REYNARD, E., (2023). ***Agricultural landscapes – tangible and intangible values of cultural landscapes.*** The Overarching Issues of the European Area, Moving towards efficient societies and sustainable ecosystems. Porto, Faculdade de Letras da Universidade do Porto. pp. 89-103
DOI: https://doi.org/10.21747/978-989-9082-88-5/ovea7

AGRICULTURAL LANDSCAPES – TANGIBLE AND INTANGIBLE VALUES OF CULTURAL LANDSCAPES

PAISAGENS AGRÍCOLAS – VALORES TANGÍVEIS E INTANGÍVEIS DAS PAISAGENS CULTURAIS

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Abstract

Landscapes combine a physical dimension and intangible aspects related to perception and representation. Agricultural landscapes are the result of a combination of natural (ecological conditions, climate, topography) and agronomic factors (cultivation choices, farming techniques and infrastructure, such as terraces or hydraulic infrastructure), as well as intangible factors (practices, know-how, values). Four example of agricultural landscapes are presented and discussed: landscapes related to a complex irrigation system with historical channels, called *bisses*, in the canton of Valais, Switzerland; hydraulic infrastructure for water and sediment harvesting – called *jessour* – in the arid context of Southeast Tunisia; wooded pastures in the Jura karstic mountains in Switzerland; and finally the terraced vineyard of Lavaux (canton of Vaud, Switzerland) inscribed on the UNESCO World Heritage List. The description of agricultural and landscape characteristics and the overview of some important management challenges allow proposing four recommendations for the sustainable management of agricultural landscapes: (i) to consider agricultural landscapes as living cultural landscapes, which means that landscape protection needs to go beyond pure conservationist approaches; (ii) to ensure healthy agricultural economy in order to sustainably manage agricultural landscapes; (iii) to consider not only the physical landscape (crops, infrastructure) but also the intangible farming practices and their transmission when speaking of agricultural landscape management; (iv) to adopt systemic approaches including various actors, in particular farmers, to guarantee sustainable management of agricultural landscapes.

Keywords: Agricultural landscape; Switzerland; Tunisia.

Resumo

As paisagens combinam uma dimensão física e aspetos intangíveis relacionados com a perceção e a representação. As paisagens agrícolas são o resultado de uma combinação de fatores naturais (condições ecológicas, clima, topografia) e agronómicos (opções de cultivo, técnicas agrícolas e infraestruturas, como socalcos ou infraestruturas hidráulicas), bem como de fatores imateriais (práticas, saber-fazer, valores). São apresentados e discutidos quatro exemplos de paisagens agrícolas: paisagens relacionadas com um sistema de irrigação complexo com canais históricos, denominados bisses, no cantão de Valais, na Suíça; infraestruturas hidráulicas para a recolha de água e sedimentos - denominadas *jessour* - no contexto árido do sudeste da Tunísia; pastagens arborizadas nas montanhas cársicas do Jura, na Suíça; e, por último, a vinha em socalcos de Lavaux (cantão de Vaud, Suíça), inscrita na Lista do Património Mundial da UNESCO. A descrição das características agrícolas e paisagísticas e a panorâmica de alguns desafios de gestão importantes permitem propor quatro recomendações para a gestão sustentável das paisagens agrícolas: (i) considerar as paisagens agrícolas como paisagens culturais vivas, o que significa que a proteção das paisagens deve ir além das abordagens conservacionistas puras; (ii) assegurar uma economia agrícola saudável para gerir de forma sustentável as paisagens agrícolas; (iii) considerar não só a paisagem física (culturas, infraestruturas), mas também as práticas agrícolas imateriais e a sua transmissão quando se fala de gestão das paisagens agrícolas; (iv) adotar abordagens sistémicas que incluam vários intervenientes, em especial os agricultores, para garantir a gestão sustentável das paisagens agrícolas.

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Palavras chave: Paisagem agrícola; Suíça; Tunísia.

1- Introduction

Whatever they are, landscapes always have two components: a physical one – characterised by its geo(morpho)logical structures, its vegetation cover and various human components – anchored in a given geographical space, and an intangible one, linked to the perception and representations of this physical space by different groups of people. According to the Council of Europe Landscape Convention, adopted in Florence on 20th October 2000 (Council of Europe, 2000), landscape is "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors". From an analytical point of view, although landscape cannot be grasped in a total and univocal way (Backhaus, 2011), its different dimensions (sensorial, aesthetic, ecological, economic, political or identity-related) can be understood through a double axis (Backhaus et al., 2008; Backhaus, 2018): an axis ranging from the physical pole (nature) to the symbolic pole (culture) and an axis ranging from the subjective pole (relating to the individual) to the intersubjective pole (societal). The different dimensions "activate" these four poles to a varying degree: for example, the aesthetic dimension will be highly individual and linked to the cultural pole, while the ecological dimension will be essentially influenced by the physical pole (geological, hydrological and climatic conditions), and so on.

Agricultural land covers approximately five billion hectares, or 38 percent of the global land surface, from which one-third is cropland and two-thirds are meadows and pastures (FAO, 2020). As they cover more than one-third of the terrestrial land surface, agricultural landscapes are an important part of the World landscapes. As they correspond to areas more or less strongly shaped by human activity, agricultural landscapes may be considered as cultural landscapes, i.e. landscapes representing "combined works of nature and of man" that embrace "a diversity of manifestations of the interaction between humankind and its natural environment" (UNESCO World Heritage Centre, 2003, p. 7). Agricultural landscapes are the result of a combination of natural (ecological conditions) and human (labour, know-how, use of fertilisers and pesticides, etc.) factors. The natural component of agricultural landscapes derives essentially from climatic and topographic conditions. The human component derives as much from cultivation choices as from the development of specific farming techniques and infrastructures, such as terraced farming (Varotto et al., 2019) or hydraulic infrastructures (Wilkinson et al., 2015; Auvet, 2019).

Agricultural landscapes not only serve to food production (private goods) but they also provide a number of valuable ecosystem services, being immaterial (quality of life, recreation), support to biodiversity or protection function and natural processes regulation (e.g. erosion, wildfire, avalanches) (Schaller et al., 2018; Mueller et al., 2021; Bennett et al., 2021).

Over the last few decades, particularly in Europe, and mainly as a result of production-oriented agricultural policies and major demographic and socio-economic changes, many agricultural landscapes have undergone profound transformations, marked as much by the abandonment of farming activity (Varotto et

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al., 2019) as by intensification and mechanisation, generally resulting in a standardisation of landscapes (Ruiz & Domon, 2005).

In this article, based on research carried out at the University of Lausanne, I compare four examples of agricultural landscapes from the point of view of their agricultural and landscape characteristics and the issues relating to sustainable management of their landscape components.

2 – Four examples of agricultural landscapes

2.1- The agricultural landscape of the Valais *bisses*, Switzerland

Bisses in French (or *Suonen* in German) are the local names given to mountain irrigation channels developed at least since the 12th century in the catchment area of the Alpine Rhone in Switzerland (Fig. 1a). The valley is characterised by a double rain shadow effect, due to the presence of two high mountain ranges (the Valais Alps to the south and the Bernese Alps to the north) which protect the region from perturbations originating from the Mediterranean Sea and the Atlantic respectively. The valley's relative dryness – with annual rainfall of no more than 600 mm in the driest parts and a water deficit of around 2 to 3 mm per day in summer – meant that irrigation had to be used when agricultural productivity needed to be increased, firstly for demographic reasons in the 13th-14th centuries, and then for the development of export-oriented cattle farming from the 15th century onwards. By the end of the 19th century, after a new phase of construction driven again by demographic reasons, the network comprised at least 1,500 km of main channels and several thousand kilometres of secondary channels. From the early 20th century onwards, and especially after the Second World War, the *bisses* experienced a certain decline, as mountain farming was partially abandoned and people migrated to the towns and cities of Valais and the Swiss Plateau. It was not until the mid-1980s that this trend was slowed and even reversed, thanks to renewed interest in the *bisses* for cultural and tourist reasons.

From a landscape point of view, the *bisses* should be seen not just as infrastructure for transporting water from rivers to cultivated areas, but as a veritable hydraulic landscape made up of a multitude of infrastructures (water intakes, channels, storage basins, water distribution structures, secondary and tertiary channels, irrigation infrastructure (gravity, sprinkler and drip irrigation) scattered over large stretches of land). The channels themselves are of great interest to the landscape, whether in terms of their construction techniques (wooden channels hanging on the rock faces, channels integrated into certain terraced landscapes, specific structures for crossing landslides) or in terms of structuring the agricultural landscape in the form of bocage, with the tree hedges making it possible to follow the course of water through the landscape. This is a landscape heritage that is still little known and poorly promoted.

In terms of governance, the *bisses* are managed either publicly, by the communes (local municipalities), or by self-organised associations of landowners, known as *consortages*, which have been recognised as a successful example of common-pool resource institutions (Ostrom, 1990) and are now

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included on the national list of intangible heritage (Antonietti, 2012). Communes and *consortages* are responsible for transporting and distributing water, with irrigation itself being carried out by farmers. It is therefore a complex system combining public (communes), common (*consortages*) and private (farmers) rights and responsibilities. The new recreational and tourist function of *bisses* makes their management more complex. Hikers are new users, as are tourism service providers (tourist offices, for example), and the rights and duties of each party have not yet been fully stabilised, particularly in terms of financing tourist infrastructure and liability in the event of an accident. The increasing tourist interest is concentrating on the most spectacular *bisses*, leading to a certain disneyfication of the heritage, to the detriment of all the secondary heritage and practices spread throughout the territory.

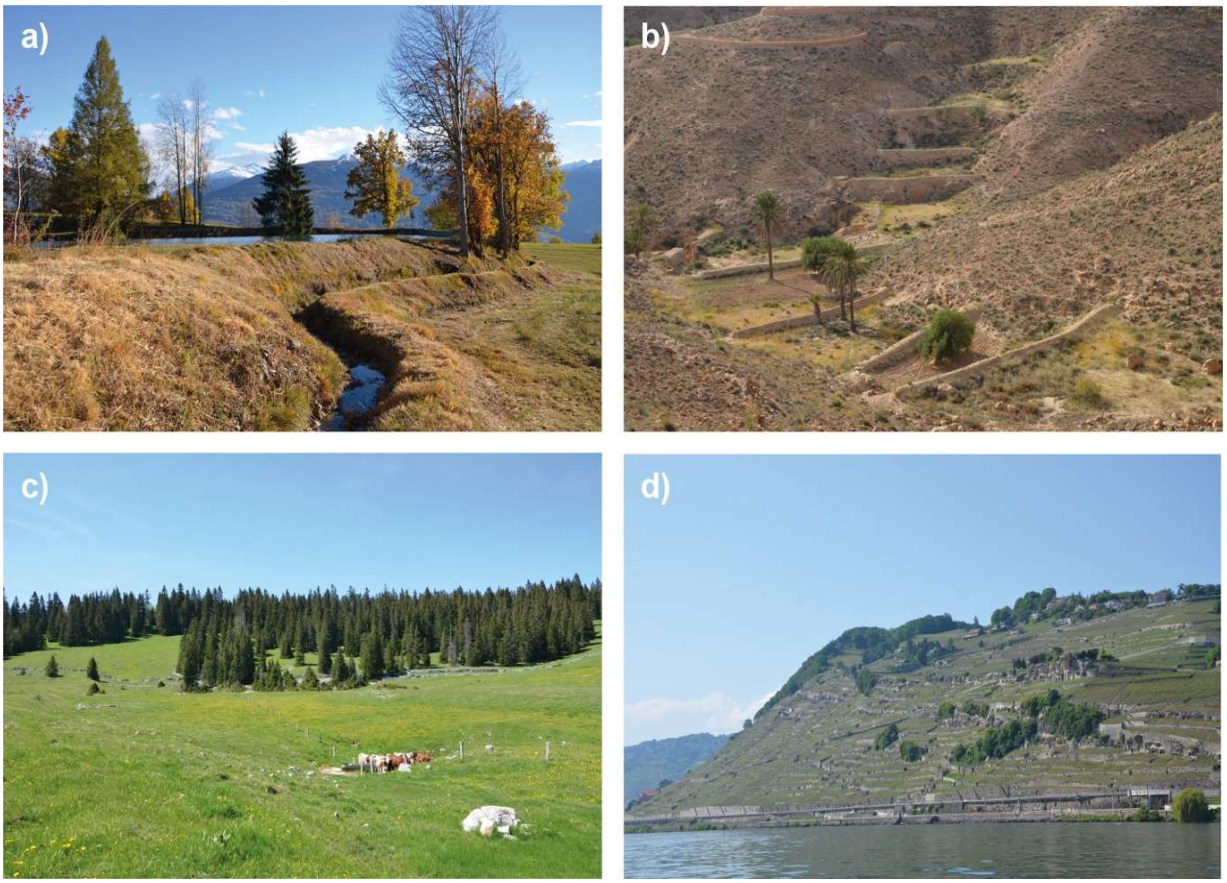

Figure 1 – The four agricultural landscapes studied. a) *Bisse* system in Savièse (Valais). The photo shows an artificial reservoir and a channel used to transport water to irrigate meadows; b) *Jessour* in Chenini (Southeast Tunisia). The dams allow harvesting water and fine sediments and practicing agriculture in a very hard climatic context; c) Wooded pasture in the Jura Mountains (Marchairuz). The differentiated pressure of grazing and the geographic distribution of water sources creates a variegated landscape; d) Lavaux UNESCO World heritage terraced vineyard (Rivaz). A built landscape made over thousand years of vine culture in a very steep context. All photographs by E. Reynard.

2.2- The *jessour* agricultural landscape in Southeast Tunisia

Jessour are a system of stepped dams along ravines and valleys drained by intermittently flowing streams (wadis) in Southeast Tunisia (Bonvallot, 1986). In an arid context, with rainfall lower than 200 mm per year and severe water balance deficit, their function is to temporarily store rainwater flowing rapidly during intense rainfall episodes and to favour infiltration (Ben Fraj et al., 2019). Reducing flow speed also allows fine sediments to be deposited, increasing soil fertility, and water erosion to be reduced, thereby preserving agricultural soils. The dams (known as *tabias*) delimit plots of land, the size of which depends on the geomorphological configuration of the talweg; very small upstream, sometimes comprising just a single tree, they tend to become larger downstream, where mixed cultivation in two or even three stages is practiced (Fig. 1b): annual crops on the ground (beans, grass, etc.) and arboriculture (olive trees, fig trees, almond trees, and date palms further south) on top (Ben Fraj et al., 2019). The plots are connected by a lateral or central weir, which allows some of the water to flow downstream and supply water to the plots located downstream. This technique substantially increases the water balance of the plots (Calianno et al., 2020; 2023) and pushes the ecological limits of crops, particularly olive trees, further south.

Jessour have several effects on the landscape. By allowing water to concentrate in the valleys and ravines, they strengthen the plant cover and add a green touch to the very mineral landscape of Southeast Tunisia. In this way, they play the same role as the oases around the waterholes. The *jessour* are also the mark of a built, highly anthropized, landscape, with walls and terraces visible from afar. Finally, together with the perched villages, the collective granaries *(ksour)* and the troglodytic dwellings, they constitute a regional landscape landmark, which is the result of the adaptation of societies to the hard hydroclimatic conditions of the area (Ben Ouezdou, 2001; Ben Fraj et al., 2019).

The smooth running of the system depends to a large extent on the balanced management of water runoff. The distribution of the rights and responsibilities of the various owners was codified in an eleventh-century document that demonstrates the desire to constantly seek a balance in the allocation of resources between owners and to make them responsible for maintaining the dams in order to preserve the subtle balance between water flow and erosion (Ben Ouezdou & Trousset, 2009). At present, the maintenance of the system is undermined by high levels of emigration and the corresponding decline in farming (Ben Fraj et al., 2019). Although a new interest in the heritage value of these structures is emerging, there is no guarantee that they will continue to exist and be maintained in the future.

2.3- The wooded pastures in the Swiss Jura

Wooded pastures are semi-natural ecosystems forming agroforestry landscapes resulting from mixed pastoral and forestry management (Gallandat et al., 1995; Buttler et al., 2009, 2012). Although legally governed by the forestry code, they include forestry features, mainly spruce, and agricultural features (extensive grazing). The density of forest cover is variable, ranging from totally treeless clearings to dense forest, with a whole intermediate range of forest density: non-wooded pastures (<1% tree cover), lightly wooded pastures (1-20%), densely wooded pastures (20-70%) and grazed forests (>70% tree cover)

(Buttler et al., 2012). Wooded pastures have a high biodiversity value, due in particular to the heterogeneity of herd pressure during summer grazing (Gallandat et al., 1995; Kohler et al., 2006; Buttler et al., 2009). These wooded pastures are the result of a long history of land clearance, which favoured the introduction of livestock farming in a karstic geomorphological context (Reynard & Schoeneich, 2021). The karstic nature of the substratum means that rainwater and snowmelt infiltrate very strongly, resulting in a certain paradox: while rainfall is abundant (1400-1600 mm per year) on the anticlines, surface water is reduced, and techniques for collecting rainwater from roofs and storing it in cisterns have been developed to guarantee sufficient water for the herds and for cheese-making. Climate simulations show that these landscapes are also highly sensitive to past and future climate change (Buttler et al., 2012; Peringer et al., 2013).

The variability of forest density results in a wide range of high-quality landscapes (Fig. 1c). Combined with techniques for collecting water and storing it in cisterns and the construction of kilometres of walls separating the communes, both in the pastures and in the forests, these wooded pastures constitute a cultural landscape, shaped by centuries of farming and forestry, typical of the Jura massif. They are one of the landscape emblems of the Jura mid-mountain massif (Canton du Jura, 2012; Parc du Doubs, 2015) and, while they have a high identity value, they give rise to a variety of perceptions, depending in particular on the density of forest cover (Miéville-Ott & Barbezat, 2005). These landscapes are multifunctional: they not only provide food for cattle (agricultural economy) and wood (forest economy); they also provide cultural services as support for recreational activities (hiking, cycling) and have an identity value for the local population. Sometimes, the reconciliation of tension between economic activities (agriculture, forestry) and recreational ones is difficult to attain.

Alpine pastures are generally owned by the local authorities, who in turn delegate their management to private individuals or livestock farmers' associations. These mountain pastures are currently facing a twofold challenge arising from climate change: the increase in summer droughts and heatwaves is a threat to the spruce (Vitasse et al., 2019, 2023), the dominant tree in the Jura, and the reduction in summer rainfall is reducing water reserves in the Jura's karstic environment, making it necessary to improve storage conditions. Over the last few decades, wooded pastures have undergone two contrasting developments: a trend towards closing off the landscape and increasing forest density in the least accessible areas, far from water sources and mountain chalets or with unfavourable topographical conditions; and a trend towards intensification in areas close to villages that are easy to farm (Buttler et al., 2009, 2012). The result is a simplification of the plant mosaic and a reduction in landscape diversity. It is therefore important to maintain balanced management of livestock farming to ensure that these areas remain both forested and agricultural (Canton du Jura, 2012). Research is currently being carried out on better management of water resources in order to guarantee water security, but also the landscape quality of wooded pastures: a balanced distribution of water sources makes it possible to maintain balanced pressure from livestock farming and preserve the open landscape character of these mixed forested and agricultural areas.

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2.4- The UNESCO World Heritage terraced landscape of Lavaux, Switzerland

Lavaux is a terraced vineyard in the canton of Vaud, Switzerland, inscribed on the UNESCO World Heritage List in 2007 (https://whc.unesco.org/en/list/1243/, accessed 10 August 2023). The vineyard is set in a particular geomorphological and morphoclimatic context (Reynard & Estoppey, 2023). The rocks, alternating conglomerates, sandstones and clay layers, are the result of sedimentation in a large alluvial fan in the foothills during the Alpine orogenesis, mainly in the Oligocene. The alternation of resistant layers (conglomerates) and softer layers (sandstone, clay) has favoured selective erosion, mainly by Quaternary glaciers. The steep slopes of Lavaux correspond to the edge of the glacial trough of the Rhone glacier, which eroded the basin of Lake Geneva. In the western part of the vineyards, richer in clay, the glacial retreat led to the development of large landslides, some of which are still active today. It is in this geomorphological context that terraced vineyards have been developed since the 11th century, initially by Cistercian and Benedictine monks, then maintained over a millennium of development and maintenance work on the terraces (Dresco et al., 2007). Generally speaking, the control of erosion is a major concern in the vineyard's management, and a number of specific techniques have been developed to manage water flow and reduce soil erosion (Reynard & Estoppey, 2021). At the turn of the 20th century, Lavaux became a tourist destination for its scenic and climatic qualities (Lüthi, 2006). With the development of the two metropolitan areas of Lausanne to the west and Vevey-Montreux to the east, Lavaux wine region came under heavy urban pressure from the end of the 19th century onwards, but especially from the 1960s onwards (Ruffy, 1979). The first measures to protect the vineyards were taken at municipal level in the 1950s, the principle of protection was included in the Vaud constitution in 1977, and a specific protection law was passed in 1979.

Lavaux vineyard is an exceptional built landscape (Fig. 1d), recognised by UNESCO as a living cultural landscape. It is the harmony between the geomorphological context (the slope), the terraced vineyard and the view over Lake Geneva and the mountains that gives Lavaux its exceptional character. The site has also been listed in the Federal Inventory of Landscapes of National Importance (IFP) since 1977, and the cultural component of the landscape is further enhanced by the historical villages, listed in the Federal Inventory of Built Sites of National Importance (ISOS). As a result, the vineyard is recognised as a heritage site both nationally (listed in various inventories) and internationally (World Heritage Site). Lavaux landscape provides numerous landscape services (Keller et al., 2019a,b; Reynard et al., 2021) to society, particularly in terms of quality of habitat, space for identification and aesthetic enjoyment. Several of these services are linked to intangible heritage components: the quality of the landscape and its long-term maintenance depend very closely on practices and know-how, which need to be passed on, while at the same time allowing winegrowing practices to evolve (LPm & UNIL, 2023).

The Lavaux vineyard is currently facing five main management challenges (Reynard & Clivaz, 2020). (1) Urbanisation: While urban sprawl, which was a problem in the 1960s-1970s, has been curbed by placing the site under protection, the main management challenge at present is to balance urban development

issues (mobility, energy transition) with heritage and landscape protection. (2) Winegrowing: Winegrowing in Switzerland and the Vaud region is facing strong pressure on prices. In the Lavaux vineyard, the cost of maintaining the terraces adds significantly to production costs, and the challenge is how best to balance the objectives of modernising agriculture and protecting the site. Financing the maintenance of terraces and infrastructure to protect against hydro-geomorphological hazards is a crucial issue. Another challenge is that of relocating wine production outside the protected site to rationalise the production and transport of wine; this could lead to a certain "museumification" of the villages located within the protected site. (3) Tourism: Inscription on the World Heritage List has strengthened the tourist dimension of the site, which has sometimes led to nuisances (damage to property, congestion in villages and on roads), but has not significantly increased wine sales. The link between the wine economy and the landscape needs to be better communicated to tourists (Reynard et al., 2019). (4) Socio-demographic issues: The core area of the site is suffering from an ageing population due to building constraints and a lack of housing. Gentrification is also taking place in the wine-producing villages. (5) Heritage: The search for a degree of landscape homogeneity within the site requires careful management of public spaces and private properties, and aims to avoid the accumulation of micro-changes that could ultimately alter the landscape quality of the site. To sum up, being listed as a World Heritage Site and in several Swiss heritage inventories entails a number of constraints for local residents, particularly winegrowers: finding the right balance between protection and socio-economic activities is the cornerstone for the management of this exceptional agricultural landscape.

3 – Challenges for the sustainable management of agricultural landscapes

The four agricultural landscapes described above have different characteristics and management issues. Table 1 summarises the main similarities and differences. Agriculture has various impacts on landscape, in the form of terraced landscapes (Lavaux) to adapt to the slope, mixed agricultural and forestry management (wooded pastures in Jura, and to a lesser extent, the bocage landscape of the Valais *bisses*) and also via hydraulic infrastructures (*bisses*, *jessour*). The examples chosen illustrate the management challenges of some major types of agricultural landscape – terraced landscapes (Varotto et al., 2019) and wooded pastures (Plieninger et al., 2015) – as well as the specific case of agricultural water infrastructure.

In all cases, there are climatic issues, but these have a varying impact on the landscape. In the case of the *bisses*, the main issue is the modification of the hydrological regime of the rivers, and therefore water scarcity, as in the karstic landscapes of Jura. In Lavaux and Southeast Tunisia, it is the extreme events that damage infrastructures such as dams (*jessour*) or terraces (Lavaux) that constitute the major management challenge.

Everywhere, agriculture decline – and its corollaries, land abandonment and the lack of infrastructure maintenance – is a challenge for the sustainable management of agricultural landscapes. In detail, however, the challenges vary, ranging from a lack of maintenance (*jessour*, *bisses*) to mechanisation difficulties (Lavaux) and structural changes in specific sectors of agriculture economy, such as milk production (Jura)

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or wine production (Lavaux). In the case of wooded pastures, a twofold development is highlighted: the abandonment of certain sectors and, inversely, the intensification of agricultural use elsewhere.

Lastly, some developments go beyond the agricultural sector itself. In most cases, difficulties in reconciling farming and leisure activities have been highlighted (*bisses*, wooded pastures, Lavaux vineyard). In some cases, the heritage value of the farming system is not (fully) recognised: Tunisian *jessour* are not yet truly recognised as cultural heritage and receive no financial support to maintain them, while "small" agricultural heritage (and associated practices) often struggle to be recognised (*bisses*, Jura hydraulic infrastructure). Lavaux, which is highly protected, presents specific challenges, such as gentrification in historic villages, the risk for the site of becoming a museum, and the difficulty of reconciling landscape protection with agricultural production. Finally, the Tunisian *jessour* are facing a problem that is less prevalent today in Switzerland: manpower emigration, which has a major impact on the maintenance of agricultural infrastructure.

Table I – Comparison of the four studied landscapes.

Challenges	***Bisses***	***Jessour***	**Wooded pastures**	**Lavaux**
Landscape	Hydraulic infrastructure, cultural landscape, bocage	Hydraulic infrastructure, cultural landscape	Mixed landscape (pasture, forest), cultural landscape	Terraced landscape, cultural landscape, World Heritage Site
Climatic issues	Changes in hydrological regimes	Extreme events, erosion	Water scarcity, forest degradation (spruce)	Extreme events, erosion
Agricultural issues	Agricultural decline, lack of maintenance	Agricultural decline, lack of maintenance	Agricultural decline, agriculture intensification	Agricultural decline, mechanisation,
Socio-economic issues	Maintenance costs	Maintenance costs	Milk market, wolf management, water scarcity	Wine market, maintenance costs, mechanisation
Socio-cultural challenges	Reconciliation agriculture / tourism; all the *bisse* system as heritage	Emigration; *jessour* as heritage	Reconciliation agriculture / forestry / tourism; mountain pasture as heritage	Reconciliation agriculture / tourism; gentrification; living cultural landscape
Management	***Bisses***	***Jessour***	**Wooded pastures**	**Lavaux**
Heritage management	Disneyfication recognition of agricultural functions and practices as heritage	Recognition as cultural heritage, tourism promotion	Management as cultural heritage	Private property *vs* common good; risk of "museumification"

Landscape management	Ecological infrastructure; biodiversity functions	*Jessour* as part of regional cultural landscapes (with *ksour*, cave dwellings)	Ecological infrastructure; biodiversity functions	Landscape as support of economy (wine, tourism)
Tourism	Agriculture *vs* tourism functions	To be recognised as a tourist value	Agriculture *vs* leisure activities in pastures	To make tourists buy wine
How research can contribute	System functioning, governance mechanisms	System functioning, water balance calculations	Water system knowledge, water scarcity modelling	Monitoring, socio-demographic surveys

Source: The author

On the basis of this brief analysis, four main issues are highlighted for the sustainable management of agricultural landscapes.

(1) Agricultural landscapes are **living cultural landscapes**. They have been created by human activity and their long-term maintenance depends on agricultural practices. However, there is a risk of considering only the aesthetic dimension of the landscape without its utilitarian dimension. In Lavaux, two opposing visions exist: some favour the aesthetic dimension and would like to freeze the landscape as it was at the time it was protected; others, notably Lavaux World Heritage association, which is responsible for managing the World Heritage site, understand that agriculture must be given room to manoeuvre so that it can adapt to new economic and climatic challenges. Indeed, if the wine-growing economy were to decline, the terraces could be abandoned and the intrinsic quality of the site would be severely degraded... a scenario that has already occurred in the Cinque Terre World Heritage Site in Italy (Brandolini, 2017; Brandolini et al., 2019; Moreno-de-las-Heras et al., 2019). Sustainable management of agricultural landscapes must include consideration of how farming activity is being modernised: landscape is not set in stone and managers must take account of how farming has changed over time. The challenge lies in coordinating the dynamics and needs of agriculture on the one hand and heritage and landscape protection on the other.

(2) The characteristics and quality of agricultural landscapes depend on the **economic health of the farming sector**. If it deteriorates, there is a risk that farmers will switch to other economic sectors or emigrate, leading to a reduction in infrastructure maintenance (terraces, agricultural hydraulics) and the abandonment (or extensification) of land. The end result is a degraded landscape (closed landscape, simplification of the landscape mosaic). The main function of agriculture is to produce food. It does not in itself has a landscape vocation, but its landscape functions can be supported either by the public authorities or by consumers. In Switzerland, since the early 1990s, agriculture's services of general interest have been

recognised and supported by the granting of direct payments for the functions of agriculture in the fields of biodiversity, landscape, sustainability and food security (https://www.blw.admin.ch/blw/fr/home/instrumente/direktzahlungen.html, accessed on 10 August 2023).

(3) A third challenge lies in the strong link between the physical aspects of the landscape, such as crops, vegetation and infrastructure (**tangible heritage**), and agricultural practices and know-how (**intangible heritage**) (LPm & UNIL, 2023). Behind the tangible heritage represented by agricultural landscapes lies an intangible heritage made up of farmers' practices and know-how. In all the cases studied, the quality of the tangible heritage stems from practices, often ancestral, for maintaining land and infrastructure. However, with the reduction in the number of people employed in agriculture and the trend towards mechanisation and optimisation of agricultural production, there is a significant risk that this know-how will not be passed on, or will even be lost altogether. In the regions studied, a number of initiatives have been set up to ensure that know-how is passed on (e.g. wall maintenance in Lavaux; waterproofing systems for the *bisses*). And measures underway to protect and enhance intangible heritage will contribute to the sustainability of agricultural landscapes. For example, two practices have been inscribed on the UNESCO's List of Intangible Heritage in 2023 (https://www.bak.admin.ch/bak/en/home/cultural-heritage/immaterielles-kulturerbe-unesco-lebendige-traditionen/immaterielles-kulturerbe-unesco-in-der-schweiz/repraesentative-liste-des-immateriellen-kulturerbes.html, accessed 22 August 2024): the alpine pasture season in Switzerland and traditional irrigation in Europe. In Tunisia, I am not aware of any concrete measures aimed at preserving the *jessour* and associated know-how.

(4) Finally, the examples discussed in this article highlight the need for **systemic management of agricultural landscapes**. Guaranteeing the ecological (habitat for species) and societal (aesthetic value, identity functions, support to health, sport and leisure activities, living environment) functions of these landscapes requires agricultural issues to be taken into account, whether they concern the agricultural economy, both locally, nationally and internationally, or agronomic issues, in particular adaptation to climate change. On the other hand, the landscape component must also be taken into account in agricultural activity. Farmers, as landowners and producers, but also as citizens (Primdahl et al., 2013), are key players in landscape management.

4 – Conclusion

In this paper, I have presented four examples of agricultural landscapes in various geographical contexts. A brief description of agricultural and landscape characteristics, as well as the listing of some important management challenges permits us to reach the following conclusion relating to sustainable management of agricultural landscapes: (i) Agricultural landscapes should be considered as living cultural landscapes, which means that landscape protection needs to go beyond pure conservationist approaches; (ii)

Sustainable agricultural landscape managements requires a healthy agricultural economy; (iii) Sustainable management of agricultural landscapes needs to not only consider the physical landscape (crops, infrastructure) but also the intangible farming practices and their transmission; (iv) Systemic approaches including various actors, in particular farmers, are needed to guarantee sustainable management of agricultural landscapes.

Acknowledgments

I warmly thank the University of Porto, in particular Prof. Helena Pina, for the invitation to deliver a keynote speech, from which this paper is issued, and the anonymous reviewer for useful comments.

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