support planetary well-being, as we argue throughout this chapter. Human perceptions of and actions on landscapes are deeply rooted in culture, spirituality, history, and the human–nature relationship, leading to incredibly diverse worldviews and practices (for example, Chapter 3). Ultimately, a great diversity of landscapes has evolved out of these everyday socio-ecological interactions.

In this chapter, we approach landscapes as place-based socio-ecological systems (Wu, 2021). Applying the landscape approach within a system analysis involves (at least) three aspects that are also crucial from the planetary well-being perspective. First, the landscape approach emphasizes the spatial nature of various phenomena linked to planetary well-being. For instance, biodiversity loss, which decreases planetary well-being, always occurs somewhere. Second, landscapes are the space where human and nonhuman beings realize and evolve their typical characteristics and capacities in relation to one another and their shared environment. Third, the landscape approach acknowledges the importance of various scale domains, such as the spatial, temporal, and organizational, and is thus able to analyze multiple

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scales simultaneously (for example, to evaluate the long-term persistence and spatial distribution of organisms under human influence). This incorporation of multiple scales is crucial to the planetary well-being perspective, as the concept assumes that Earth system and global processes are linked to lower-level phenomena (organismal need satisfaction) and has a temporal dimension (persistence of evolutionary lineages).

The purpose of this chapter is to exemplify how the landscape approach integrates spatial thinking into planetary well-being framework, allowing for studies of the interconnectedness of humans, nonhuman organisms, and abiotic nature while placing them in a temporally evolving spatial context. This allows researchers to investigate how decisions relating to the main dimensions of landscape—biophysical elements, processes, and actors—affect both human and nonhuman need satisfaction. Within this conceptualization (Figure 5.1), we specifically emphasize the ecological dimension of landscapes.

The ecological characteristics of landscapes

Ecologists consider landscapes as consisting of spatially organized, temporally evolving, and interacting biophysical elements. These biophysical elements can be viewed as land uses from the human perspective or as habitat patches from a nonhuman-species perspective (Figure 5.1). Land-use types and intensity reflect human activities, affect the ecological characteristics of the landscape, and, ultimately, determine the suitability of the landscape as a place of living for nonhuman species. Land uses directly impact the heterogeneity of a landscape, which is based on its composition and configuration. The term “composition” refers to the types, relative amounts, and the diversity of biophysical elements in the landscape, whereas “configuration” denotes the spatial organization of these biophysical elements (Fahrig *et al.*, 2011). Landscape composition determines the types of ecosystems and diversity of organisms that can be present in a landscape. Landscape configuration affects landscape-level processes that link ecosystems and species communities across the landscape through fluxes of energy and nutrients, as well as the movement of organisms (Forman and Godron, 1981).

As a result, landscapes are studied as systems of interacting elements that are linked by various processes. These processes are ecological functions that operate within and between ecosystems and can be perceived as ecosystem services by humans when they contribute to human activities (Figure 5.1). Processes are co-produced by actors, *i.e.*, the humans and nonhuman organisms, present in the landscape and supported by the biophysical elements. Certain biophysical elements and processes within landscapes are essential in meeting organismal needs. Therefore, their existence is a prerequisite for planetary well-being (Figure 5.1). A prime example of this is pollination, a process performed by pollinators (actors) in habitat patches with flowering plants (biophysical elements). It is essential for the reproduction of many plants and the feeding of many insects, as well as being

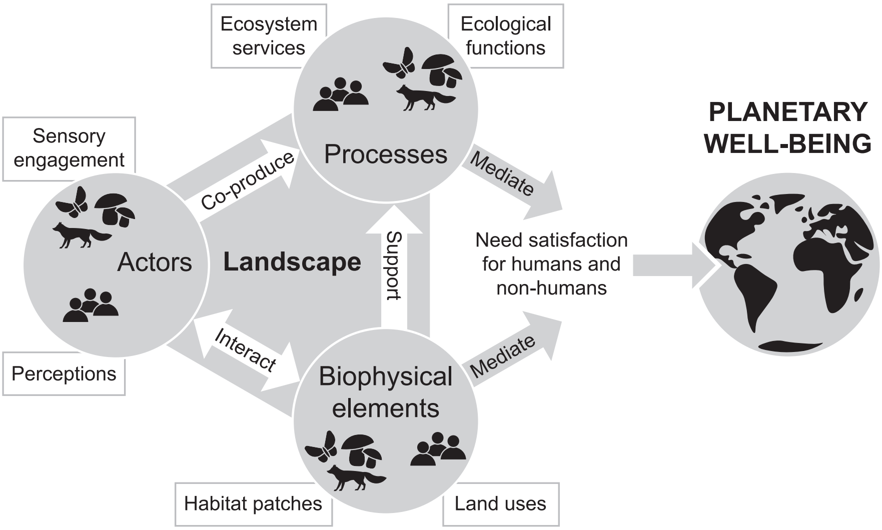

FIGURE 5.1 Conceptualization of a landscape approach to planetary well-being. Landscapes are an operational arena for planetary well-being because the biophysical elements and processes that meet human and nonhuman needs are situated in landscapes, as are the human and nonhuman beings themselves (hereafter referred to as: Actors). The three basic dimensions of a landscape (actors, processes, and biophysical elements) can be seen from the human and nonhuman perspective (icons). This chapter focuses on the biophysical elements and processes that mediate need satisfaction for humans and nonhumans. Figure created by Māris Grunskis/@PHOTOGRUNSKIS.

an important ecosystem service for humans, as 75% of the world's food crops are at least partially dependent on pollination (Food and Agriculture Organization of the United Nations (FAO), 2016).

Pollination illustrates how landscapes host socio-ecological processes. The humans involved in and influenced by any landscape process are commonly termed stakeholders. They are important in land-use planning, *i.e.*, targeting the use of land in a spatially explicit and meaningful manner (Antrop, 2000). The best environmental practices often require collaboration between stakeholders to create functional landscape features that ensure the persistence of nonhuman species and their associated functions and simultaneously meet the objectives of the stakeholders (Vialatte *et al.*, 2019). To illustrate the transformative potential of the landscape approach to planetary well-being, we present three examples of land-use planning principles that acknowledge the role of landscape-level processes and support planetary well-being. In the following sections, we examine the benefits of agroecological farming, urban green infrastructure, and multi-objective forest management zoning approaches to planetary well-being. These examples show how to put planetary well-being into practice (Figures 5.2–5.4).

Agroecological farming systems: From field to landscape levels

Decades of farming intensification and landscape homogenization have substantially decreased biodiversity in agricultural landscapes (Benton, Vickery and Wilson, 2003). In contrast to industrialized farming systems, which are based on agrochemicals and mechanization, the agroecological approach relies on biodiversity-driven ecological functions to support food production (Jeanneret *et al.*, 2021). Key ecological functions, which are perceived as ecosystem services by humans, include soil fertility (Chapter 6), natural pest control and pollination. Importantly, agroecological practices build on and benefit from the local diversity of species and their biotic and abiotic interactions which maintain ecological functions (Dainese *et al.*, 2019). Given the very large extent of agricultural land on Earth and the vital societal importance of agriculture, the agroecological landscape approach has tremendous potential to enhance planetary well-being by supporting biodiversity and various ecosystem services. Figure 5.2 shows how the agroecological landscape approach is linked to planetary well-being, with a focus on organism food provisioning.

The biodiversity of agricultural landscapes (including species that co-produce processes useful to humans) depends on the provision of resources needed by the

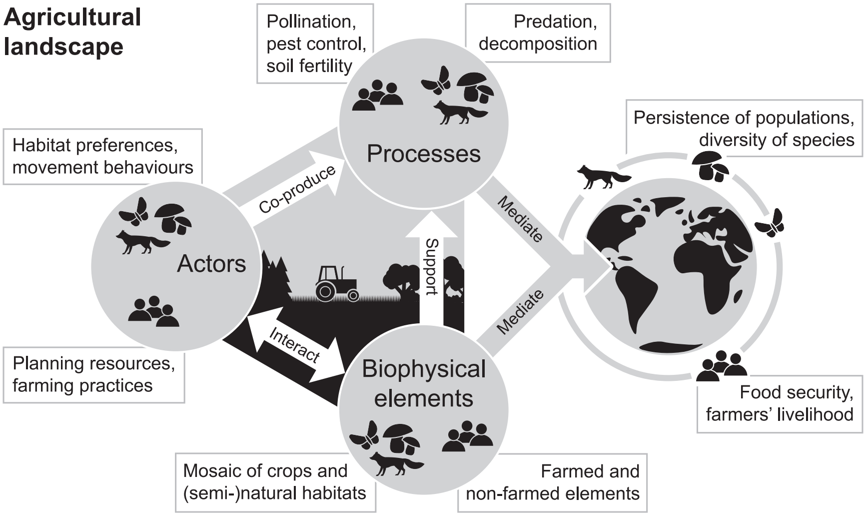

FIGURE 5.2 Conceptualization of a land-use planning principle of agroecological farming, as a landscape approach to planetary well-being, with a focus on food provisioning for humans and nonhuman species. The three basic dimensions of a landscape (actors, processes, and biophysical elements) can be seen from the human and nonhuman perspective (icons). This chapter focuses on the biophysical elements and processes that mediate need satisfaction for humans and nonhumans. Figure created by Māris Grunskis/@PHOTOGRUNSKIS.

species, such as feeding, shelter, and reproduction and overwintering sites. These are often not available within the crop fields but, rather, in their surroundings. Thus, the central process is the movement of species between semi-natural habitats and crop fields or between crop fields of different types, enabling species to access their required resources at different places and time and adapt to recurrent disturbances (Blitzer *et al.*, 2012). At the field level, the intensity of farming practices, *e.g.*, related to the amount of pesticides, determine the suitability of a crop for hosting diverse species and supporting associated ecological functions (Duflot *et al.*, 2022). Typically, organically farmed fields have higher species diversity and abundance (Puech *et al.*, 2014). At the landscape level, most organisms rely on resources provided by semi-natural habitats (*e.g.*, floral resources or overwintering sites), therefore, landscapes with a high percentage of such non-crop habitats have higher biodiversity and ecological functions (Duarte *et al.*, 2018).

Because most species in agricultural landscapes are very mobile, the agroecological approach acknowledges the need to maintain adequate ecological conditions at both the local-field and landscape levels (Jeanneret *et al.*, 2021). The synergetic influence of landscape heterogeneity and farming intensity on biodiversity and the associated functions (Ricci *et al.*, 2019) suggests that environmentally friendly practices are required at both the field and landscape levels. Practices such as less intense soil management (*e.g.*, no tillage and direct seeding), longer and more diversified crop rotations, and crop mixtures have significant potential to maintain biodiversity, functional agroecosystems, and productive farming systems (Duru *et al.*, 2015). At the landscape level, increasing the proportion of semi-natural habitats, crop diversity, and reducing field size promote biodiversity and ecological functions that contribute to crop production (Sirami *et al.*, 2019). Complex configuration pattern with many edges between different habitat types and smaller fields will facilitate species access to multiple resources and, therefore, further enhance biodiversity, related ecological functions, and crop yields (Martin *et al.*, 2019).

Agroecological approach also provides a socio-ecological perspective to food production and highlights the leading role of farmers and the importance of self-sufficient farms for sustainable landscape management (Jeanneret *et al.*, 2021). For this purpose, agri-environment-climate policy schemes (such as a part of the EU Common Agricultural Policy) subsidize a selection of agroecological practices aimed at reducing field-level intensity of practices and restoring some form of landscape heterogeneity (*e.g.*, through implementation of grassy or flower strips). While reducing farmers' dependency on agrochemicals and promoting biodiversity, the implementation of such agri-environment-climate schemes remains limited due to lack of institutional support and financial resources (Pe'er *et al.*, 2020). As agricultural landscapes consist of spatially intermingled networks of farmers and non-farmers, and corresponding farms, fields, field margins and other landscape elements, such schemes would, however, also benefit from additional strategies for integrated landscape-level cooperation (*e.g.*, through collective contracts; Jeanneret *et al.*, 2021; Vialatte *et al.*, 2019).

Green infrastructure in urban design: Restoring processes in heavily modified ecosystems

Over 55% of the world's human population live in urban landscapes, with further urbanization being projected (United Nations (UN), 2019). Moreover, urban area is increasing twice as fast as the urban population, spreading into other valuable land uses, and is expected to quadruple globally by 2050 as compared to 2000. Urban expansion transforms vegetated land covers into artificial surfaces within urban areas and their surroundings. Urban landscapes are heavily modified by humans, with an altered biophysical environment and ecosystem functioning, thereby compromising planetary well-being. For instance, urbanization increases the fragmentation and shrinking of green areas, which result in dramatic decline in biodiversity in urban landscapes (Lepczyk *et al.*, 2017). It also disrupts important ecosystem fluxes, as artificial surfaces prevent water infiltration, which creates a dry environment and flooding risks (Chapter 6), and increases solar energy absorption and storage, which increases the air temperature in cities (IPBES, 2019). The development of urban landscapes with green infrastructure, *i.e.*, an interconnected network of nature-based elements (hereafter green spaces), provides various benefits for both humans and nonhumans (*ibid.*) and may, thus, support planetary well-being. Figure 5.3 shows how the effects of green infrastructure are linked to planetary well-being, with a focus on organism mobility.

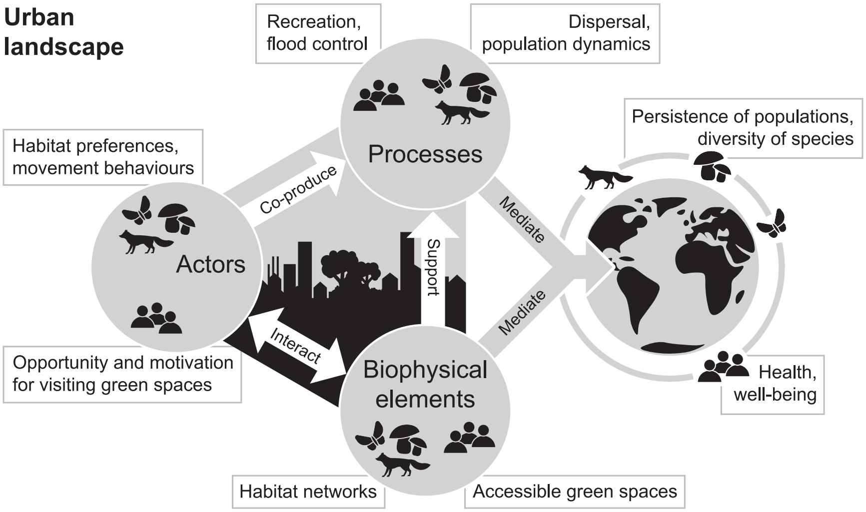

FIGURE 5.3 Conceptualization of a land-use planning principle of urban green infrastructure, as a landscape approach to planetary well-being, with a focus on human and nonhuman organism mobility. The three basic dimensions of a landscape (actors, processes, and biophysical elements) can be seen from the human and nonhuman perspective (icons). This chapter focuses on the biophysical elements and processes that mediate need satisfaction for humans and nonhumans. Figure created by Māris Grunskis/@PHOTOGRUNSKIS.

Urban green infrastructures offer a variety of habitats, ranging from remnants of native vegetation, vacant land, and gardens to green roofs and managed parks (Lepczyk *et al.*, 2017). In urban landscapes, habitat patches are typically small, and species' habitat selection is often governed by patch size and landscape heterogeneity (*e.g.*, Pithon *et al.*, 2021). Therefore, green infrastructure is commonly planned in the form of habitat networks, consisting of multiple habitat patches that are connected by corridors to allow organisms to move within the network (Lepczyk *et al.*, 2017). The ability to move is based on landscape connectivity, which is considered a major factor in species survival and the long-term persistence of biodiversity (Crooks and Sanjayan, 2006). Thus, urban biodiversity is best supported by the careful spatial planning of green spaces and their land uses, including specific habitat management actions (*e.g.*, infrequent grass mowing). Urban green infrastructure can support populations of species that can adapt to urban environments and provide complementary habitats for species threatened by intensive farming and commercial forestry in rural areas (*e.g.*, Selonen and Mäkeläinen, 2017). Biodiversity also supports ecosystem functioning in urban areas, thereby, promotes planetary well-being.

Recreation in green areas benefits human health via three main pathways (Markevych *et al.*, 2017): (1) Reducing harm, *e.g.*, reducing exposure to heat and noise; (2) restoring capacities, *e.g.*, relieving stress (Tyrväinen *et al.*, 2014) and producing positive psychological effects (see Chapter 12); and (3) building capacities, *e.g.*, supporting immune balance (Haahtela, 2019), facilitating social cohesion, and encouraging physical activity. Simultaneously, elements of green infrastructure provide ecosystem services to humans, *e.g.*, by reducing water runoff, they provide peak flow control and flood alleviation for intense rainfalls and stormwater management (Li *et al.*, 2019). Ideally, green infrastructure is developed at the landscape level during the urban development planning phase. However, elements of green infrastructure can be added to existing urban landscapes. For example, setting aside vacant land to unmanaged or less intensively maintained green areas is shown to be a cost-efficient way to increase green infrastructure and increase access to green spaces (McKinney and VerBerkmoes, 2020). Furthermore, encouraging residents to turn their yards into gardens with native species can contribute greatly to green infrastructure and support multiple processes (Cameron *et al.*, 2012). Involving stakeholder groups in green infrastructure development and management may increase knowledge for decision-making, as well as empowering citizens and the local community to take agency (Grêt-Regamey *et al.*, 2021), but it also requires the consideration of social inclusiveness and the reconciliation of differing views.

Multi-objective forest management: Improvements through landscape zoning

Managing forest resources while balancing the ecological needs of species living in forested landscapes require a specific focus on the frequency and intensity of forest management. Traditionally, forest management has prioritized timber profits (Faustmann, 1849), operating on homogenous parcels of forest land. This timber-oriented management aims at sustained timber extraction, that is, maximizing forest growth while ensuring an even flow of timber for the forest industry. Meanwhile, the habitat needs of species living in the forest have been largely ignored in practice, harming forest biodiversity. Innovative management practices intended to enhance the quality and amount of suitable forest habitats strive to mimic natural disturbances and the associated variability of forest structures, *i.e.*, habitat heterogeneity (Kuuluvainen *et al.*, 2021). To reconcile human interests and biodiversity conservation, the division of forest landscape into intensive use, extensive use, and reserve zones has been proposed (Himes *et al.*, 2022). This landscape approach plans and conducts forest operations at multiple levels, first via landscape zones, with each of them prioritizing a specific objective (*i.e.*, timber production, multiple use, and conservation), and then via locally applying diverse management practices, with varied harvesting intensities and cutting methods (*e.g.*, continuous cover forestry or delayed clear-cut harvests). Such land-use planning of forest management focuses on balancing the societal demand for raw material and energy with the needs of nonhuman species and ecosystems, that is, contributing to planetary well-being itself. Multi-objective forest management zoning is shown in Figure 5.4, which describes how human active and passive management of the forest landscape impacts planetary well-being, focusing on maintaining resource extraction while preserving the processes of the forest ecosystem.

The processes of natural disturbance-succession dynamics, *i.e.*, the progress of forest regrowth after partial or total nonhuman tree destruction, is crucial to forest biodiversity, as various species groups depend on the diversity of successional stages and the structure created by disturbances, *e.g.*, deadwood (Hilmers *et al.*, 2018; Tikkanen *et al.*, 2006). Prioritizing biodiversity conservation will, therefore, require a transformation of how we manage human-modified forest landscapes (Arroyo-Rodríguez *et al.*, 2020). The forest management zoning strategy allows landscape processes to proceed along differing disturbance-succession dynamics. Extensive forest management aims at maintaining some level of forest complexity locally and of heterogeneity at landscape level. This can be achieved through substantial adjustments in how forestry is applied and the diversification of management practices (Duflot, Fahrig and Mönkkönen, 2022). However, managed forests are not comparable with natural forests, because the tree species composition, tree age structure, and characteristics of deadwood composition differ considerably, even if forests are managed extensively. Thus, forest reserves must be included in the land-use plan to allow ecological processes without human interference.

Meanwhile, some proportion of carefully located areas of intensive forestry, primarily oriented towards timber production, could be used to meet human needs. Intensive extractive activities in the forest landscape can provide an even flow of timber, allowing for a shift away from non-renewable resources (*e.g.*, fossil fuels),[1] indirectly contributing to enhanced planetary well-being (*e.g.*, climate

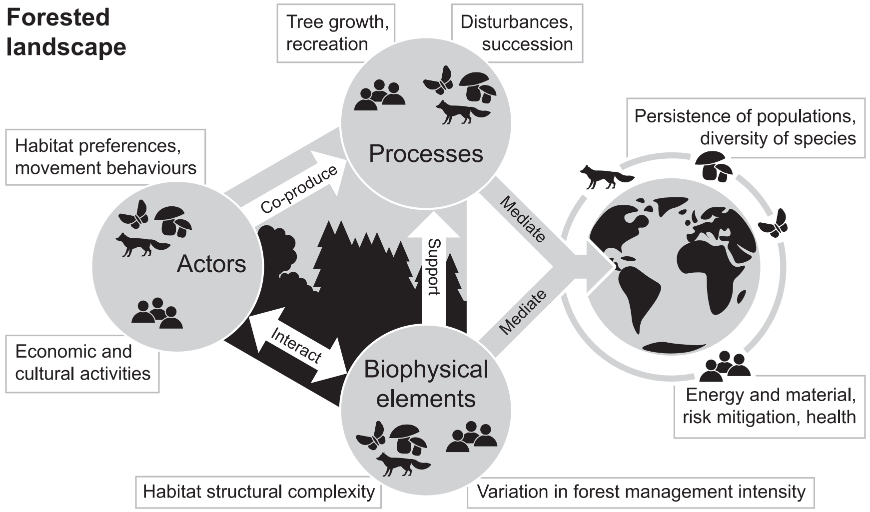

FIGURE 5.4 Conceptualization of a land-use planning principle of forest management zoning, as a landscape approach to planetary well-being, with a focus on sustained forest management. The three basic dimensions of a landscape (actors, processes, and biophysical elements) can be seen from the human and nonhuman perspective (icons). This chapter focuses on the biophysical elements and processes that mediate need satisfaction for humans and nonhumans. Figure created by Māris Grunskis/@PHOTOGRUNSKIS.

change mitigation). Intensive timber extraction can conflict with, and reduce, the availability of other forest benefits for both humans and nonhumans (Eyvindson *et al.*, 2021). Human activities in the forest disrupt the natural functioning of forest ecosystems, leading to a substantially reduced long-term ecological value for biodiversity and ecosystem services (Pohjanmies *et al.*, 2021). Extensive management focused on multiple uses, including non-timber services (*e.g.*, water quality and recreation) can have synergies with the ecological functioning of the forest landscape. For example, for recreational areas, humans prefer subtlety managed forest so as to ease access and create places to enjoy landscape vistas (Pukkala, Lähde and Laiho, 2012).

Determining the relative proportion and spatial distribution of the management zones is challenging (Himes *et al.*, 2022). Forested landscapes are often dominated by human activities, with the intensity of management being defined by the human demand for timber and non-timber resources. This human-centric perspective must shift towards a focus on planetary well-being. This can be accomplished by wisely managing the forest in a way that minimizes damage to the ecological system, *e.g.*, choosing the management plan with most similarity with the natural disturbance-succession dynamics (Côté *et al.*, 2010). The specific distribution and organization of the zones should also be carefully considered, as improved ecological outcomes (*e.g.*, representativeness and connectivity of protected area networks) are possible at a relatively low economic cost (Tittler *et al.*, 2015).

Conclusion

As illustrated by the above land-use planning principles, landscapes host conflicts and synergies between human and nonhuman nature, providing an opportunity to put planetary well-being in practice. The availability of suitable biophysical elements and their spatial organization in a landscape are important aspects of each of our examples, demonstrating how the existence of life-supporting processes depends on the ability of organisms to co-occupy the landscape. Ecological processes, such as dispersal and succession, are impacted by intensive land use. To relax the human-induced pressures faced by nonhuman nature and facilitate ecological functioning, the planning of land uses at the landscape level must be done carefully. Landscapes are the arena in which human actions take place; thus, landscapes are the operational level to achieve planetary well-being. Because they have transformative potential, landscapes can act as an interface across various disciplines and stakeholders, providing a shared representation of space as maps, which are powerful tools to guide human activities towards planetary well-being.

However, all landscape approaches have two main limitations that may hinder their ability to enhance planetary well-being. First, landscapes are open systems subject to external influences. Thus, not all problems can be solved at the landscape level if they originate from outside of the system. Landscapes are embedded in larger entities, such as ecological regions, cultures, or economic and institutional contexts, which impact the organization and dynamics of landscapes. Transforming negative impacts into planetary well-being positive will also require actions beyond the landscape level. In addition, what is done in a landscape may “leak” elsewhere. For example, planning for less dense cities with more green spaces will likely promote further urban expansion. That being said, the challenges resulting from the unboundedness of landscapes can be somewhat controlled for by considering context dependencies in landscape analyses.

Second, landscape approaches often elude ethical consideration; the presented examples offer no principles regarding how to balance between human and nonhuman needs. They do not define legitimate or just actions via which to meet the basic needs of organisms, except the presumption that supporting biodiversity, as a manifestation of evolution, is desirable. The lack of a unified ethics on planetary well-being-oriented land uses is reflected in the provided examples, which differentiate ecosystem services (human needs) from biodiversity conservation (nonhuman needs).

Although land-use planning is generally a process that has been conducted primarily by and for humans, it provides an opportunity to look for synergies between ecosystem services and biodiversity conservation. We argue that land-use planning based on knowledge about ecosystem and landscape processes can strongly benefit both human and nonhuman organisms and ultimately promote planetary well-being. Landscape approaches are powerful in detecting such mutual benefits given that nonhuman species are equally considered as actors in landscape-level processes. In that sense, the concept of planetary well-being might trigger a revolution in land-use planning by giving equal moral significance to human and nonhuman species.

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Note

1 Studies exploring the potential displacement of carbon emissions from wood substitution highlight that, in general, substitution of wood decreases GHG emissions (Myllyviita *et al.*, 2021).

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