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Traditional Cultural Landscapes Revisited: Classification, Diversity, Services, and Their Restoration

Stefan Zerbe

Faculty of Agricultural, Environmental and Food Sciences, Free University of Bozen-Bolzano, Universitätsplatz 5, I-39100 Bozen-Bolzano, Italy; Institute of Geography, University of Hildesheim, Universitätsplatz 1, D-31141 Hildesheim, Germany, stefan.zerbe@unibz.it, https://orcid.org/0000-0002-9426-1441

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Abstract

Due to urbanization, land-use intensification as well as land abandonment, traditional cultural landscapes are continuously declining worldwide. However, those landscapes often exhibit a high biodiversity and can provide numerous ecosystem and landscape services. Accordingly, traditional cultural landscapes with their low-input land-use systems might act as a blueprint for sustainable land use and landscape development. Against this background, a classification of traditional cultural landscapes is suggested as a basis for further research and for environmental or rural development policies. This is based on a holistic understanding of landscapes and cultural landscapes, respectively, and the perception of traditions. The criteria for the classification of traditional cultural landscapes encompass prevailing land-use types (e.g., pastures, agroforestry systems), particular land-use practices in order to overcome natural limitations for land use (e.g., terracing of slopes, irrigation), and/or cultural-historical drivers for long-term landscape development (e.g., impact of monasteries). The value of traditional cultural landscapes for nature conservation and sustainable rural development is given through ecological/environmental, social, and economic multifunctionality and multifaceted landscape services. Through their often embedded indigenous and local (ecological) knowledge, they can also contribute to current environmental and socio-economic challenges such as climate change adaptation. A global Red Books of Threatened Landscapes, already suggested in the 1990ies, could support national and international environmental and rural development policies. The restoration of traditional cultural landscapes will not only contribute positively to biodiversity on all levels and the re-establishment of lost or degraded ecosystem and landscape services but will also promote sustainable social-ecological systems.

Keywords abandonment, agrodiversity, landscape restoration, multifunctionality, social-ecological systems

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1. Introduction

Worldwide, ongoing urbanization and land-use intensification as two global trends of land development have led to a continuous decrease in biodiversity and ecosystem services in the past decades (Intergovernmental Panel on Climate Change [IPCC], 2019; The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services [IPBES], 2019). These environmental crises in the current Anthropocene (Crutzen & Stoermer, 2000) call for immediate and consequent action of environmental policies (Burns et al., 2020; United Nations Environment Programme [UNEP], 2021). With currently 55% and a projected 70% of the world's population living in cities by 2050 (United Nations [UN], 2018), urban landscapes have grown in size all over the globe. The number of megacities (number of inhabitants > 10 million) is projected to rise from currently 31 to 43 in 2030 (UN, 2022). Simultaneously, cultural landscapes, where food and natural raw materials are produced by agriculture, forestry, and/or fishery for this high number of urban dwellers, have changed throughout the world from low- to high-input production systems on the landscape level (Kastner et al., 2021; Winkler et al., 2021).

Another global trend which seems to be underestimated in global environmental discussions and policies, although well quantified on all continents (Zerbe, 2022) is land abandonment. The Food and Agriculture Organization of the United Nations (FAO, 2006, p. 1) defines land abandonment as "a process, whereby human control over land (e.g., agriculture, forestry) is given up and the land is left to nature." This land abandonment leads to a "polarization" between very concentrated and intensively used land, on the one hand, and vast areas of abandoned or, at least, less-used land, on the other hand (Tress et al., 2005; Vos & Klijn, 2000). Affected by this land abandonment are often highly diverse and traditional cultural landscapes with a high multifunctionality, which have evolved through human impact over centuries or even millennia. Different patterns of change are the consequence of land abandonment, which reach from total abandonment and the subsequent succession towards an uncultivated, (semi-)natural landscape (MacDonald et al., 2000) to a spatial shift of crop cultivation or partial abandonment of some parcels, generating a landscape pattern of unused and cropped parcels (Bielsa et al., 2005; Keenleyside & Tucker, 2010).

Based on a meta-analysis of studies on the abandonment of agricultural land, Benayas et al. (2007) identified socio-economic factors—such as immigration into areas with better economic opportunities offered to rural people—as the main driving forces for land abandonment. Accordingly, ecological drivers (e.g., soil erosion) seem to be of secondary importance. These findings were later confirmed by Huang et al. (2020; see also Subedi et al., 2022). Campbell et al., (2008) estimated the total area of abandoned farmland in the 20th century to be 385–472 million km^2. Although, few studies have estimated the amount of land abandonment in different regions of the world at different periods (Subedi et al., 2022), it has been quantified, for example, for Europe as 128.7 million hectares of abandoned farmland (which is 25.4% of the total farmland) between 2001 and 2012 (Estel et al., 2015). In China, 2 million hectares of agricultural land are estimated to fall out of production each year (Liu & Li, 2017). Although, land abandonment can be an opportunity to promote nature conservation objectives and, particularly, habitat regeneration (Queiroz et al., 2014), its often negative consequences for cultural landscapes with their natural and cultural heritage and their multifaceted traditional and sustainable use of natural resources are obvious (e.g., Dax et al., 2021; Quintas-Soriano et al., 2022).

It is shown by an increasing number of studies that traditional cultural landscapes with their low-input land-use systems bear a higher biodiversity and provide more ecosystem services compared to intensively used landscapes with their high-input land-use systems (e.g., Benton et al., 2003; Ekroos et al., 2020; Katayama et al., 2014; Walz, 2011). Following the up-to-date definition by the FAO (2007, p. 1), low-input farming systems are hereby defined as seeking "to optimise the management and use of internal production inputs (i.e., on-farm resources) and to minimise the use of production inputs (i.e., off-farm resources), such as purchased fertilisers and pesticides, wherever and whenever feasible and practicable, to lower production costs, to avoid pollution of surface and groundwater, to reduce pesticide residues in food, to reduce a farmer's overall risk, and to increase both short- and long-term farm profitability."

Although the global decline in traditional cultural landscapes has been recognized on the international scale and environmental policies have been developed to protect these traditional multifunctional landscapes, the above-mentioned global trends could

not have been halted. International programs and initiatives for the preservation and sustainable development of traditional cultural landscapes encompass, for example, the Man and Biosphere (MAB) Program (UNESCO, 2019), the European Landscape Convention (Council of Europe, 2000; Déjeant-Pons, 2006), Globally Important Agricultural Heritage Systems (GIAHS; FAO, 2021), and High Nature Value (HNV) Farmland (e.g., Plieninger & Bieling, 2013).

Against this background, knowledge on traditional cultural landscapes should be promoted, and tools and instruments developed for their restoration and sustainable development. Thus, for example, environmental and agricultural policies could support and promote farming practices and land management which preserve highly valuable traditional cultural landscapes, re-activate abandoned cultural landscapes and restore features and functions of sustainable cultural landscapes and their services for human societies. This requires a good and clearly structured overview of traditional cultural landscapes throughout the world.

In this paper, accordingly, (1) the concept of *traditional cultural landscape* is outlined, taking the historical perception in landscape studies as well as up-to-date definitions into account. The main objective of this paper is (2) a classification of traditional cultural landscapes based on prevailing land-use types, practices of land use and/or cultural-historical drivers for long-term landscape development. Traditional cultural landscapes are addressed which can occur all over the world and/or are specific to particular natural preconditions and historical land-use developments. After (3) highlighting their often high value for nature conservation and resource protection as well as for the sustainable development of rural communities, a plea is made for a systematic global survey of threatened landscapes and the sustainable development, re-activation, and restoration of traditional cultural landscapes. As outlined by Zerbe (2022), traditional multifunctional cultural landscapes and their adaptation to modern requirements and demands (e.g., infrastructure, energy production) can contribute to the implementation of most of the 17 Sustainable Development Goals (Devision for Sustainable Development Goals [DSDG], 2020).

2. Methodological Approach

Firstly, the term and concept of traditional cultural landscape are explained, taking into account a holistic view on landscapes. Following Schmitz and Herrero-Jáuregui (2021, p. 1), cultural landscapes should be perceived as "the result of social-ecological processes that have co-evolved throughout history" or considered as social-ecological systems (Villodre et al., 2023). Hereby, the perception of a *cultural landscape* is outlined and *traditional* defined as the basis for the classification of traditional cultural landscapes.

Then, as the core of this study, a classification of traditional cultural landscapes is presented. This classification is based on the prevailing land-use types, particular land-use practices which have shaped the cultural landscape and/or the main driver(s) for long-term landscape development. Accordingly, a conceptual approach is presented here and the criteria of the classification of today's traditional cultural landscapes are

- the prevailing land-use types shaping the landscape, with a high proportion of diverse, extensive, and low-input land-use systems which are related to the regional climate conditions and, additionally, influenced by other abiotic (e.g., soil, geomorphology, water balance) and biotic site conditions (e.g., species pool, vegetation) as well as cultural-historical factors (e.g., long-term management practices, property rights); these prevailing land-use types are, for example, pastures or agroforestry systems;
- land use depending mainly on the geology of the region, with the extraction of minerals in small-scale mining pits (e.g., silver, copper, chalk) or sedimentation basins (salt) which, in addition to the related infrastructure, have shaped the landscape;
- traditional land-use practices which overcome natural limitations for land use, for example, terracing of slopes or irrigation systems under semi-arid or arid-climates;
- the use of terrestrial and aquatic natural resources, strongly related to and having co-evolved with open water bodies such as rivers, lakes, or coastal environments;
- cultural drivers, for example, monasteries or spiritual practices which have shaped the landscapes.

Finally, referring to the current knowledge on traditional cultural landscapes, their value and significance for sustainable rural development is highlight-

ed. Hereby, multifunctionality and landscape services are specifically addressed. This paper addresses traditional cultural landscapes all over the world. However, examples mainly focus on Europe.

3. Results

3.1 What is a Traditional Cultural Landscape?

The term *landscape* is used within the wide range of a physical section of the Earth's surface towards a metaphor, thus shifting by the context and by the background of the users (Antrop, 2013). Landscape ecologists define landscapes as "spatially heterogenous geographic areas characterized by diverse interacting patches of ecosystems, ranging from relatively natural terrestrial and aquatic systems … to human-dominated environments including agricultural and urban settings" (Wu, 2008, p. 527). According to the European Landscape Convention (Council of Europe, 2000, p. 1), landscape means "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors." Consequently, the concept of landscape integrates (1) the natural abiotic (geology, soil, geomorphology, water balance, climate) and biotic (flora, fauna, vegetation, microorganisms) preconditions within a spatial unit of the Earth's surface, which (2) historically were and continuously are shaped, influenced, and organized by humans, and (3) the human perception with regard to, for example, diversity, aesthetics, values, identity, and symbols.

German geographers already used the term cultural landscape (*Culturlandschaft*) in the first half of the 19th century, first mentioned by C. Ritter in 1832 (Potthoff, 2013). The term and concept of cultural landscape was brought to an international audience and defined by Sauer (1925, p. 343) as "a landscape fashioned from a natural landscape by a cultural group. Culture is the agent, the natural area is the medium, the cultural landscape is the result." Later, the concept of cultural landscape was extended beyond its material-physical manifestations towards the intangible values, symbols, and shared identity and diversity of the local inhabitants (Antrop, 2006; Groth & Bressi, 1997; Stephenson, 2008).

After having laid the foundations for the concept of landscape and cultural landscape, a traditional cultural landscape has to be defined. The term and concept refer to traditions as "a belief, principle, or way of acting that people in a particular society or group have continued to follow for a long time" (Cambridge Dictionary, 2020). Thus, traditions are considered as a combination of elements through which it is possible to evoke collective memories, identities, and social cohesion (Presenza et al., 2019) and encompass tangible as well as intangible goods and resources. Applied to a traditional cultural landscape, this means a combination of building structures, land-use patterns and land-use systems, management systems, food processing, infrastructure, local governance, local education systems, regional language, local arts and crafts, music and dance, sports and games as well as medicinal, spiritual, and religious practices. Traditional in the above-described sense should not be misinterpreted as the opposite of "modern" or "scientific" or as denoting simple, primitive, static, ignorant, anachronistic, or irrational which are often stereotypes related to this term (Ellen & Harris, 2000; Warren, 2004).

With regard to the time frame, a traditional cultural landscape might have been shaped by millennia and centuries of human impact or as Antrop (1997, p. 109) defines those landscapes "with a long history, which evolved slowly and where it took centuries to form a characteristic structure reflecting a harmonious integration of abiotic, biotic, and cultural elements." Thus, a major characteristic of traditional cultural landscapes is their continuity over at least 200 years. The scale of landscapes as spatially heterogeneous areas and as mosaics of patches "may be as large as thousands of square kilometers or as small as tens of square meters" although, "human-scale landscapes that span over tens or hundreds of square kilometers are more familiar and convenient to us" (Wu & Qi, 2000, p. 1).

3.2 Traditional Land Use and Drivers Which Shaped Cultural Landscapes

Certain land uses and land-use systems, respectively, performed over centuries or millennia have not only led to certain anthropogenic ecosystems and land-use types such as meadows, coppice forests, or heathland, but have also shaped the landscape. One of the oldest land uses, besides land which was made arable for crop production, is grazing and forest grazing, respectively, which dates back to the Neolithic Period (Hejcman et al., 2013). Extensive grazing as part of agricultural land use has thereby opened the forests

and created a mosaic of grassland, wood pastures, and embedded forest patches. Examples are still abundant in the mountains and lowlands throughout the world, although often less used anymore or abandoned (see Figure 1A).

As a mixture of agricultural and forestry land use, agroforestry systems have been developed. Still occurring in the tropics, these agroforestry systems can cover large areas and thus, become landscape shaping. As a forestry component, fruit and nut trees or trees for timber and litter production can serve for land users, and as the agricultural land use on the same land, grazing and mowing or the production of wheat, corn or vegetables are performed (e.g., Zerbe, 2021).

Particularly in mountain areas, terraces have been built to stabilize slopes (e.g., with dry-stone walls) and to perform agriculture on the terraced land. Additional to facilitating agricultural management on steep slopes, terraces also promoted topsoil accumulation and water availability (Deng et al., 2021). One of the most striking examples is the Inca settlement Machu Picchu at an altitude of about 2,500 m above sea level in the High Andes of Peru, with its terraces on extremely steep slopes (see Figure 1B).

In arid and semi-arid regions sophisticated irrigation systems have been developed which made agriculture possible even under the conditions of low mean annual precipitation or prolonged dry seasons. Examples from all over the world reflect this irrigation land use, such as the *karez* water system in Central Asia (Luo et al., 2017), the *qanats*, *falaj*, *foggara*, and *khattara* in Asia and Northern Africa (e.g., Estaji & Raith, 2016), the below-ground aqueducts with their funnel-shaped holes called *puquíos* in the coastal desert of Peru (Schreiber & Lancho, 1995) or the *bisse* and *Waal* irrigation system in dry valleys of the European Alps (Crook & Jones, 1999). However, not only as an adaptation to arid and semi-arid climates or prolonged dry seasons, irrigation has also been practiced for centuries as an adaptation to the crop cultivated on a large scale. Accordingly, Asian rice culture as an irrigated cultural system fed by rain has also shaped cultural landscapes (e.g., Kaida, 1991, p. 574: "waterscapes").

Lakes, rivers, and coastal areas have formed the development of local communities and their land and water use often in a particular way differing from terrestrial sites, since the water was used for mobility, fishery, energy production with mills, and site-adapted settlements and agriculture on wet ground. Accordingly, lakescapes in regions with large lakes (e.g., Lake Atitlan in Guatemala) or a high number of smaller to medium-sized lakes, riverscapes along flowing waters (see Figure 1C), and seascapes at the coast have developed (e.g., Haslam, 2008; Potocka, 2013; Pungetti, 2012). In those regions which were geomorphologically formed by the late glaciation as, for example, in Scandinavia, northern Central Europe, and the northern part of North America, lakescapes with a huge number of lakes have evolved.

Particular geological and geomorphological prerequisites have stimulated humans already in ancient times to exploit mineral resources which, in some cases, led to the evolution of landscapes. Salt production, for example, has the power to transform a landscape (Landa et al., 2016) such as in the Mediterranean region (e.g., Spain, Italy, Malta) and on the Canary Islands (Kortekaas, 2004; Landa et al., 2016). Extensive open-cast or below-ground mining created particular landscapes, for example, the multifaceted chalk quarries on Rügen Island in northeastern Germany (Zerbe & Schacht, 1998), the National and UNESCO Global Geopark Colline Metallifere in western Italy, and the mining area Mansfeld in the German federal state Saxony-Anhalt.

The impact of hunting of former land rulers was landscape shaping as well as the activities of monasteries throughout the centuries. Those landscapes preserved for hunting, particularly in river floodplains, were, mainly in Europe, often transformed to landscape parks later. Well-known examples are the *Große Tiergarten* near the river Spree in Berlin, the *Schönbusch* near the river Main in close vicinity to the city of Aschaffenburg in southwestern Germany (see Figure 1D), the *Gartenreich Wörlitz-Dessau* at the river Elbe, and the castle and park Rogalin near the river Warthe south of the city of Posen in northwestern Poland.

Concerning monasteries and their land-use impact, in particular, the Cistercians had a considerable impact on the spatial development of the landscape, what Schenk (1989) calls *Raumwirksamkeit* (spatial impact). This is emphasized by Rösener (2000, p. 110) by citing the Abbot of Loccum who proclaimed in 1890 that no other order than the Cistercians had such a profound influence on agricultural development, in particular, on sites which were not very suitable for land use.

Figure 1 Examples of Landscapes

Note. Examples of landscapes which have been shaped by century-long extensive and low-input traditional land use with (A) the vast wood pastures of the National Park Pollino (southern Italy), (B) the ancient terraces at the steep slopes of Machu Picchu in the Peruvian Andes, (C), the lower Drin valley in northwestern Albania with its meandering river, floodplain forests, and pastures, and (D) the landscape park Schönbusch in the river Main floodplain near the city of Aschaffenburg in southwestern Germany (all photos by S. Zerbe).

Last but not least, religious and spiritual cults were performed in certain ecosystems (e.g., forests) which was also expanded to the landscape scale. Accordingly, sacred natural sites are part of the landscape and cover a wide range of spatial extents, ranging from ponds and springs towards rivers, lakes, mountains, and entire islands (Wild et al., 2008). On the landscape scale, that means "a temporal and spatial fabric spread over a geographic region, unifying all the rituals conducted at the various sacred places within a narrative framework" (Reese-Taylor, 2012, p. 752).

Although these traditional land uses described above shaped landscapes with a high importance for natural and cultural heritage preservation all over the world, they might have been developed in a non-sustainable way during historical times or reflect current non-sustainable land use. The former might be the case with, for example, hunting landscapes if former land rulers have socially and economically oppressed the local population for their own purposes. This has been shown, for example, for the Spessart mountains in southwestern Germany where the southern part was mostly kept free of other land uses (enforced by land-use regulations and laws) because it was a large hunting reserve for the rulers and nobility (Zerbe, 1999). The latter might hold for traditional mining practices still performed today. It has been shown, for example, that traditional gold-mining activities particularly in the Global South are harmful to the environment (Léopold et al., 2016; Petelka et al., 2019). In any case, traditional as well as modern land uses and land-use systems should be coherent with a commitment to protect the environment as well as to the Sustainable Development Goals.

3.3 Classification of Traditional Cultural Landscapes

Given the various specific land-use impacts which formed particular landscapes throughout the world, traditional cultural landscapes can be classified (see Table 1). Although, these cultural landscapes may be as large as thousands of square kilometers (e.g., forest landscapes in the tropics or Taiga forests of the northern-hemisphere) most of these classified "human-scale landscapes" span over tens or hundreds of square kilometers as stated by Wu and Qi (2000, p. 1). Besides the unique landscapes, which have been designated as outstanding examples for conservation and sustainable development (examples given in Table 1), also the "everyday" cultural landscapes (Plieninger et al., 2014, p. 1) with a high proportion of traditional structures and practices and a mosaic of ecosystems and land-use types have to be considered here.

Table 1 Classification of Traditional Cultural Landscapes in the World

Forest landscapes
Criteria for classification Prevailing land-use type under given climate conditions
Main features Landscape characterized by mainly woodland and the use of forests for timber production and non-timber forest products
Examples of occurrence Boreal, temperate, and tropical climate zones throughout the world; mountain areas below the subalpine altitudinal belt
Outstanding representatives Mata Atlântica in Brazil as UNESCO Biosphere Reserve
Agroforestry landscapes
Criteria for classification Prevailing land-use type under given climate conditions
Main features High percentage of extensive to moderately intensive agroforestry systems with trees for timber production and/or the use of wood and other products of the trees (e.g., fruits, resin, bark, leaves), combined with pasture, meadows, crop cultivation on arable fields on the same area
Examples of occurrence Formerly, widespread in Europe as traditional land-use system (e.g., extensively used meadow orchards); today, mostly in the tropics
Outstanding representatives Calakmul in Mexico as UNESCO Biosphere Reserve
Pasture landscapes (see Figure 1A)
Criteria for classification Prevailing land-use type under given climate conditions
Main features Having been developed through centuries of extensive grazing by a variety of animal species for the production of meat and other animal-related products (e.g., milk, cheese, wool); often structurally highly heterogeneous with open grassland, shrubs, forest patches, and single trees
Examples of occurrence Practically, all over the world; often, on those soils which are too nutrient poor for arable land, in mountain areas on steep slopes or in high altitudes, traditionally related to transhumance
Outstanding representatives The Causses and the Cévennes, Mediterranean agro-pastoral Cultural Landscape in France as UNESCO World Heritage Site

Terraced landscapes (see Figure 1B)

Criteria for classification
Land-use practice to cope with natural limitations for land use

Main features
Slopes terraced, often with dry-stone walls for stabilization, for the cultivation of grapes, fruit and olive trees, rice, potatoes, and other crops

Examples of occurrence
Practically in most of the world's mountainous areas, e.g., in the Mediterranean region, the Andes, and in Central and South-East Asia

Outstanding representatives
National Park Cinque Terre in Italy

Irrigation landscapes

Criteria for classification
Land-use practice to cope with natural limitations for land use or as an adaptation to the cultivated crop (e.g., rice)

Main features
Landscapes in arid and semi-arid regions which are irrigated by traditional irrigation systems with water from the nearby mountains or with seasonal rainfall; landscapes with irrigation systems because of a seasonal water deficit; landscapes where rice is the major crop

Examples of occurrence
Central Asia, South and Central America, North Africa; also, in European landscapes (e.g., Alps), where traditional irrigation systems are integrated into other landscape types (e.g., pasture, orchards); rainfed rice-farming systems in East and South-east Asia

Outstanding representatives
Aksu-Zhabagly in Kazakhstan as UNESCO Biosphere Reserve

Lakescapes

Criteria for classification
Open water bodies as main driver for the use of terrestrial and aquatic resources

Main features
Landscapes with a high number of lakes or a large lake and related fishery

Examples of occurrence
Landscapes in northern and north-western Europe, northern Central Europe, and North America, geologically and geomorphologically formed by glaciation

Outstanding representatives
English Lake District as UNESCO World Heritage Site

Riverscapes (see Figure 1C)

Criteria for classification
Open water bodies as main driver for the use of terrestrial and aquatic resources

Main features
Traditional use of rivers for fishery and floodplains with remnants of the natural floodplain vegetation (e.g., soft- and hardwood floodplain forest) and a high diversity of wetlands, which are used extensively for grazing and as meadows

Examples of occurrence
Along rivers, often not strongly shaped through engineering technology; mostly in tropical Africa, Latin America, and Asia; but also along moderately shaped rivers such as the trans-border lower Oder Valley in northeastern Germany and northwestern Poland

Outstanding representatives
Oueme Lower Valley in Benin as UNESCO Biosphere Reserve

Coastal landscapes and seascapes

Criteria for classification
Open water bodies as main driver for the use of terrestrial and aquatic resources

Main features
Traditional land use, often with pasture on coastal grasslands (e.g., with polder systems) and traditional fishing systems, culturally evolved as a close interaction of the marine and terrestrial environment

Examples of occurrence
Extensively used coasts throughout the world which have not been heavily urbanized, transformed for tourism or subject to technological transformation

Outstanding representatives
Landscape of Grand Pré in Canada as UNESCO World Heritage Site

Saltscapes

Criteria for classification
Extraction of minerals

Main features
Coastal or inland areas where natural salinization of the water and topsoil has often created unique features of traditional salt extraction

Examples of occurrence
Coastal areas, particularly under warm climates such as the Mediterranean region and inland sites with natural topsoil salinization

Outstanding representatives
Belo-sur-Mer Kirindy-Mite in Madagascar as UNESCO Biosphere Reserve

Mining landscapes

Criteria for classification
Extraction of minerals

Main features
Traditional and small-scale open-cast or underground mining of minerals such as chalk, copper, potassium, and silver in small mining pits or underground at low depth

Examples of occurrence
Regions where the minerals of interest occur near the earth surface or in low depth

Outstanding representatives
National and UNESCO Global Geopark Colline Metallifere in western Italy

Hunting and park landscapes (see Figure 1D)

Criteria for classification
Cultural-historical driver

Main features
Landscapes, mainly woodland which was owned and used for hunting by the nobility and land rulers, and later often transformed to landscape parks

Examples of occurrence
Central European floodplains

Outstanding representatives
The Par Force Hunting Landscape in North Zealand, Denmark as UNESCO World Heritage Site

Monastic landscapes

Criteria for classification
Cultural-historical driver

Main features
Landscapes strongly influenced by the impact and land use of monasteries

Examples of occurrence
Central Europe, England

Outstanding representatives
Landscape shaped by the Cistercian monastery Chorin as part of the Biosphere Reserve Schorfheide-Chorin in northeastern Germany

Sacred and spiritual landscapes

Criteria for classification
Cultural-historical driver

Main features
Landscapes in which religious practice is performed, often combined with monasteries or sacred places and groves

Examples of occurrence
Africa, Asia

Outstanding representatives
Sacred Mijikenda Kaya Forests in Kenya as UNESCO World Heritage Site

Note. Adapted from Zerbe (2022).

4. Discussion

It has been shown by many studies from all over the world that traditional cultural landscapes can bear a high to very high biodiversity on the species, ecosystem, and landscape level. Additionally, they are often characterized by multifunctionality with regard to land-use types and socio-economic features, as well as they might provide a large range of landscape services. Traditional cultural landscapes with their low-input and multiple land-use systems, in general, bear a higher agrobiodiversity (e.g., crop varieties, local breeds and habitats) compared to intensively used land and landscapes (Agnoletti & Santoro, 2022). Scientific proofs of this fact are abundant and—besides studies on particular species, groups and/or habitat types—have been presented by comprehensive textbooks and reviews (e.g., Gonthier et al., 2014; Stein-Bachinger et al., 2021; Tscharntke et al., 2005). In Europe, farmland birds, for example, have been taken as indicators for the loss of biodiversity in post-war Europe because of agricultural intensification. Given that cereal yield almost tripled between 1960 and 2000, cereal yield alone (closely correlated with increased fertilizer use) has been shown as a predictor of over 30% of the variation in the decline in European bird populations (Donald et al., 2001). A similar declining trend is observed by comparing ecosystem services of traditional and low-input with intensive and high-input land-use systems (e.g., Bezák et al., 2020).

Additionally, traditional ecological knowledge (Berkes et al., 1995), indigenous knowledge (UNESCO, 2017) as well as local ecological knowledge (Gann et al., 2019) is often still present in those traditional cultural landscapes. Particularly, this knowledge regarding crop varieties, traditional farming practices, natural resource management, and the governance of local communities can help to solve current environmental problems (e.g., the decline in biodiversity and agrobiodiversity), to mitigate the effects of climate change (e.g., through enhanced carbon sequestration in forests and agroforestry systems), and to cope with environmental uncertainties. This has been particularly shown for climate change adaptation. Hosen et al. (2020), for example, explored indigenous communities in Malaysia and how their traditional knowledge helps them to observe and respond to local climate change effects. These communities responded to an increase in temperature, with uncertain weather and seasons, by environmentally-adapted management of their land and resources to ensure food and resource security. Taking a much wider geographical range into account, Leal Filho et al. (2022) performed a structured review to explore the role of indigenous and local knowledge, often embedded in traditional

cultural landscapes, in climate change adaptation in Africa. The authors highlight "the remarkable value of [indigenous and local knowledge] in Africa for climate change adaptation and its value for supplementing climate services, particularly in areas with limited access to modern climate and weather forecasts" (Leal Filho et al., 2022, p. 250).

4.1. Multifunctionality of Traditional Cultural Landscapes

Multifunctionality in the context of traditional cultural landscapes is here meant holistically with regard to the landscape as a social-ecological system. Following Naveh (2001, p. 269), multifunctional landscapes are "tangible, mixed natural and cultural interacting systems." Multifunctionality is often directly related to multifunctional agriculture or land use in general (e.g., Helming & Pérez-Soba, 2011; Organization for Economic Cooperation and Development [OECD], 2001; Wiggering et al., 2006). Thus, it is closely related to agrodiversity which is defined by Brookfield and Padoch (1994, p. 9) as "the many ways in which farmers use the natural diversity of the environment for production, including not only their choice of crops but also their management of land, water, and biota as a whole." Objects of ecological/environmental multifunctionality are thus, biodiversity, agrobiodiversity, and agrodiversity as well as ecosystem services, protected areas, landscape connectivity and fragmentation (e.g., Stürck & Verburg, 2017; van der Plas et al., 2018).

However, with regard to cultural landscapes, it should go far beyond land use and can be closely related to sustainability (Otte et al., 2007). If multifunctionality is directly related to sustainability (Kato & Ahern, 2009; O'Farrell & Anderson, 2010), the three pillars ecological, social, and economic sustainability can serve as criteria for a qualitative and quantitative approach to and an assessment of a multifunctional cultural landscape. Whereas there is a common understanding of ecological and environmental multifunctionality and various approaches for its qualitative and quantitative assessment are available (see above), this is not the case for economic and social multifunctionality with regard to cultural landscapes. Attempts for the assessment of economic multifunctionality of agricultural landscapes have been made by, for example, Waldhardt et al. (2010) by comparing an existing landscape with an expert-generated multifunctional landscape scenario. Economic as well as social multifunctionality of agricultural landscapes have been recognized by Song et al. (2020), while social dimensions of multifunctionality have been addressed by Nowack et al. (2022) for agricultural landscapes.

Dimensions for the operationalization of multifunctionality of traditional cultural landscapes, following the three-pillar paradigm of sustainability and differentiating ecological/environmental, social, and economic multifunctionality as well as indicators for their assessment are given in Table 2. Hereby, the dimensions of ecological, social, and economic multifunctionality can be strongly interrelated. Agrodiversity, for example, with the diversification of crops and farming systems can have a positive impact on biodiversity (Jones et al., 2023) and can enhance the financial profitability of farms (Sánchez et al., 2022). In addition, environmental education increases awareness of biodiversity and ecosystem services and the implementation of sustainability in farming practice (Børresen et al., 2023).

Examples of multifunctional cultural landscapes with a still high proportion of traditional land-use systems and practices are abundant. Pinto-Correia and Vos (2004), for example, highlight Mediterranean traditional cultural landscapes as multifunctional, with their typical and complex agricultural-, silvicultural, and pastoral components. Accordingly, these landscapes are characterized by manifold other landscape functions and services than just agricultural production, which encompass, for example, recreation, cultural identity, and the preservation of natural resources. Many biosphere reserves throughout the world (see also Table 1) represent multifunctional traditional cultural landscapes. Jackson et al. (2021) present the example of the Kafa Biosphere Reserve in southwest Ethiopia and point to the role of the local community with its traditional resource management.

Table 2 Dimensions for the Operationalization of Multifunctionality of Traditional Cultural Landscapes, Following the Three-Pillar Paradigm of Sustainability

Criteria	Dimensions for the operationalization of multifunctionality	Selected indicators for assessment	References (examples)
Ecological/ environmental multifunctionality	Biodiversity, agrobiodiversity (incl. specific groups of organisms such as pollinators; agricultural pest antagonists)	Species (numbers, diversity indices, Red-List species, etc.), habitats (number, quality, grade of degradation, threatened habitats, etc.)	Jones et al. (2021), Damiani et al. (2023)
	Agrodiversity	Crop diversity, diversity of farming practices, diversity of farm types	Houssni et al. (2023)
	Ecosystem services	Categories (provisioning, regulating, cultural) and variety within categories, thresholds, synergies and trade-offs	Hölting et al. (2019)
	Protected areas	Number, area size, quality (e.g., naturalness, grade of degradation), management	Gohr et al. (2022), Chen et al. (2023)
	Landscape fragmentation and connectivity	Quantitative (e.g., number of patches in a given area) and qualitative (e.g., diversity of patches) indicators for fragmentation and connectivity (e.g., distance of certain patch types, presence of corridors)	Llausàs and Nogué (2012), Larrey-Lassalle et al. (2018), Spanowicz and Jaeger (2019)
Social multifunctionality	Medical and social services	Presence and number of physicians, accessibility to services, Health-Related Quality of Life	Makai et al. (2014), Coombs et al. (2022)
	Age, gender, ethnics of rural communities	Population census data with information on age, gender, ethnics, languages, and other population diversity indicators	European Union (2010), Fromentin (2023)
	Local communication and information technology	Internet access, Rural Communication Services, early warning systems against natural hazards	FAO (2017), Maja et al. (2020)
	Environmental education	Access to schools and/or the non-formal education sector, modern curricula, implementation of Education for Sustainable Development, access to online education resources	Zikargae et al. (2022), Silva et al. (2023)
	Governance and decision making	Implementation of participatory decision-making, rules for the use of commons, expansion of rights and opportunities for the rural community (empowerment)	Chirenje et al. (2013), Sisto et al. (2022)
Economic multifunctionality	Diversity of cropping and land-use systems (e.g., rotation systems, agroforestry systems, intercropping, forestry, fishery)	Crop diversity, diversity of farming practices, diversity of farm types	Jordan and Warner (2010), Hufnagel et al. (2020)
	Multipurpose crops	Use options for single crops such as e.g., food, fodder, building material, fertilization, ecosystem restoration, phytoremediation (e.g., coconut tree)	Allegrini et al. (2022), Pandey et al. (2022)

Economic diversification such as agriculture, forestry, fishery, tourism, local handicraft, local food processing, local/regional farmers' markets, etc.	Range and functionality of profitable economic sectors, diversity of income sources, revenues from economic sectors	Merenkova et al. (2019), Abebe et al. (2021)
Local and regional infrastructure	Facilities and structures to provide services such as transport, energy/electricity, drinking water and sanitation, housing, information and communications technology, health, and education, access to regional markets	Danneberg and Kulke (2016)

4.2 Landscape Services

The concept of *landscape services* transfers the ecosystem service approach to the landscape level. Introduced by Termorshuizen and Opdam (2009), the concept of landscape services builds on the multifunctional perspective of landscapes and incorporates both, natural and cultural aspects (see also Hermann et al., 2011; Vallés-Planells et al., 2014). Since ecosystem services are associated primarily with the functions of ecosystem and land-use systems, landscape services are associated with the ecological functions of landscapes ("landscape functions"; see Willemen et al., 2010). Accordingly, these concepts address different spatial scales. Since the concept of landscape services was introduced, a growing number of studies have investigated and assessed these qualitatively and quantitatively. Vallés-Planells et al. (2014), for example, by referring to the Common International Classification of Ecosystem Services (CICES; Haines-Young & Potschin, 2018), state cultural landscape services with regard to health, enjoyment, self-fulfillment, and social fulfillment. Recreation and tourism, spiritual and religious values, educational aspects, cultural heritage, as well as inspiration, sense of place/continuity, and cultural identity have to be added to cultural landscape services. Of a growing concern is human health related to landscapes which was coined by Gesler (1992) with the concept of therapeutic landscapes. Study examples particularly relate the promotion of health and wellbeing in multifunctional cultural landscapes (e.g., Lin et al., 2022; Milligan et al., 2004).

4.3 Restoration of Traditional Cultural Landscapes

Given all these potential benefits of traditional cultural landscapes for the environment and human societies, their re-activation and restoration should be promoted on the regional, national, and international level. Based on the long-term research and experiences from restoration ecology (e.g., Allison & Murphy, 2017) during the past decades, numerous projects have been realized throughout the world to restore elements of the traditional cultural landscape which means near-natural ecosystems or extensive and low-input land-use types, respectively (see e.g., the compilation from Zerbe, 2023 for Central Europe). Against the background of the degradation, abandonment, and decline of multifunctional traditional cultural landscapes since the middle of the last century, landscape restoration is of growing concern (Chabay et al., 2016; Moreira et al., 2006; Toma & Buisson, 2022). An example for a current restoration of a traditional cultural landscape is given with a part of the Biosphere Reserve Schorfheide-Chorin in northeastern Germany. Additionally to the introduction of organic agriculture, hedges and traditional orchards have been re-established there, as well as a coniferous monoculture removed and an extensive pasture re-activated on this site (see case study in Zerbe, 2022).

Landscape restoration hereby should not only stop and reverse land degradation, re-establish multifunctionality, and implement sustainable land use, but should also reactivate local social-ecological systems (Gann et al., 2019; Wortley et al., 2013). The restoration of traditional and multifunctional cultural landscapes has to consider larger systems such as a catchment area, with particular attention to ecological interactions of ecosystems and land-use types (e.g., the landscape water balance), socio-economic sustainability, and aesthetics. Moreira et al. (2006) have highlighted main differences between ecosystem and cultural landscape restoration approaches. Accordingly, for example, biodiversity is considered the main objective of ecosystem restoration whereas the restoration of cultural landscapes includes cultural, aesthetic, religious, and/or historic values and human health, and integrates in a

holistic way ecosystems and land-use types managed with various intensities for sustainable ecological and socio-economic development.

5. Conclusion

Worldwide, we currently face the continuous decline, abandonment, and degradation of traditional cultural landscapes. Many of those could contribute to the preservation of biodiversity, promote ecosystem and landscape services, and support many of the Sustainable Development Goals on the local, regional, and national level. Since traditional cultural landscapes, often having developed towards multifunctionality with regard to ecological, social, and economic criteria, have been set on the international environmental policy agenda, a systematic mapping and comprehensive assessment might promote their conservation, re-activation, and restoration. This might give new impetus to Red Books of Threatened Landscapes that have been already suggested by Naveh in 1993 as a tool for holistic landscape conservation, taking long-termed developed and diverse Mediterranean landscapes as an example. These Red Books should present "recent, adverse biological, ecological, cultural and socio-economic changes in highly valuable and not yet irreversibly despoiled landscapes and their future threats, and suggest alternative, sustainable land-use strategies with sounder conservation and restoration options" (Naveh, 1993, p. 241). The later called Landscape Green Books should provide information on endangered natural assets as well as on cultural, historical, and scenic assets which "compose the total landscape ecodiversity" (Naveh & Lieberman, 1994, p. 330).

Given the first step of the classification of traditional cultural landscapes (see Table 1), these various landscape types could be identified on the global scale. The occurrence and current condition of particular traditional cultural landscapes within each of the 13 landscape types could be mapped and characterized. Following the Red List categories of species (e.g., International Union for Conservation of Nature) and habitats (e.g., Finck et al., 2017 for Germany), the endangerment of traditional cultural landscapes could be assessed. Additionally, reference landscapes could be filtered out for the restoration of multifunctional landscapes with their assets of natural and cultural heritage (see the outstanding representatives in Table 1). Particularly emphasizing ecosystem and landscape restoration, these books should serve as a "guideline for the political and professional decision-maker and for all those who deal directly with these landscapes such as land administrators, owners and managers, agronomists, foresters, pasture and range specialists, conservationists, regional planners, landscape architects, and environmental engineers" (Naveh, 1993, p. 245).

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