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The Journal of Terraced Landscapes
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Introduction

Innovative perspectives for transformation of terraced landscapes

Timmi TILLMANN and Maruja SALAS

It took us some time until we decided to resume the edition of our Journal of Terraced Landscapes. We present here the first number of Volume 2, the peer reviewed Journal of ITLA. Since our editor in chief Lucka Azman Momirski passed away more than one year ago we have collected several peer reviewed scientific papers which do not belong to one special theme, as we had published before. Vol 1 Nr 1 was dealing with terraced landscapes inventories and Vol 1 Nr 2 presented a perspective of women in terraced landscapes. This time we expose the articles who give us valuable knowledge inviting all of us to continue these topics, to develop further reflections and studies as this is the method of science – not to have a result but new insights for understanding and to commit to the transformation of our rural ways of life. The order of the papers was decided on by looking into the territorial scope – from a smaller scale of terraced valleys in Germany and in Peru, then follows the nationwide study of terraced landscapes in Switzerland and finally we include a reflection of architecture and terraces in the mediterranean region as a contribution to consider the value of the landscape for our habitat design.

The first article by Boewingloh and Stumm describes with much detail the process of land consolidation of steep slope vineyards in the Lahn Valley (Middle Rhine) and emphasises the participation of the local villagers in the planning process and the reshaping of the abandoned terraced landscapes. An important element of the land consolidation process is to look back into the history of the rural life in this valley and to find out the extent of vineyards and the importance of viticulture in the rural society centuries ago. This model project interviewed elder citizens and analysed the forest cover to find out large range of dry-stone walls hidden underneath. Together with the citizens they cleared the overgrown fields and forests, contracted dry-stone wallers to protect the slopes, started new vineyards on the gained areas and built compensation areas as part of the land transformation regulations. As a result, hiking trails were created and secured, wine tourism was enhanced and a citizen's vineyard locally managed was established.

The focus of the article by M. Salas on nomenclature of terrace technology in the Andes is on the local Andean knowledge inherited since prehispanic times. The specific knowledge on soils, stones, water and plants is expressed in the language transmitted by wise elders, who reflect on the reciprocity of labour and knowledge in the social organisation of terrace agriculture. Colca Valley has a high diversity of corn varieties, which characterise the food culture of the communities. The author collects a variety of testimonies of men and women from 3 videos published by DESCO in 2014 and shows us a local soil classification, which can contribute to revise the external soil classifications and to offer relevant answers to very localized slope and terrace agriculture. We find new insights in the recognition of Pachamama (Mother Earth) as a living being, which needs to be protected and respected to be able to give us the diversity of food towards food sovereignty.

Going into a wider geographic scope we appreciate the detailed study by Liechti, Marmet and Schneider of the progress of an inventory of terraced landscapes of Switzerland based on detailed cartography and surveillance. ITLA started after the last ITLA Congress on the Canary Islands even before COVID with the task to organise inventories of terraced landscapes for each region. A working group started with criteria to define the state of the terraces in specific regions and its characteristics. We published Vol 1 Nr 1 with first results and a proposal by Lucka Azman on the importance and perspective of inventories as a future task for ITLA members worldwide. This previous issue included also approaches for the acknowledgement of terraced landscapes in Galicia and Canary Islands (Spain), the efforts to recover terraces in the stone village of Salamiou in Cyprus and the policies of maintenance of Tanada rice terraces in Japan. We presented and published a critical view about the limited inventory of Andenes in Peru from 2013 showing a discrepancy between the official inventory pointing out 350 T has as the total area of terraced landscapes (80% still in use) and our review estimating approximately 1 million has of terraced fields with 70% abandoned terraces.

The Swiss inventory is an important approximation to identify areas for maintenance and recovery of agricultural terraces mostly for wine but also for other food crops. We get a national picture of terraced landscapes differentiating the areas even for each canton. As the authors conclude it requires to go deeper with field visits and involving the local people to get even a more complete map of terraces to be able to undertake the transformation of the landscape. The inventories are not only ways to understand the landscape and its history, but they are also concrete instruments to work with the people for the strengthening of the local identity and traditions as a means for transformation.

Architect G. Pasquale from Pantelleria develops a focus on Italy and the Mediterranean region. She emphasises an architectural design with an active use of historical and cultural heritage. Terraced landscapes must be kept alive with living people and their local identity based on the stones in the landscape. Contemporary architecture must find a major connection with the terraces and using the stones as its essence. And she shows us examples of architectural design offering us the need for consciousness of architects and local peoples about their identity as mountain people living with stones. Another perspective of transformation at a much wider general range.

One of the oldest, but also most efficient, adaptations of humans to harsh living conditions is the terracing of steep mountain slopes in different climatic zones on all continents. Research and scientific studies on terraced landscapes have intensified in recent decades. Our Journal of Terraced Landscapes (JOTL) aims to contribute to these and focus on current, neglected and stimulating topics. We look for studies with insights and practical ways of valuing the knowledge for the transformation of the terraced landscapes as heritage of our ancestor's innovative knowledge and skills. In the future volumes we invite our readers and their networks to present scientific articles on Soils, Stones, Water, Biodiversity which let us experience the ingenuity of the terrace guardians since the neolithic revolution.

January 2026

Article

Frank Böwingloh (Germany)
(born in 1963 in Gütersloh) is a trained gardener and landscape architect and has been working at the Service Center Rural Area Westerwald-Osteifel in the state of Rhineland-Palatinate since 2004. He works as head of environmental planning in the field of land development and rural land consolidation. He has played a key role in the development and practical implementation of model land consolidation projects of statewide significance aimed at resolving land use conflicts in historically grown cultural landscapes. He is particularly committed to the sustainable combination of agriculture/viticulture, nature conservation, tourism, nutrition, and civic engagement. Frank Böwingloh is also a successful tour guide and is committed to preserving the craft of dry-stone walling throughout Germany.

Heiko Stumm (Germany)
(born in 1976 in Rhineland-Palatinate) studied geodesy at the University of Bonn. Today, he is deputy head of office and head of department at the Service Center Rural Area (DLR) Westerwald-Osteifel. In this role, he coordinates land development and rural land use planning measures. In doing so, he con-tributes to improving agricultural structures in rural areas, supports municipal and regional projects, and creates the conditions for water management and nature conservation projects.

Saving a steep slope relict vineyard landscape through an integrated model project of land consolidation in the Lower Lahn Valley

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ABSTRACT

With the model project of land consolidation in Rhineland-Palatinate, which was launched in 2012, an integrated planning approach made a significant contribution to the preservation and design of a steep-slope relict growing area in the last two steep slope municipalities of Obernhof and Weinähr an der Lahn in the Middle Rhine wine-growing region. The interests of viticulture, nature conservation and tourism were brought together in an exemplary manner. The bottom-up approach is pursued, in which various project and financing partners work together across municipal boundaries and use various rural funding instruments.

KEYWORDS

Citizen participation, steep slope viticulture, integrated planning approach, dry stone walls, land management

INTRODUCTION AND BACKGROUND

Relict Vineyard Landscape Lahn

Viticulture on the Lahn can look back on a history of more than 800 years. For many centuries it was an important economic factor and shaped the landscape and people with its maximum extension of up to 200 hectares in the 16th century. Especially in the lower Lahn valley, which is cut more than 200 m deep into the Rhenish Slate Mountains, terraced viticulture shaped the landscape with its slate dry stone walls, staircases, rock outcrops, stone harvest heaps and greywacke vineyard huts on the steep slopes facing south (Fig. 1). Due to the locally occurring flat greywacke, the "fish pattern" is traditionally shown in the "face" of the dry stone wall typical of the region.

The growing area became famous for its central role in the fight against phylloxera, which appeared from the end of the 19th century. Phylloxera could not establish itself in the Lahn Valley and was therefore an ideal location for state testing until the 1960s. In addition to many pruning gardens and model vineyards, the Prussian Rebveredelungsanstalt was

Figure 1. Historic terraced vineyard Schreiberley from 1934 with vineyard walls, Wingert hut, single pile technique, binding willow and rock as well as the regionally typical dry-stone wall with "fish pattern" (type II)

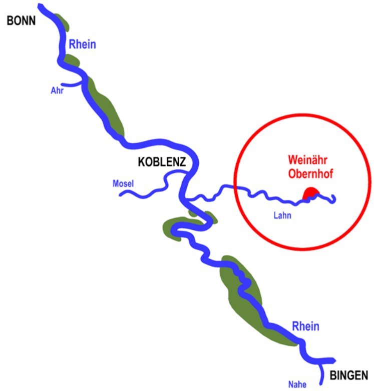

Figure 2. Relict wine-growing site Lahn in the Middle Rhine wine-growing region (left) (from DeutscherWein.de, modified) and the last two wine-growing towns Obernhof and Weinähr in the "fisheye perspective" with DJI Quickshot-Modus: Asteroid (r.)

founded in Oberlahnstein in 1910, which in 1925 rose to become the largest institution of its kind in Germany and left architectural traces in the landscape here. In 1971, the Lahn wine-growing region, which had become inconspicuous, was incorporated into the Middle Rhine region with about 10 hectares of cultivation area at the time. (Fig.2)

As a visitor today, there is not much left to see of the historic wine-growing landscape. Forest and isolated rocky outcrops characterize the valley again. However, if you look under the forest cover, you will still find many remnants of the former wine-growing landscape, as there was no over-formative successor culture here. Only 5.3 hectares of vineyards with 5 wineries and 7.5 km of vineyard walls are now relict cultivation areas in the wine villages of Obernhof an der Lahn and in the adjacent Weinähr am Gelbach. The labour difficulties with the high amount of manual labour in the steep slopes, as well as a secluded, almost forgotten rural area, ultimately led to one of the smallest contiguous wine-growing areas in Germany. The fact that the Lahn wine survived is ultimately due to the tourism that began in the 50s and 60s, which went hand in hand with the marketing of the now rare Lahn wines, and to a first land consolidation in the 1980s.

Starting situation

The historically shaped wine-growing landscape of the last two wine-growing towns of Obernhof and Weinähr is approx. 87 hectares. Today, more than 90% of these lie fallow and are mostly forested. The remaining vineyards form a mosaic of vineyard terraces, areas cultivated in the direction of slope and largely by hand, fallow and wooded areas and dry-stone walls. Steep slopes of 50 to a maximum of 78 % are reached. The five remaining wineries market their wines almost exclusively via direct marketing to customers. The demand for the rare Lahn wine exceeds the supply. However, the current bottle price does not adequately reflect the economic necessity in the still predominantly historically cultivated, property-fragmented steep site. For the survival of the farms, adjustments in modern cellar management, an increase in acreage, consolidation of vineyards, infrastructure, marketing and a significant improvement in the mechanical cultivation of the steep slope are necessary soon.

In Rhineland-Palatinate, the Lahn Valley, together with the other steep-slope wine-growing regions of the Middle Rhine Valley, Moselle, Nahe and Ahr, is of extraordinary importance for rare and highly endangered heat- and drought-loving animal and plant species. Many of these species reach their north-eastern distribution limit in the Lahn Valley. Due to the heavy bush encroachment following the abandonment of the vineyards, the habitats of characteristic species of the dry biotopes, which depend on extensive areas with little or no vegetation, disappeared. The current cultivation of the vineyards with the current cultivation recommendations, the widespread uniform use of machinery and the neglect of the maintenance of the vineyard walls leads to further restrictions for many of these specialised species. Remnants of the typical vineyard fauna are still present with wall lizard, smooth snake, blue-winged wasteland grasshopper, butterfly, wine crest, rock diver and ant lion. In Obernhof is the last pair of Rock Bunting on the Lahn. The last terraced vineyard on the Schreiberley, the open vineyard walls along the farm roads and an exceptionally thick 2,500 m^2 stone harvest pile (called “Steinrassel or Steinriegel”) in the Lahn Valley is a hotspot of this biodiversity. A further abandonment of the wine-growing areas or cultivation that runs counter to nature conservation would be the end of the accompanying typical flora and fauna in a few years.

The tourist offer in the Lahn Valley has so far concentrated on the activities directly on the river. The Lahn has been one of the most popular rivers for water hiking in Germany for decades. An accompanying long-distance cycle path and the Lahn hiking trail with its arrival and exit options via the parallel Mayen-Wetzlar railway line successfully complement these efforts. Heavily frequented campsites and increasing motorbike tourism are increasing the flow of movement in the narrow lower Lahn Valley. Due to the progressive forestation, however, the visitor hardly notices the former wine-growing landscape. In the last two wine-growing towns of Obernhof and especially in Weinähr, forestation is also increasing and accommodation, restaurants and wine bars are steadily decreasing. Only now, attractive tourist offers and impulses related to the wine-growing cultural landscape and the expansion of wine-growing areas can avert the trend reversal.

THE INTEGRATED MODEL APPROACH

Conception

The Lahn relict wine-growing region has an exceptionally high development potential for viticulture, nature conservation and tourism. It is a gem away from the well-known vineyards on the Middle Rhine and Moselle and is generously equipped with unique selling points. The region's economic and environmental prospects are very promising.

The model project of land consolidation aims to bring together the exceptionality, the beauty and the rarity of the still existing elements of the relic wine-growing landscape, the requirements of the strictly protected species, as well as the prerequisites for modern, sustainable viticulture in an integrative way and sustainably. The small-scale nature of the landscape and the historic wall elements are to be preserved, supplemented or redesigned as far as possible, despite modern mechanical viticultural cultivation. Necessary compensation areas according to nature conservation law should be sensibly interspersed in the cultivation areas and should also be managed as completely mechanically as possible. In order to increase the wine-growing area from 6 hectares to 15 hectares, former already bushy and reforested sites must be converted to make them suitable for viticulture. This change of use is subject to compensation under nature conservation and silvicultural law. A legally binding link between the new wine-growing area and the associated compensation area is to be sought. Due to the sensitivity of the rare animal and plant species and the large-scale redesign of the landscape, ecological construction supervision and a monitoring programme to check the effects with a follow-up of measures will be necessary.

The Lahn Valley is considered one of the most undiscovered regions in Rhineland-Palatinate. Not far from the conurbations of Koblenz, Frankfurt and Cologne, this is a real insider tip for tourism. For the nearby World Heritage Site of Bad Ems, the Lahn wine is an important unmistakable trademark with radiance for the entire region. To increase the number of visitors again, new impulses for tourism are urgently needed. Only an offer that has an impact beyond the region is forward-looking. The combination of innovative external services and an active grassroots participation of the citizens from the region are intended to show new ideas here.

The need for financial and content-related support is very great in the region. Added value can only be achieved through the integration and bundling of the various rural support instruments. Due to the high construction, approval and funding requirements, experience in the German funding landscape together with moderation tasks and citizen participation is indispensable as a key building block. Land consolidation can play a central role here and, with its own specialist staff, can take on supporting tasks for the responsible municipality.

Approaches to solutions in rural development

Rural development in Germany aims to preserve and promote rural areas as an economic and social area. Various instruments and measures are available for this purpose, which are described in the “Guidelines for Rural Development” of the federal state working group “Sustainable Land Development” (see https://www.landentwicklung.de/ziele/leitlinien-2011). The model project in the municipalities of Obernhof and Weinähr primarily addresses the areas of integrated development concept, LEADER, land consolidation, nature conservation, rural infrastructure and tourism.

On the initiative of the winegrowers, the project “Sustainable structuring of viticulture on the Lahn” was launched in 2008 as part of the Integrated Rural Development (ILE) Lahn-Taunus. This project opened the possibility of securing viticulture on the Lahn for future generations on the one hand and improving networking with other existing or emerging projects on the other hand. Based on this, the Westerwald-Osteifel Service Centre for Rural Areas (DLR), as the responsible land consolidation authority, prepared a project-related study (PU), the results of which were incorporated into the Obernhof-Weinähr land consolidation procedure initiated in 2012

LAND CONSOLIDATION PROCEDURE OBERNHOF-WEINÄHR

Land consolidation in Germany is an officially led procedure for the reorganisation of rural properties. According to the Land Consolidation Act, various goals can be pursued, such as the improvement of agricultural production conditions, the preservation and promotion of the cultural landscape, the protection of nature and the environment, the development of rural areas and the safeguarding of property. The land consolidation comprises various measures, which are described in detail below, based on the Obernhof-Weinähr procedure.

Space management

Land management is the central task of land consolidation. It includes the recording, valuation and redistribution of the plots of land, considering the wishes and interests of the owners and tenants. To counteract the management task and thus the loss of viticultural, nature conservation, landscape aesthetic and tourist value, a new use and development concept was developed in coordination with the state conservation goals, which also considers the prerequisites for mechanical cultivation in cable or direct trains. The different demands on the use of the landscape could be harmoniously combined here by creating a balance between the interests of viticulture and the interests of species and biotope protection as well as the preservation of the traditional landscape.

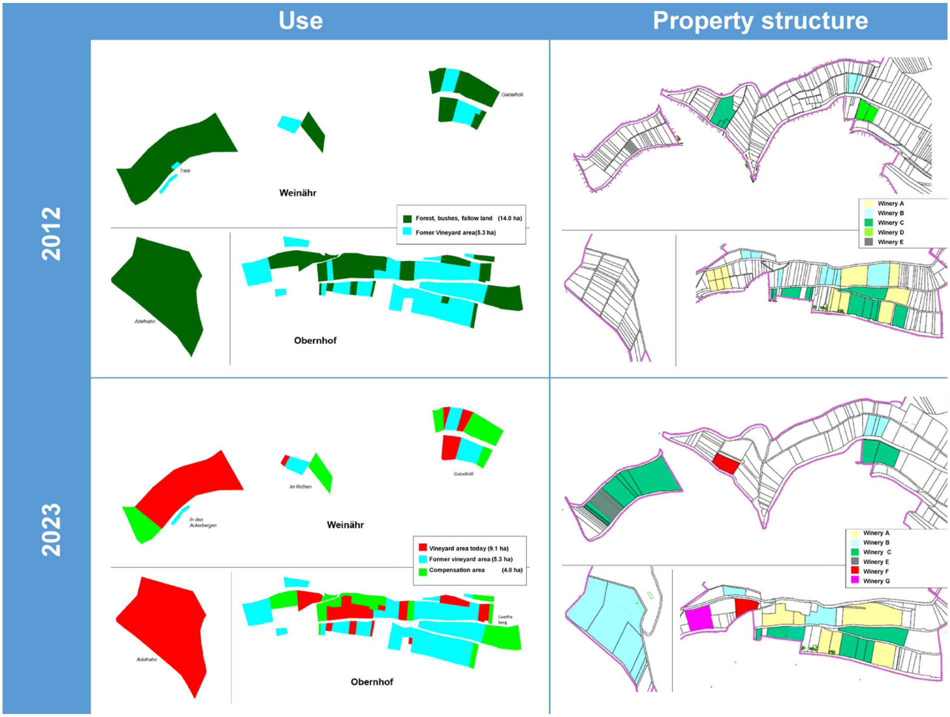

Figure 3. Use (left) and property structure (right) of wineries before and after land management

During the redesign of the process area, larger cultivation units were formed in the vineyards and the area under cultivation was almost tripled. In 2012, seven wineries shared a vineyard area of 5.3 ha, and in 2023 after the merger, six wineries shared a vineyard area of 15 ha. In addition, there are 4 hectares of open-land compensation areas (see Fig. 3). This means that today's open cultural landscape, which is dominated by viticulture, will once again reach 19 hectares in use. Of the historically shaped wine-growing landscape in Obernhof and Weinähr, about 21% have thus been made viticultural sustainable again and are visible again in the landscape.

Measures

The planning of all measures was worked out together with the board of the participating community (TG) and the planning approval for the construction of the measures as well as the modification, relocation and confiscation of existing facilities was prepared. The board is elected by the participants in the land consolidation as a representative of all owners. The involvement of this body ensures that all local concerns are considered. Finally, the planning approval of the structural and design measures establishes the admissibility of the projects about all public interests affected by them. In addition to planning approval, other official decisions, in particular permits, permits and permits, are not required. The planning approval regulates all public-law relationships between the developer of the project and those affected by the planning in a legally structured manner. Public concerns, such as the preservation of the landscape or biotopes, are also considered.

The structural and design measures carried out as part of the land consolidation are referred to as investment measures. They serve to improve the agricultural infrastructure, enhance the cultural landscape and promote nature and environmental protection. The integral land consolidation procedure is therefore a very powerful instrument for the implementation of complex land planning projects.

With a few exceptions, the process area was sufficiently developed by main farm roads that were predominantly paved with bituminous pavement. However, in view of the increased use of crawler mechanisation systems (RMS) for the cultivation of vineyard areas planned in the future, improvements in the development of the vineyards were necessary. For this purpose, mainly grass paths were newly created or expanded on existing lanes. Most of the cultivated areas have been developed with paths in such a way that the RMS can be used

Figure 4. New vineyard wall with safety rail (left) and insertion of the RMS from the trailer (right)

by a special trailer with an associated tractor running above the rows of vines. This also applies to some of the compensation areas. However, some areas were not accessible in this form, so that the installation of safety rails (a total of 280 m) including the necessary operating stairs above the rows of vines was necessary for the RMS. (see Fig. 4)

In addition, along many sections of the path on the valley side and partly also on the mountain side, retaining walls made of natural stone dry masonry, with a height of up to 4 m, were in danger of collapsing and therefore urgently needed restoration. In some cases, sections of the Wall had already completely collapsed and had to be rebuilt. Many crowns of walls that were basically still stable also showed damage that had to be repaired. The required new stone material (greywacke) was selected according to colour, structure and format, with special consideration of the existing natural and landscape image.

With the new construction or restoration of approx. 2,100 m^2 and the release of 4,000 m^2 of dry-stone walls, a significant contribution was made to the preservation of these

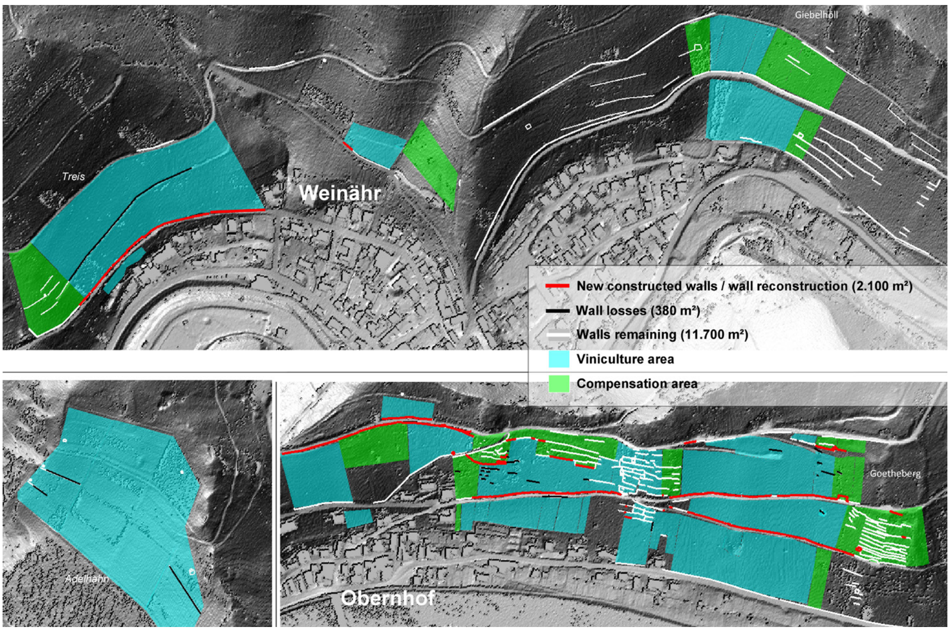

Figure 5. Wall balance after land consolidation

individual elements that characterise the landscape (see Fig. 5).

Another extensive package of measures is the production of the areas used for viticulture. As part of the land consolidation, the vineyards were redesigned to enable optimal cultivation in the future. All new vineyards and the compensation areas were newly planted on former vineyards, some of which were heavily forested and fallow. Grading was carried out only to a very limited extent to remove obstacles to the future mechanical cultivation of the vineyards or to maintain the compensation areas and was mostly related to the removal of walls (see Fig. 6). The old walls in these areas, usually up to one metre high, were demolished where necessary and levelled in the area. Usable stones from the removal of walls were reused in the construction of walls.

The necessary change of use from forest, bushes and fallow land to new vineyards as well as the removal of vineyard walls and the construction of paths are subject to the intervention regulation and must be compensated for in accordance with applicable nature conservation law. In addition, species protection requirements must be considered in the planning.

For the change of use, a total of 4 hectares of compensation areas in the form of fallow vines and orchards had to be implemented by the TG. After five years of furnishing maintenance, permanent maintenance is expected to be handed over to a person liable for maintenance from 2025. For this purpose, a legally binding linking and allocation of the new vineyard area (private owner and using winegrower) and compensation area (usually owned by the local municipality) is carried out as a model. Here, sustainable maintenance of the target biotope is guaranteed as long as cultivation takes place on the new vineyard area. All other structural changes were compensated for by the restoration or new construction of vineyard walls and vineyard huts.

Since 2018, ecological construction supervision has been taking place, including a monitoring programme to check the effects. This resulted in additional follow-up measures during the construction work. The planting of flower fringes made of certified

Figure 6. Restoration of wine-growing areas with regard to existing structural relics (2017 o., 2018 m. and 2023 u.)

seeds from the region along the wall heads and wall feet, including a sustainable care concept for the neighbouring farmers and the local communities, are particularly noteworthy here. The monitoring of the specified construction time windows and the adaptation of these specifications to the local conditions is another important task. The production maintenance of the compensation areas will also be further reviewed until it is handed over to the maintenance party and, if necessary, further optimised ecologically and

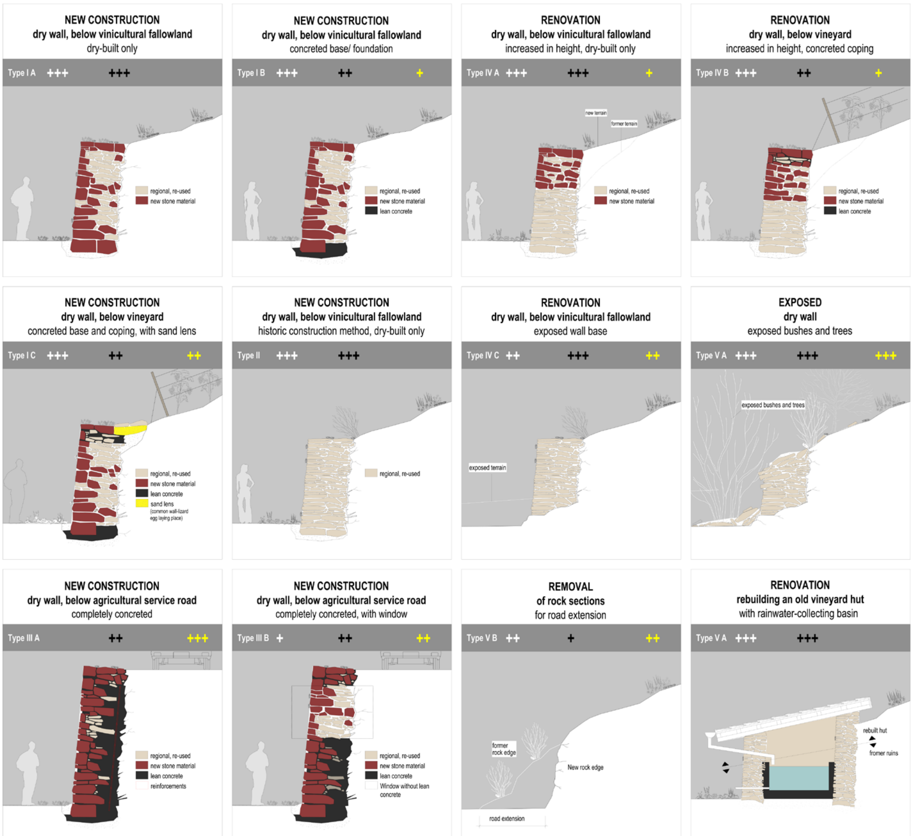

Figure 7. Different types of walls implemented reflect the different usage requirements (white = nature conservation, black = landscape, yellow = economic efficiency; Demand: +++high, ++medium, +low, none)

economically. The greatest challenge for the ecological construction supervision, however, was the structural improvement in the construction of the wall or the construction of new walls from the point of view of species protection for the strictly protected small population of the wall lizard, which lives here at its distribution limit.

During the implementation, various locally adapted solutions were implemented in cooperation with the ecological construction supervision in wall construction to meet the different demands on economic efficiency, nature conservation and landscape (see Fig. 7).

The high increase in area of exposed, restored and newly rebuilt dry-stone walls and the enlarged mosaic-like flower-rich open land area showed the first successes for species protection shortly after the construction measures. Many strictly protected heat- and drought-loving species (e.g. smooth snake, sail butterfly, blue-winged grasshopper, praying mantis, ant lion) were able to spread over the area and in some cases record large population increases. The last rock bunting occurrence in the Lahn Valley could be maintained, and further breeding attempts have already been observed in other places. The wall lizard also shows an expansion into the many newly created habitats. Particularly pleasing was the rapid recolonization of the oldest terraced site in Obernhof from the 1860s, which was uncovered in 2020 (see Fig. 8).

Figure 8. The terraced complex "Cassiopeia", which is valuable for nature conservation and tourism, before (left) and (right) after the exemption

In the land consolidation planning, quantitative and qualitative improvements for existing and new hiking trails in connection with other funding projects (LahnWeinStieg, Lahnwanderweg and Gelbacht-Trail) could be considered. Here, missing connections were created in an attractive route and expansion quality with many new experience highlights as part of the land consolidation. The merger of the last two wine-growing towns has thus received a very decisive boost in the perception of the visitors. The large-scale removal of trees has cleared many historical landscape elements such as vineyard walls, vineyard huts and stone depots. They were processed in terms of content, partly rebuilt and prepared for later funding projects.

Many new sightlines, vantage points and landscape sub-spaces were created for the visitor (see Fig. 9). The nature conservation efforts in biotope and species protection and especially the new abundance of flowers on the paths and wall edges as well as on the compensation areas are particularly noticeable to the visitor. The perception as an independent, open wine-growing landscape with exciting stories and the very special natural features is showing its first successes. The Lahn-Taunus tourism region is once again increasingly focusing on the last two wine-growing towns on the Lahn in its external presentation and offer. The quality, the special feature and the rarity currently contribute to the fact that the region is a real insider tip with a rapidly increasing number of visitors.

Figure 9. New insights into a tourist vantage point before (2010) and after (2023) the land consolidation on the Alte Poststraße in Obernhof with a view of today's Citizen's vineyard.

Execution work

A large part of the expansion work was carried out by the Association of Participating Communities (VTG) itself. For this self-directed work, the association has specialist construction workers, measuring assistants, machine operators and construction supervisors at its disposal throughout the country. The machinery and equipment include self-propelled machines and construction equipment. Due to the many years of experience of VTG's workers and their specialisation in land consolidation work, VTG's own management work is an integral part of the implementation of land consolidation procedures. In the Obernhof-Weinähr land consolidation procedure, only a few measures (e.g. rock stabilisation measures with rockfall protection nets and clearing work), for which the VTG's existing machinery is not designed, were awarded to external companies. The work on the vineyard walls was carried out almost exclusively by experienced VTG employees who have been working exclusively on them for many years in the vineyard land consolidation (see Fig. 10). This work is monitored as part of the official construction supervision of the land consolidation authority in conjunction with ecological construction supervision.

Figure 10. Work on a nature conservation wall by the VTG

Costs and financing

The costs and financing of the land consolidation depend largely on the scope of the planned measures. The personnel and material costs of the authority organisation are borne entirely by the state of Rhineland-Palatinate. The processing team at DLR Westerwald-Osteifel in Montabaur is made up of qualified personnel from various departments (surveying, construction, landscape management and administration). 90% of the expenses for the construction of the common facilities, as well as the material and non-official wage costs incurred in the surveying, marking and valuation of the parcels, are covered by grants from the federal government and the state of Rhineland-Palatinate. The remaining 10% of the costs are borne by the local municipalities of Obernhof and Weinähr as well as the active winegrowers. The project costs up to the present time amount to around € 3.2 million.

INTEGRATED FUNDING PROJECTS

In addition to land consolidation, other funding instruments from the European Union, the federal government and the states are available in rural areas, which, if optimally combined and supplemented, can achieve an enormous financial and substantive advantage for the entire region. In addition, there are other projects resulting from the legally enshrined nature conservation compensation obligation. Land consolidation is suitable as a central integrated planning instrument here (see Fig. 11).

The integrated LEADER and Nature Park projects are presented below. Projects that contribute to the further upgrading of the district, mainly without direct participation of the land consolidation, are, for example, the installation of a wine vending machine in Weinähr, the construction of a new guest toilet and the construction of a landscape swing on the LahnWeinStieg. In Obernhof, it is the Lahnufer family playground, the redesign of the train station and the new installation of the electric boat charging stations on the banks of the Lahn. In addition, there is the construction of dry-stone walls as a compensation measure for construction work by Deutsche Bahn. In the neighbouring community of Seelbach, the financially complex restoration work in the nearby pilgrimage site "Kloster Arnstein" is having an effect. In addition, there are various funding measures

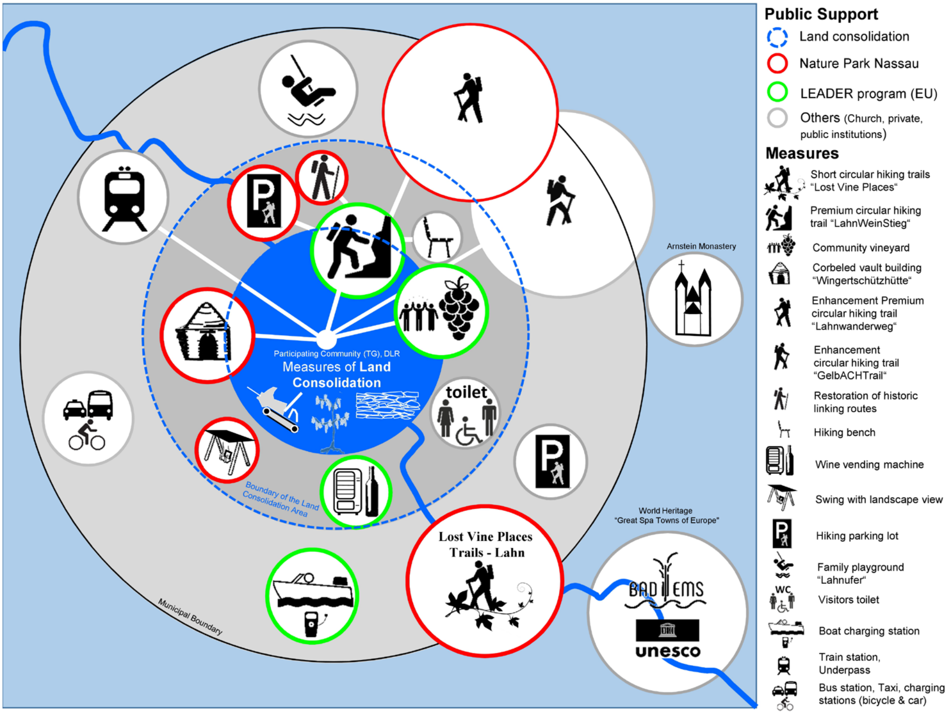

Figure 11. Land consolidation and integrated funding projects with long-distance effect – land consolidation as a central integrated planning instrument for the preservation of the Lahn relict wine-growing landscape in Obernhof-Weinähr

in the district town of Bad Ems as a UNESCO World Heritage Site "Great Spa Town of Europe".

LEADER

LEADER stands for "Liaison Entre Actions de Développement de l'Économie Rurale", i.e. the combination of actions for the development of the rural economy. LEADER is a methodological approach to regional development: it enables people in rural areas to develop their region together. This approach has been used in EU Member States since the 1990s. In the new EU funding period from 2023 to 2027 www.netzwerk-laendlicher-raum.de/dorf-region/leader/leader-kurz-erklaert/, there are 372 LEADER regions in Germany; almost 2700 across Europe. Obernhof and Weinähr are in the LEADER region "Lahn-Taunus". The following LEADER projects were implemented within the framework of the old LEADER funding period 2014-2020 (extended until 2022):

LahnWeinStieg

The cross-community Lahn-Wein-Stieg is designated as an approx. 11 km long dream tour (certification and signage according to the criteria of the German Hiking Association). With the help of a new type of information transfer and trail equipment, the wine-growing tradition and the cultural landscape are to be made accessible to tourists in an eventful way. The hiking trail is intended to make the region, its history and, above all, the Lahn wine better known. A varied mixture of hiking, landscape, culture, wine and enjoyment is intended to provide guests with a beautiful overall experience (see Fig. 12).

The Lahn-Wein-Stieg with its 570 meters of altitude can be walked in one hike in about 4-6 hours. The path is classified as a difficult route for hikers. It is also possible to divide it into

Figure 12. The LahnWeinStieg with varied and eventful routing and modern infotainment

three individual circular tours: Adelhahn (4.6 km), Weinähr (4 km) and Obernhof (3.5 km). The easy to moderately difficult climbing passages (Adelhahn, Gotheberg, Gipfelkreuz) pose three special challenges. A variety of views of the Lahn and Gelbach valleys and 31 adventure stations including 6 installations along the route with topics on viticulture, nature conservation, mining, fruit growing, ice cellars, Gelbach, timber transport, building culture and Goethe (see Fig. 13) provide variety.

The new information transfer and route equipment (design, scenography, architecture, infotainment, manual installation), signposting and certification are funded by the Lahn-Taunus LAG. The costs for the accompanying concept planning, including the implementation of workshops, as well as the "story building" used for the first time for hiking trails and the construction of the paths and paths, will be funded almost entirely from land consolidation funds. Only the section of the "Adelhahn-Steig" that runs outside the land consolidation area is financed by the Nassau Nature Park and Touristik Bad Ems-Nassau. Today, the LahnWeinStieg is one of the top hiking trails in the region, connects the two wine villages sustainably and attracts tourists and wine lovers from near and far. It receives the best ratings from visitors and is also very well

Figure 13. Curiosity attracts! – A historic test tunnel, staged with storytelling, connects mining with viticulture.

received by families with children. It has already become the flagship of the Lahn wine-growing region.

Citizens' vineyard

As part of the Citizens' vineyard project, a citizen participation model is being developed for the cultivation of two historic vineyards. The idea was born in 2018 on historic wine-growing sites in Obernhof and Weinähr and was tested and implemented across municipalities between 2020 and 2023 with the help of the LEADER project "Model Project Citizens' Vineyard". In order to determine a suitable form of organisation and participation as well as a perspective for further economic development, external scientific support was consulted during the project. This resulted in the organizational form "geweinschaft e.V." in 2021. Everyone interested in wine now can participate in the project. This can be to join as a sponsor of vines or as a member of the association. For both forms of support, active work in the vineyard is desired. Part of the work is carried out by the members, the work with the use of machinery by a contractor. Today, the Citizens' vineyard is mainly financed by the sale of its own wine production, by sponsorship and membership fees and by the proceeds of educational work on the Lahn wine cultural asset. The "Vinovent" information centre in the centre of Obernhof serves the association as a starting point for hikes and courses. These rooms are available to visitors for wine tastings at weekends during the main tourist season (see Fig. 14).

Figure 14. Participation and financing model "Bürgerweinberg" (pictures of geweinschaft e.V. from left to right): active work in the Weinähr vineyard, the current Wine Queen 2022/23 of the Middle Rhine growing region Verena Schwager as a vine godmother, the planting of the historic vines in the zig-zag path and the association-run vinotheque "Vinovent" in Obernhof

The project now has 2,750 newly planted vines on two sites with a total area of around 6,000 m^2 and two new vineyard huts built according to historical models. So far, the areas have been actively looked after by two paid viticultural experts, the so-called Wingertschützen. In Obernhof, a historic pruning garden from 1905 of the then Royal Institute for Fruit and Viticulture in Geisenheim was restored with modern cultivation conditions (see Fig. 15). In the sense of a test facility, PIlzWIderstabil grape varieties and individual old table grapes are grown here. The first wine of the new vines was harvested in 2022. On a vineyard site that has been known for centuries, another modern vineyard with two PIWI varieties was built in Weinähr in 2021. The first wine could already be tasted from the old vines in 2021. The main varieties in both vineyards are "Souvignie de gris" and "Cabernet Cortis". In 2023, the Geisenheim University of Applied Sciences – Institute for Vine Breeding, as the successor organization to the old school, provided the project as a historically connected partner organization with 75 historic vines in 10 different grape varieties that stood in the original pruning garden in Obernhof. These are the historic vines: White Heunisch, Yellow Orleans, Lambert grape, Medoc, Milton, Muscat St. Laurent, Chasselas musqué, Orange grape, Gold Riesling, Grüner Veltliner). Further information can be found on the project homepage www.geweinschaft.de.

Nassau Nature Park

The Nassau Nature Park is a national protected area and one of nine "National Natural Landscapes in the State of Rhineland-Palatinate". As a special-purpose association of the two districts of Rhein-Lahn and Westerwald, the nature park is a purely non-profit institution and supports measures in the areas of land conservation, nature conservation

Figure 15. The pruning garden II Obernhof of the Royal Institute for Fruit and Viticulture in Geisenheim, built in 1902 (photo from the 1920s), serves as a historical model for today's Bürgerweinberg in 2023.

and nature-friendly tourism. The project funding of the nature park contributes to the implementation of the action programme. (www.naturparknassau.de). Project funding plays an important role in the development of these goals in the region. Here, the initiative of local citizens is essentially supported in manageable, mostly smaller, unbureaucratic projects. Overall, this funding instrument is an ideal partner for the integrated approach. In connection with the land consolidation, two funding projects related to and supplementary to the LahnWeinStieg and the local history of viticulture should be mentioned. They ideally complement the nature conservation and tourist destinations:

Trails

The premium long-distance hiking trails "Lahnwanderweg" and the premium circular hiking trail "LahnWeinStieg" were conceptually and in terms of planning integrated into the land consolidation procedure. Small sections of these hiking trails were outside the land consolidation area and were funded by the nature park at the request of the local communities. These are measures to restore historical paths, which Johann Wolfgang von Goethe already rode with his donkey cart on his Lahn hikes in 1774. The installation of a landscape swing, a climbing passage and the preparation of a new hiking car park complete the hiking trails.

Wingertschützhütte Obernhof

In the land consolidation, large areas of historic wine-growing areas were freed up. In addition to wall relics, many ruins of the former Wingerthütten also came to light. In cooperation between the nature park, the local municipality and the land consolidation authority, these buildings were then mapped, measured and further historically processed. A total of about 40 buildings could be recorded in both districts. Its history of origin is recorded in the 1920s/1930s. Two of these huts, which are still preserved in the foundation walls, are attributed to a year of origin from the second half of the 20th century. They served the so-called Wingertschützen or Flurwächter as a shelter, which was supposed to prevent grape thefts and drive away birds, among other things. One of these huts was built in the 1860s in connection with the oldest vineyard terrace in Obernhof, which still exists today. It is assumed that this is an unusual building construction for the Lahn Valley with a cantilever dome roof made of stone without mortar. This makes this hut one of the oldest known buildings in the vineyard around Obernhof and Weinähr and a nationally valuable figurehead for the history of viticulture on the Lahn. With the reconstruction, the local municipality of Obernhof wants to make this historic site directly on the premium hiking trail "LahnWeinStieg" accessible to tourists again. At the same time, the special construction of the hut in dry stone wall construction with many gaps and crevices between the stones creates a habitat for wall lizards, for example.

The reconstruction of the 4x4m Wingertschützhütte could be implemented in the first half of 2023 with financial support from the nature park and planning and organisational support from the land consolidation authority (see Fig. 16). Mostly on weekends, stone on stone was placed by volunteer, mostly experienced dry stone wall builders and helpers from the region until the foundation wall, which was over two meters high, was completed. Construction was carried out without the use of major machines.

At the beginning of May, the roof construction in cantilever dome construction was then in-structed by two experts from the Dry-Stone Wall School of Austria from the Wachau. Here, too, the use of machines was completely dispensed with. Stones weighing up to 320 kilos were hoisted to a height of three metres via a ramp, in the manner of a pyramid building, so to speak.

In the end, there were about 85 tons of stones in 1,400 hours of helpers, all of which were dragged and set by hand. It is assumed that such a structure in the Federal Republic of Germany, in this way, i.e. without formwork, freely bricked and without the use of mortar or plaster, has probably not been built for 100 years. The project shows the high level of commitment of the local people to the winegrowing tradition and at the same time highlights the project as a milestone in the preservation of this ancient craftsmanship.

Figure 16. The reconstruction of the Wingertschützhütte Obernhof an der Lahn in 2023 was a major craft event with nationwide appeal for all planners, experts and helpers involved and represents a new highlight on the premium hiking trail "LahnWeinStieg" (Photos Stefan Tannenberg).

SUMMARY AND FINAL EVALUATION

In the land consolidation procedure, the existing vineyard area was expanded from 5.3 ha to 15 ha plus 4 ha of fallow vines as compensation areas with corresponding infrastructure. For the use of crawler mechanisation systems (RMS) for the cultivation of vineyards, 280 m of safety rails including the necessary operating stairs as well as new and improved farm roads were created. Mechanical cultivation is now possible on almost all vineyards. Two historic terraced sites were preserved or freed from woody plants. With the new construction or restoration of approx. 2,100 m^2 and the clearance of 4,000 m^2 of dry-stone walls as well as the reconstruction of two Wingert huts, essential landscape-shaping individual elements could be made visible again. The costs of the land consolidation procedure to date amount to around €3.2 million, 90 percent of which are funded by the federal government and the state of Rhineland-Palatinate.

Overall, the most valuable winegrowing relics could be preserved, made visible again or renewed. During the expansion, the wine-growing area has blended into the relics like a mosaic in sensitive areas, or large-scale revitalized wine-growing areas have been created under modern economic conditions. The prerequisites for sustainable viticulture (infrastructure, structural measures and legal certainty through re-surveying) have been created. The operating hours have fallen sharply on the steep slopes. In 2023, part of the grape harvest could be carried out for the first time with the steep slope full harvester.

The active wine-growing area was tripled. The historic vineyard terraces can remain in cultivation if sufficient other profitable areas are available. The demand for Lahn wine, food and accommodation has increased sharply due to the great public interest and the tourist and landscape valorisation.

The conditions for the recolonisation potential of the typical vineyard fauna and flora have improved greatly through the targeted planning consideration, including ecological construction supervision and an accompanying monitoring programme. In particular, the consideration of the construction time windows, the generous planting of flower-rich fringes and fallow vineyards as well as the nature conservation optimisation of the dry-stone walls are having an impact on the area. Most of the specialised species with a distribution margin in the Lahn Valley show positive final developments. The mixture of new construction and construction, preservation and clearance of forested dry-stone walls is positively reflected in the resettlement pattern. The compromise in wall construction, which is individually adapted to the local situation, consisting of economic efficiency, landscape and nature conservation, is a long communicative and legal balancing process between all the interests of use. A milestone for sustainability is the legal linking of new wine-growing area with an allocated compensation area. Here, the new land user or beneficiary is actively forced to deal with the topic of nature conservation.

Tourism also benefits significantly from the integrated approach. The funding projects "Lahn-Wein-Stieg", "Bürgerweinberg" and "Historical reconstruction of a Wingertschützhütte" set new valuable attractions in the region with a sharp increase in visitor numbers. It pays off in the long term to invest in quality and unique selling points with correspondingly high professional standards and financial resources. This shows that only by bundling funding projects can a region survive in the nationwide competition for tourist numbers. Attraction points suitable for the masses in this narrow, small-scale landscape are not expedient here and would be interchangeable at will. The claim of soft tourism has so far been fulfilled by actively bringing together innovative ideas from outside and municipal initiative by the land consolidation authority. The Lahn region has already become a real insider tip in a short time. In total, public funding of approx. € 4.5

million has currently been used in Obernhof and Weinähr. In the long term, however, the economic valorisation depends on how much the local and regional population, or the entrepreneurs benefit directly from it. It is known from other regions that there are time shifts of several years between supply and demand. This means that advance payments and a lot of patience must be made, especially in the current tense macroeconomic situation. A slight improvement in the accommodation and gastronomy sector can be seen in the two wine villages after just a few years. In the end, there is the question of the success of the monetary transfer to those who ensure the long-term preservation of the Lahn relict wine-growing landscape both in terms of viticulture, cultural history and nature conservation.

The model project on the Lahn will not yet be completed in 2023, but the independent holistic planning instrument, including the implementation of measures, is already showing clear successes for the future viability of the small growing area. In addition to the central task in the approval procedure and in land management, the land consolidation authority was able to take on other integral control and steering tasks. As a central player in moderation processes, as a partner and technical companion, as a source of ideas and supporters in the funding landscape and in project design, land consolidation has so far been able to meet the high-quality standards together with the local people.

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Article

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Nomenclature and Local Knowledge in Terraced Agriculture in the Peruvian Andes: An Intercultural Perspective

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ABSTRACT

This article presents an appraisal of ideas generated by extant scientific studies and oral testimonies. The focus, nomenclature and local knowledge is a way to highlight the conceptual universe from the perspective of local people in the terms and categories they use in describing and explaining stone walls, irrigation canals, classification of soils and crops. These names convey the meaning attached to the slopes transformed into agricultural terraced landscapes in the Colca Valley in Arequipa, Peru. The acknowledgment of both sources of ideas, scientific and local, follows the purpose of creating wider horizons of understanding terraces within a process of intercultural dialogue by building epistemological bridges between knowledge systems. This is an essential step to bring about fruitful transformations of terraced agriculture in the Andes.

KEYWORDS

agricultural terraces, local names, local knowledge, Andean region, intercultural perspective

1. INTRODUCTION AND PURPOSE

The reflection on the possibilities of intercultural dialogue is embedded in a scenario of a complex epistemic divide that can be traced by the disruption of Andean Civilization in the XVI century. In this article we deal with contemporary knowledge production on terraced agricultural land focusing on the ideas achieved by scientific and local knowledge systems. Our aim is to widen horizons of conceptual understanding to build epistemological bridges as opportunities to envision the future of terraced landscapes.

Agricultural terraces are visible, material infrastructures in mountainous regions entailing a "world of names, a world of terraces, a world of diversity" (Murtas and Tillmann 2018:28). Terraces are elaborated in singular, unique, diverse cultural forms of perceptions of the environment beyond the simplistic dichotomy between material culture and symbolism, contesting the accepted formula that the landscape is a one-way result of cultural action upon the physical environment. Therefore we propose to rethink agricultural terraces as a dynamic and mutual process by which a particular cultural conception shapes nature and at the same time human transformations resonate on the way knowledge is constructed (Altman and Chemers 1984; Abram 1996; Berkes 1999).

Our objective or concern in this article is to focus on how local names in agricultural terracing disclose cultural perceptions of the physical environment revealing a knowledge and practices attached to specific meanings that uncover values and norms of a cosmovision inextricable link to nature (Toledo 2008; Maffi and Woodley 2010). Taking for granted that no conceptual or terminological system is superior nor can one culture impose or assume its cultural conception upon another, this article proposes an intercultural dialogue (Mall 2000; Dietz 2018). The particularities of intercultural dialogue surpass an exchange of information and validation of facts and introduce us into an epistemic interaction between knowledge systems. This is a process that involves local narratives of people explaining their ideas and beliefs about the environment that might seem "counterfactual" to the modern scientist (Anderson 1996). The spirit of dialogue entails equality between subjects of knowledge with the full capacity to explain the world in their own terms and categories. Therefore the aim of this article is bridging epistemologies between scientific and local knowledge in order to arrive to new understandings of terraced agriculture. The vision ahead is to jointly visualize a repertoire of multiple possibilities for the future of local and global society. It opens democratic and creative opportunities for mutual enrichment of ways of knowing and cultural diversity to overcome the modern crisis (de Sousa Santos 2014).

2. STRUCTURE AND METHODOLOGY

The presentation of the results derive from focusing on two different knowledge traditions: on one hand bibliographical academic studies dealing with the topic Andean terraces and on the other hand relying on testimonies in which local actors engage themselves in making sense of their own construction of their narratives. (Geertz 2000)
Therefore this article starts from an overview of contemporary scientific knowledge selecting pioneering perspectives and the ideas that have set the foundations for the achievements of multidisciplinary studies about terraced landscapes.

The second and core section of this article deals with local knowledge. It is dedicated to the presentation of agricultural terraces in local voices. These local knowers describe and explain in their own words, terms and categories the stonewalls, water canals, soils and crops in the communities where they live, Yanque, Cabanaconde, and Coporaque located in Colca Valley, Caylloma, Peru. We also acknowledge particular scientific studies that bring local voices closer to the purpose of establishing epistemological bridges between scientific and local knowledge systems.

This article concludes with a conceptual effort to understand Andean terraces as a process of cultural diversity emphasizing the multiple connotations of the term Pachamama. It is an appeal for more inclusive, symmetrical and empowering relations between science and local knowledge in the future, reflecting upon fruitful ideas actions for intercultural dialogue between scientific modern knowledge and local knowledge.

3. SCIENTIFIC KNOWLEDGE ABOUT ANDEAN TERRACES

3.1. Denominations of Andean terraces

The following terms in Spanish, Quechua, Aymara introduce a cluster of generic words related to terraced agriculture documented in dictionaries opening the world of names in the past and the present:

Anden, andenes, andenerias: are the Spanish terms for agricultural terraces that appear in chronicles written since the first years of the Conquest of Peru, in the 16th century. These expressions refer to the cultivated terraces, platforms, benches and field staircases; constructed with stonewalls, which covered the Andean mountain slopes. These words are "purest" Spanish and have been incorporated in the common vocabulary of all Peruvians. British historian Markham included in his Quechua-English dictionary the word a*nden* as a Quechua term, but as Juan de Arona explained in 1883 it is an error (de Arona 1974).

Pata: is the Quechua name for terrace, *pata-pata* for staircase terraces and *pata patachani* means the action of building terraces. These terms were registered by the Spanish Jesuit priest Diego Gonzales Holguin (1560-1620) compiled in the 'Vocabulario de la lengua general de todo el Perú llamada lengua Qqichua' (*Vocabulary of Quechua language)* published in 1608 in Lima (Gonzales 1952).
Pata-Pata: is the Aymara term for retention walls built with stones to avoid soil erosion in the high mountain slopes, registered in Ludovico Bertonio (1555-1628), an Italian Jesuit, who dedicated 25 years of his life to compiling the Vocabulary of Aymara language published in Lima (Bertonio 1612).

Patilla and *Pata*: are Quechua terms for slopes with agricultural terraces registered in the *Reflected Vocabulary of Andean agrarian activities. Agrarian Quechua terminology* by Ballón et al. (1992).

3.2. Pioneering sources

O.F. Cook, son of a stonemason and a professional botanist says "the people who did this finest ancient work are not only gone and forgotten, but lack even the distinction of a name" (Cook 1916: 474). His seminal works using high quality photographs and vivid scientific descriptions rendered homage to the anonymous builders of Machu Picchu, Pisac, Ollantaytambo, and the terraces around the Vilcanota and Urubamba Rivers. Cook correlated the origin of terraces to societies with most advanced agricultural developments.

Donkin (1979), a British historian and geographer, dedicated his investigations between 1966 and 1969 to study agriculture terraces in the Highlands of Middle and South America. He focused on terracing in different ecological habitats where agricultural societies reached an advanced stage of development as plant breeders in diverse forms of land cultivation.

A corroboration of the diversity of agricultural terraces are the various names used, nomenclature, related to constructions in the New World—some with exclusive defence purposes, others combining defence with agricultural purposes like *andenes* and *pucara* in Peru and *trincheras* in northwest Mexico. Other terrace names meaning "raised fields", related to agricultural use exclusively, are *gradas* or *graderías, tablones, terraplenes*, *bancales* and *llanadas*. In the Venezuelan Andes these are known as *poyos* or *apoyos*. The Náhuatl word *katáltin* describes the ancient irrigated terraces above Texcoco in the Valley of Mexico. In Peru and Bolivia, agricultural terraces are named *pata*, *suca*, in Quechua and in Aymara *taka*, *takha*, *takhana* in Aymara, the name of *humacas* are for the terraces with coca cultivation. (Donkin 1979)

Donkin underlines the potential of further investigations in the field of nomenclature, especially in indigenous languages, to disclosure the importance and deeper meanings granted to terraced landscapes. In the Peruvian Andes Donkin identified and described more than one hundred terraced sites providing photos and rich bibliographic sources.

3.3. Andean ecological diversity

In the 1930s, the Peruvian geographer Javier Pulgar Vidal set the foundations for a new approach to understanding the Andean environment. Based on the collection of innumerable names of places, toponymy, from indigenous knowledge and languages, he recognised recurrent pattern of variability. After many years of systematic classification He structured them by areas according to altitude, climatic conditions, flora and fauna, production of crops, and human transformations, resulting in a vertical sequence of eight regional categories (Pulgar Vidal 1981).

This section elucidates Pulgar Vidal's eight regions: *Chala*, *Yunga*, *Quechua*, *Suni*, *Puna*, *Janca*, *Rupa-Rupa and Omagua*. Each one is inserted in a delicate web of interconnected elements of reciprocal relationships, underlining the intertwining of nature and culture in the Andes, in which we include that of agricultural terraces.

Chala (0 to 500 MASL) are areas of persistent fog, a longitudinal thin strip of desert along the Pacific Ocean interrupted by 53 transversal rivers flowing downwards from the Andes into the Ocean. It was the habitat of fisher groups, hunter-gatherers who lived more than 10,000 years ago. After many generations these groups gradually domesticated animals and plants such as maize, cotton, lima beans, peanuts, beans, chilli and fruits like *lucuma, pacae, palta, camote* and developed agricultural knowledge to transform the natural desert into cultivated land.

Chala is the area of the first civilization in the Americas: in 3000 BCE the stone city of Caral was erected with formidable masonry conceived as an agro astronomic calendar system, and the modality of social relationships extended systems of exchange networks with other ecological zones, including the tropical forest (Shady 2008).
The Agrorural Inventory establishes that less than 2% of *Chala* territory is covered with agricultural terraces and all were abandoned a long time ago (Agrorural 2021).

Yunga, is the region of temperate valleys (500–2,300 MASL) located higher than the line of the irrigation channels of the *Chala*. The narrow gorges of the *Yungas* are covered with terraces, e.g. in Poma Ticlio, Santa Eulalia and Songos in the Rimac Valley, Pacarán in the River Cañete and elsewhere that continue into the *Quechua* Region. Probably they demanded the greatest efforts to their builders due to the stony and steep slopes. Some of the retention walls are 2 to 5 m high. The terraces built up the slopes are considered to provide optimal conditions for the crops of the *Chala*, including the cultivation of *coca* (Erytroxylum coca). These terraces still impress as hanging gardens irrigated by canals called *huayanchas*.

The inventory of Agrorural (2021) reports that only 2% of agricultural terraces are located in the *Yunga*.

Quechua is the temperate zone (2,300-3,500 MASL) that fluctuates in temperature. During the day it gradually reaches 20 degrees Celsius and at night the temperature drops drastically, in the cold season down to 8 degrees below zero. The term is also used for the denomination of culturally diverse groups of people who live in *Quechua* Valleys.

The agrobiodiversity in the *Quechua* Valleys is represented by crops like maize (Zea mays), squash (Curcubita moschata), caigua (Cyclandera pedata), granadilla (Passiflora ligularis), llacón (Polymnia sonchifolia), numia (Phaseolus sp.), pashullo (Erithrina edulis), papaya de olor (Carica pubesces) and sacha tomate (Cyphomandra betacea).

Some 80% of agricultural terraces are located in the *Quechua* region of Central and Southern Peru and probably still in use (Agrorural 2021).

Suni are high and cold areas (3,500 - 4,000 MASL) clearly distinguishable by their rugged relief at the western and eastern flanks of the Southern and Central Cordilleras. The inhabitants of these areas have built stone houses since prehistoric times that endure until the present. Thousands of agricultural terraces have been constructed on these sharp gradients. The term *Suni* is not applicable in the northern Andes since the mountains are lower, not so cold, humid and not so rough, therefore in the North this zone is named *Jalca*.

The *Suni* region is known for its great diversity of Andean crops like *mashua* (Tropaelum tuberosum), *quinua* (Chenopodium quinoa), *cañigua* (Chenopodium canihua, Chenopodium pallidicaule, Chenopodium hastatum), *achis* (Amaranthus edulis, Amaranthus cadatus), *tarwi* (Lupinus tauri, Lupinus mutabilis), *olluco* (Ullucus tuberosus).

An estimated 5% of all agricultural terraces are located in this region, and are rain-fed mainly in Cuzco and Puno where most of them are located and are almost abandoned. In the Suni region of Puno there are also the agricultural systems of *Camellones*, raised fields and *Qochas*, water ponds in the plains (Agrorural 2021).

Puna are elevated areas (4,000-4,790 MASL) with extreme daily and seasonal oscillations of cold temperatures, below 0º, and maximum temperatures of 22º and 25º centigrade. The *Puna* is near the beginning of the Andean snowcaps.
This region has a wealth of cultivated and uncultivated varieties of potato (Solanum tuberosum), with other agricultural technological evidence of the *Puna* as a centre of origin.

Janca (4,800-6,768 MASL) are highest areas at the top of the valleys arranged in a discontinuous cluster of summits covered with white snowcaps in the eastern and western Andean chains. The most famous mountains are Huaytapallana, Sara Sara, La Viuda, Huascarán, Huaylillas, Ampato, Coropuna, Ananea, Palomo, Vilcanota, Yanasinga, Ausangate, Salkantay, Pariaqaqa. Local cultures address them respectfully as *Apu*, referring to their protective character as providers of local identities within territories. Also attached to the mountains is a symbolic dimension associated with water sources, *pakarinas,* places perceived as the origin of life (Carrion Cachot 1955).

The *Janca* are areas of very rich species of grass, herbs, moss and lichens and the region where the vicuñas and alpacas graze since they are best adapted to the cold and high altitude.

Rupa-Rupa is located at the basin of the eastern flank of the Andes, at an altitude ranging between 400 and 1000 MASL. This region of mountains, gorges, hills, slopes, and valleys offers the best conditions for innumerable species of fauna and flora. Some examples of the hundreds of original trees species of the *Rupa-Rupa* are *Sacha -pashullo* (Erythrina sp), *Hoju* (Ficus glabrata) and *Huampo* (Ochroma lagopus).

According to the Inventory of Agrorural (2021) the ancient agricultural terraces in this zone have been covered by tropical forest.

Omagua is the tropical forest region where the Omaga people live, known also as the region of abundant freshwater fish since the Amazon River flows through it. It is a hot spot of biodiversity with a high concentration of indigenous people, whose knowledge systems contain the key to guaranteeing sustainable living. As such it represents a model of nature and people living harmoniously.

3.4. Agricultural terraces: A growing multidisciplinary field for policy action

In the years after de Agrarian Reform of 1968, the millenary agricultural tradition of Andean terraces entered in the academic debates to propose scientific knowledge to overcome the agrarian crisis.

De la Torre and Burga (1986) compiled an important state of the art of academic articles generated by 20 researchers from different disciplines focusing on raised fields and agricultural terraces, evidencing a rich milestone production of knowledge. These challenging reflections triggered insightful research trends as well as policy action recommendations that still encourage the current debates on alternatives to the agricultural crisis in Peru. Portocarrero (1986) concentrates on the topic of soil erosion affecting the livelihoods of Andean agriculture in mountainous areas as a physical and social problem. The analysis proposes national policies regarding conservation practices, like the agricultural terraces among others, for the promotion of development of Andean territories.

The topic of conservation and abandonment of agricultural terraces edited in 19 research articles reveal an increasing and rich field of studies of the terraces in Andes of Peru

(Llerena et al. 2004). The book compiles articles from the point of view of scientists in history, economy, archaeology, anthropology, sociology, culture, ecology, climatology, geomorphology, agronomy, edaphology, hydrology, forestry and technology, and establishes multiple lines of research and action considering old as well as new challenges like climate change and environmental protection. An extensive bibliography about agricultural terraces of the Central Highlands prepared by a multidisciplinary team closes this important state of the art.

3.5. Scientific achievements

For five hundred years, the colonial perceptions of nature summarized with the terms *Costa*, *Sierra*, and *Selva* (Coast, Highlands and Jungle) had prevailed. The work of Pulgar Vidal set a new basis for understanding diversity and variability in the Andean space. The construction of an ecological typology of the Central Andes recovering the local names, renaming the natural regions based on indigenous knowledge can be interpreted as a form of symbolic empowerment. It is a process of rehumanising the landscape, reinforcing the identities of local groups with their environments and the feeling of belonging to the land.

The conceptual frame linking the organization of social relationships with the multifaceted mountain ecology known as Verticality Model guides the logic of maximum use of the diverse regional differences for agriculture and applies in general to Andean agriculture and in particular to agriculture terraces. The ecological models of verticality are a rich intellectual legacy that reinforces and increases the variability of natural conditions at micro scale for the abundance of crop diversity. This human made variability has a key creation in the Andes: the multiple agro astronomical Calendars, technical and ritual based knowledge for the predictability of the climatic conditions. (Murra 2017; Earls and Cervantes 2015; Mayer and Fonseca 1979)

Having in mind the Andean ecological variability of the wide spread spatial distribution of terraces, there are noticeable regional differences product of diverse independent cultural developments (Kendall 2008). For example the *andenes* of Andamarca in Ayacucho constructed in *Huari* style masonry prior to the Inca (Aguirre-Morales 2009) disregard the theories that identify the Inca State as the centre of technological diffusion. Throughout the historical development of agricultural terraces there are observable cultural regional differences. Some examples of these differences are recognised in the Inca monolithic masonry of Ollantaytambo (Cook 1916) that contrast with the fine complexity of the terraces from the Cabana and Colla people in the Colca Valley (Cook 1916, Denevan 2002). The terraces in Abancay result from a web of transformative processes of Aymara people, Chanca and Inca influence (van Dalen 2011). The Yauyo people in Huarochiri constructed different regional styles of agricultural terraces absorbing the local knowledge of a mosaic of ethnic groups melted within the course of their evolution (Aguirre-Morales 2008).

One can conclude that terraces are more a matter of a plurality of endogenous regional developments as a process of general expansion of one type of technology (Kendall 2008, Denevan 2002, Cook and Cook 2011).

Another manifestation of diversity is the combination of agricultural systems. For example, in the Chala region terraces, *lomas* and *tendales* are similar structures to manage the smooth slopes with specific purposes, which are distinguishable (Canziani 2007). In the higher zones of *Quechua, Suni* and *Puna*, one can find a cluster of agricultural systems like *Sucacollos:* high raised fields, *Qochas:* water reservoirs, *Aynocas:* sectorial rotational farming, that share basic ecological traditional knowledge in dealing with climatic variability, water, soils and use of tools (Erikson 2000, Flores Ochoa 1986, Mujica 1979).

We close this section on scientific achievements recognising the conceptual contributions that have generated in-depth studies that provide specific intellectual elements to understand Andean agricultural terraces. These scientific approaches to terraced fields explain the diversity of cultural landscapes in the Andes in terms of the conceptual links between Andean agriculture, environment, society and culture. In the next section we open the opportunities of intercultural dialogue by concentrating on people's voices, the protagonists who keep the terraces as living landscapes.

Figure 1. Location of the communities and snow-cap mountains in the Colca Valley mentioned in the testimonies (elaborated by Jorge Novo)

4. TESTIMONIES OF LOCAL KNOWLEDGE ON AGRICULTURAL TERRACES

This section aims at opening an indispensable step for intercultural dialogue between two knowledge systems. It consists in creating the space for local knowledgeable men and women to express themselves in their own cultural terms and categories and construct the world of names and ideas on what and how they know about the terraces they are conducting in their communities. For that purpose we have transcribed and translated each one of the oral testimonies from three videos elaborated by DESCO (2014 a, b, c). In the case of referring to written sources we specify them. The explanations using a world of names about stonewalls, water canals, soils and crops disclosing the uniqueness of local knowledge in the Colca Valley will unravel the challenging attempt to identify epistemological bridges between scientific and local knowledge.

4.1. Dionisio Checa, master rehabilitator of terraces, describes and explains how to maintain stonewalls and aqueducts in his community Yanque, Colca Valley, Caylloma district, Arequipa

This testimony comes from two sources, a written one that was presented at the Second International Conference on Terraces (Tillmann and Bueno de Mesquita 2015), and the other one results from the video *Rehabilitación de andenes* (Rehabilitation of terraces) (Desco 2014a) in which he walks along the paths of the terraces and water channels in his community explaining his perceptions and ideas.

"Terraces are an ancient technology built many generations ago, a legacy that is worth conserving. The rehabilitation of the terraces is initiated with a *pago,* an offering to *Pachamama,* Mother Earth, arranging *coca* leaves *(Erytroxylum coca)*, *chicha* (maize beer), fire and burning aromatic herbs on a flat stone. The presence of all the community members is required to renew the rules of reciprocity between *Pachamama* and the crew of terrace workers called *cuadrillas,* or *waijes*, brothers and sisters. There are traditional forms of reciprocity such as *minka, ayni*, as well as daily payment. The role of women is indispensable - cleaning weeds from the walls and the preparation of food and *chicha,* so that the crew feels at ease during the work.

An *anchaca* is a retaining wall built with carefully placed stones, working from the base, from larger to smaller, according to size. *Base* or *cimiento* is the foundation of the wall dug 50 cm into the soil. *Zapata* is the part of the wall above the foundation that reaches a height of approximately 30 cm. *Pirca* or the body of the wall is the technique of placing irregular stones articulated to the foundation, following the contour of the level, slightly inclined inwards. The width of the body of the wall varies. It decreases as the height of the wall and the size of the stones increases, and the height of the wall depends on the original slope of the terrain. The *filtro* (filter) of the wall is the arrangement of stones and gravel of different sizes inserted into the wall, which allows water to drain from the terraces.

Pata is the embankment, platform or bank of the platform where the crops are grown. It is covered by a top layer of 50 to 80 cm of soil from the hillside or transported from elsewhere. Below this layer of soil, that is, in the subsoil, there are two more layers, one of stones of different sizes, whose function is to drain and another layer of rubble and sand waterproofed with clay soil. *Bordo* is the 50 to 60 cm high edge made of accumulation of earth that protects the terraces below by stopping excess water from flowing down when we irrigate the platforms.

We distinguish two types of gradients in the platforms, longitudinal and transversal, that are important in ensuring the proper circulation of water so that the water runs and does not escape from the edges. The main irrigation is related to four types of ditches or canals according to the flow of water they carry:
The *orccoyas* distribute water from the head of a sector to three or more terraces. They are

Figure 2. The terraces spread along the Colca river watershed, a legacy worth conserving (Photo Timmi Tillmann)

made of cobblestones and the water is distributed through inlets, *acequias de bajada*, which deliver water to both sides of the terraces, and are made of cobblestone and often have paths for animals and people. *Pakchas* are stone structures that allow the rough water to fall from an upper platform to a lower one where there are *k'alchas*, the long flat stones that have been placed laterally and at the bottom of the *pakchas*, to prevent the falling water from damaging the stonewall. They are also channels to cushion the force of the water; they have a double function, irrigation and drainage. *Wiqchunas* are drainage ditches located at the end of a group of terraces.

Zarupas, charq'eñas and *patiqllos* are groups of four to six protruding stones that are distributed obliquely along a platform wall. They serve as recessed steps that allow quick access to an upper or lower platform. They also form a visually attractive V shape on the stonewall and the repetition of this motif creates a beautiful order. *Pukara* is a projecting stairway parallel to the wall with carefully secured stone steps. It is located on the front face of the wall and is used for oxen to access the platform. *Jatun Pukara* is a transverse staircase that joins several platforms and is located parallel to the descending ditches. It is built of stone in such a way that it avoids water erosion. *Jatun Pukara* has a dual function, in some cases as irrigation ditch and also a path to give access to agricultural work to farmers and animals.

*Utahalla*s are cobblestone structures located under the agricultural soil. They may have a door in the front of the wall. They are used to shelter from the rain and cold as well as to store agricultural implements. The *Piedra Caja* is the sacred place of the terraces, where offerings are deposited annually to the *Pachamama*, Mother Earth, an agricultural ritual of respect and gratitude."

Figure 3. Stonewalls and water canals compose an aesthetic and functional unity in Yanque (Photo Timmi Tillmann)

4.2. Marcelino Llaza Inca describes and explains the irrigation system in Yanque Hurinsaya in the Colca Valley

This testimony comes from the Video *Sistemas de riego en andenerías* (Irrigation systems in terraced lands) elaborated by Desco (2014b).

"Our water comes from the Nevado Mismi, the snowcap mountain, the source of Yanque Urinsaya's irrigation system. The spring flows 25 km down like waterfall providing water to the main irrigation ditch. The four *Apus*, sacred mountains, feed the springs that form the main, old canal called *Mismi*, which flows into *Ccochapata*, the pond where water is stored at night. This water is our life, our subsistence. The water continues to flow on *Wicchus*, *Wichunas*, bridges, structures that regulate the flow of the spring and serve to divert in case of excess water and also for the cleaning of the irrigation ditch. There are

Badenes, carved stone structures above the main canal and *Chakas*, small bridges that regulate the passage of water and also serve for the transit of people from one end of the canal to the other in the sectors of *Chachayllo* and *Umajala*. We keep them clean and in good shape, conservation of these places is important for us.

We also have water coming from the Majes irrigation scheme that is used after the second watering of the field, reducing the applications to once every 15 or 20 days. From Ccochapata the water flows to the *boqueron,* a place where large stones, mud mixed with balls of greens, are placed to stop and release water to irrigate the different sectors.

All users celebrate *Yarq`a Jasp'iy,* the annual cleaning of irrigation ditches. It begins on August 1, with a ritual to renew the offering box of the previous year and to forecast the weather for planting. This work-festival lasts four days and three nights, the villagers spend the night on the hill following the guidance of our *Yacu alcalde*, the water authority. On the fourth day, we all go down to the community where we continue the worship of the water of the *Mismi* Canal, dancing and drinking *chicha*. We do it voluntarily and with faith.

Our *Yacu alcalde*, or *regidor del agua*, is the communal authority in charge of distributing and controlling the irrigation water from the water intakes in each sector of the terraces. He also coordinates *Ccocha Jasp'iy*, the cleaning of the ponds' water inlets twice a year by all water users on the 1 of July and 1 of February. From *Ccochapata,* our pond, the *Yacu Alcalde* distributes water on Mondays and Thursdays, according to the location of the *Bocatomas,* water intakes. The water intakes are named according to the location of the irrigated terraced sectors: *Ccolloni, Chersa, Ccacoyo*, *Mosocchique Canteria, Huancarpampa, Chapirana*,.

Mitacion is the order followed by the *Yacu Alcalde* for the water distribution according to sectors. Water allocation is calculated by the corresponding *boqueron*, the type of cultivation of the *chacras* (fields), to the size in *topos,* the altitude of the fields, to the type of soils according to their water retention ability, and the existing microclimates. *Loqme*, is the period of fifty or sixty days between the first and second watering of the fields. During the first *mitacion*, it is the turn of fields planted with maize mixed with alfalfa and fava beans. The second *mitacion* takes place in the sectors of *Chersa*, *Ccacoyo*, *Ccolloni* and *Quiwiña* for all the terraces with maize. The last *mitacion* is for the terraces with potato and barley around November when we are culminating the watering of the terraced fields. This is the inlet of *chapirana* that distributes the water on both sides of the terraces. We are watering a field, a *chacra* of four terraces. It is more or less three-quarters of a *topo*, the ancient measure of the land surface that measures approximately one-third of a hectare. It is taken into account as the unit of irrigation of the terraces per hour. Three-quarters of a *topo* is irrigated in four or five hours. Each user receives 35 litres per second, at an average of twenty days per agricultural season. A *chacra* is the cultivation area belonging to a family, which can be spread over one or more terraces.

We irrigate a field by means of the *melga*, ditch that carries water from one platform to another. Each terrace has a *bordo*, a ridge of earth at the edge of a platform that prevents the water from falling out along its course. Without *bordos* our stonewalls would be eroded

Figure 4. The Yacu alcalde distributes the water according to a fair set of rules called Mitacion (Photo Timmi Tillmann)

in a short time. We can see from here that in between two terraces there is a *K'alcha*, vertical ditch built of cobblestones and flagstones, so that the water falls to the next platform without damaging the wall.

There are also *Paqcha* structures that allow the water to pass from one platform to another freely, falling to a stone at the base that cushions the precipitation. *Tuycu, Saruna, Sarupas* are the long stones embedded in the walls to shorten the way from one platform to another without damaging the stonewalls. *Orccoya* is an old curved canal completely built only with stones that bears the same name of the sector. *Umareo* is the first irrigation of the crops after sowing.

Some modern agricultural practices are deteriorating our terraces like the use of tractor and chemical inputs, they might destroy the terraces built in the past by our grandparents with a lot of intelligence. We also fear the climate change that is affecting us. We want to maintain our terraces and canals following the tradition of our grandparents, recognizing the values of what they built should last for many coming generations."

4.3. Juan de Dios Castro Tinta describes and explains the irrigation of the Cabanaconde countryside

The following oral testimony has been transcribed and translated from the video *Sistemas de riego en andenerías* (Irrigation systems in terraced lands) produced by Desco (2014b).

"*Hualca Hualca* is the snowcap mountain from where the water for the countryside of Cabanaconde and other towns in the Colca Valley originates. Its waters irrigate the terraces where the *Cabanita* maize grows. Our ancestors have controlled the water flow of the *Hualca Hualca* sector in an orderly and organized way to provide water. Since 1995, we have been requesting water from the Majes irrigation system. As we have more or less sufficient water flow we no longer worship Mother Earth, as it should be. The volume of water increases by many snowfalls, I hope that our natural dam of the *Hualca Hualca* is not drying up.

Here we are in Cusqui, the fourth intake of seven places of the water catchment of the Hualca Hualca River for the countryside of Cabanaconde. This is the *Canal Matriz* that irrigates more than 400 hectares. The *Yaku Alcalde* is the authority hired by the irrigation commission for water distribution — it is a rotating position between two people who control the water permanently, in shifts of two days and two nights. In the countryside, the water never rests for a moment. The *irrigators* are the persons who conduct the water in the plot using shovels so that not even a white spot is left, so that everything is well flooded, flooded and soaked homogeneously. In twenty minutes they can irrigate four small plots. Larger plots can be irrigated in forty minutes or half an hour.

Seccana is a sector of narrow terraces where we do not irrigate because we do not grow *cabanita* maize there. *Cusqui* is the sector of terraces here in the countryside where the terraces are very wide and we plant *cabanita* maize. *Barbecho* is the ploughing of the land before irrigation, either with oxen or tractor. *Qarpay*, or first irrigation, we let the water enter the fallow land until it is well waterlogged, well wet, well filtered to sow the *cabanita* maize that grows very well in this countryside.

The *borders*, the earth piled up and compacted between the stonewall and the embankment, have the function of preventing the water from running off and so soaking the small plot of land is done homogeneously. *Apero* is a stick plough pulled by oxen with which the furrows are opened to sow the corn after flood irrigation. Furrow *Kila, Kowa,* second irrigation, after sowing the furrows are flattened and the ground is left well levelled to flood the land when the maize is about twenty centimetres high.

Irrigation is carried out in all sectors, depending on the water flow, the type of crop and the quality of the soil. This is the way our ancestors have taught us and we want to continue this way because it is the best way to maintain our land. Using more water is not in accordance with the customs of our ancestors, but we do have a dream: to finish the old Huatac canal that was left unfinished from the Macura lagoon to Cabanaconde. That would give a guarantee for the life of the new generations."

4.4. Bridging epistemologies - stone walls and water

These three testimonies in Spanish language with Quechua terms reveal the continuity and changes of Prehispanic knowledge on engineering, architecture and hydraulics as well as the integration of functionality, art and spirituality perceived in the stonewalls and water canals. The knowledge and praxis of maintaining productive the agricultural infrastructure of the stonewalls and the water canals disclose an intimate familiarity and feelings for each minute detail differentiated in more than 25 names of structural elements for canals and walls according to function, shape, size, position, beauty and sound of water when it falls into the stones. Each terraced sector is known with a particular name fitting to type of walls, if they are curved, narrow, or wide, the type of crops that grow, the microclimatic characteristics of the spot, soil quality and the water absorption. All these categories are memorized names through the work experiences in daily live.

The names of the bigger space, the watershed, the snow mountains, the water falls, the water ponds and the immense slopes covered with terraces convey a feeling as if space and the persons were a community of living beings. The on-going celebration of rituals to Mother Earth is therefore indispensable to maintain the balance of stonewalls and water canals in a continuing flow of links between the objective reality and beyond the visible reality. Both realities coexist in one knowledge corpus that use material elements and ritual practices for sustaining the life of all families and terraced plots. Rituals are ways of renewing the rules of reciprocity between humans and nature and among members of society creating an order that guarantee life in the present and for the next generations.

The different and specific names for social rules of reciprocity in the agricultural tasks and the responsible fulfilment of them for the maintenance of stonewalls and canal and the distribution of water are expressed with accentuated self-esteem and empowering awareness. This is a necessary recognition for an intercultural dialogue between knowledge systems.

5. SOILS IN AGRICULTURAL TERRACES

Soil classification is a wide spread knowledge learned from early childhood by sensorial observation when children go with their mothers to the fields. They see, touch, smell, play with different earth and notice in which type of soil one or a cluster of crops grow well or where the irrigated fields are more prone to absorb water.

The Peruvian anthropologists, Ricardo Valderrama and Carmen Escalante (1988) lived between 1985 and 1988 in the communities of Yanque Hurinsaya and Yanque Hanansaya at the heart of the Colca Valley participating in the work cycles of agricultural terraces and studying the perceptual and cognitive maps of local people. The registered twenty terms used by local people referring to the types of soil that can be found throughout the terraced territory.

5.1. Soil ethno-classification as part of local knowledge corpus

These terms ensemble the logic of the senses in six general categories: temperature, humidity, texture, colour, topography and fertility.

Temperature

Qoñihallpa, warm soil can be found near the riverbanks and in the terraces down below

Chirihallpa, cold soils can be found in high flat terrains and in upper terraces

Humidity

Churahallpa or *Churana*, moist soils

Chakihallpa, dry soils

Texture

Sakllhallpa stony soils, scattered in some areas. These soils are very difficult to plough but necessary task before sowing time.

Aqohallpa, sandy soils that appears in very reduced parts

Llink'ihallpa, clayey soils, very common and can be identified because when it dries is very breakable

Figure 5. *Soil knowledge combines sensorial observations as well as aesthetic values (Photo Timmi Tillmann)*

Hakuhallpa, /Sumaqhallpa, loamy soils are the most predominant and favourite in terraced areas, this type of soils are sometimes transported from far away distances to cover the upper surface of the terrace platforms

Colour

Yuraqhallpa, light soils
Qellohallpa, yellow soils
Pukahallpa, red soils
Ch'umpihallpa, brownish soils
Oqehallpa, grey soils
Yanahallpa, black soils

Topography

Pampahallpa, soils at the river bank plains
Patahallpa, soils on the terraces
Andenhallpa, soils at the river banks climbing into the high plains and the mountain slopes
Qathahallpa, soils at the gradients, are very seldom fields located between plains and terraces that have hummock, small elevations of earth

Fertility

Tulluhallpa, thin soils very sandy stony, they moisten easily but retain water a very short time. They need longer and affluent irrigation. They are very productive, only alfalfa, peas and barley grow well in these soils.
Wirahallpa, rich soils in clay, they are black and loamy. They do not absorb quickly the water therefore these soils are irrigated with moderation but for longer time. They retain water very efficiently. Crops like maize, fava bean, oat and potato grow very well in these types of soils.
Saliwa means the combination of hot, humid, clayey, light qualities of soil in terraces where maize grows better.
Chalhuanca combine cold, humid clayey, red, high plains characteristics of soils in terraces where potatoes grow better.

5.2. Bridging epistemologies and soils

The interest of linguistic studies in soil coincides with local knowledge. For example, a report on agricultural patrimony in Quechua agricultural areas of Puno, Huancayo and Cajamarca, identified more than one hundred fifty names of soils. They are listed, translated and explained under the general categories of topography, material, content and type of terrain and the combination of the Quechua terms *Allpa, Hallpa* for soil in the high slopes. The numerous soil vocabulary express a rich and complex Andean knowledge of people, who still farm the fields according to their local culture, appreciated by a meticulous taxonomic and semantic analysis (Ballón et al. 1992: 48-70).

The soil scientist Sandor (2006) studied Andean local soil terminology. He found over 50 names for soils resulting from a process of many generations working in and learning from the physical environment that provides the key in the long lasting sustainability of agricultural terraces. Sandor elaborated the over 50 names for soil classification systems in a four-tiered taxonomy, which shows how closely intertwined are soil stewardship and knowledge also affirmed in the traditional ritual agricultural practices in the productive cycle.

6. THE DIVERSITY OF CROPS GROWING IN THE TERRACES

The last two testimonies present and explain the great diversity of food crops in the terraces. The first testimony is from Marcial Sulco Mamani, from the community of Coporaque (Desco 2014c). The second testimony by Flora Evarista Chuquicondor comes from her presentation in the Second World Congress on Terraces in Cuzco (Tillmann and Bueno de Mesquita 2015) and the video *Conservación de la agrobiodiversidad en andenes* (Conservation of agrobiodiversity on the terraces) produced by DESCO (2014c).

6.1. Marcial Sullco Mamani presents the conservation of agrobiodiversity in the community of Coporaque

We raise microclimates with the construction of terraces where 80% of our crops grow.

There are terraces in the lower areas, where water is not scarce, so we plant maize. There are extensive terraces where we grow beans and barley. Quinoa, *quiwicha*, *oca*, *olluco* are grown exclusively in the high terraces of *Jamallalla*, the sector where the terraces are of low height, in *Jaira* where the stairway terraces have walls 7 meters high that if we do not take care of them, they will deteriorate, which would be a shame because they were made by the ancient settlers, and in the sector of *Toqo* stairway where the water comes directly from the springs. In the high part on the side of *Choccpayo* and *Amallallo*, native potatoes, *olluco*, *isa*ño and *oca* are grown there.

Our terraces are very important because there we grow many varieties of native potatoes, each with its own name such as *peruanita, serranita*, *yellow, huaccrahuaccra, huayro, cuchiaca, cachunwacachi, sica, white, ccompis,* as well as other tubers like *olluco, oca* and *mashua* grow in association and all varieties are eaten prepared in delicious dishes. The black *oca*, *yanaoca* is eaten raw and is medicinal. Quinoa, we have different names for its colours: yellow, white, orange, cream, and each one tastier than the other. Peas, beans and barley also have their names for their colours and shades and all are edible.

The varieties of maize have hundreds of names according to their colours and the mixture or combination of colours. The names also vary according to their degree of sweetness, their local culinary use for *cancha*, roasted corn, or *chicha*, maize beer, their medicinal value and their association with other crops. *Tinkasar*a are different varieties of maize used for rituals of gratitude, to the water and to Mother Earth.

6.2. Flora Chuquicondor presents and explains how and why she conserves agrobiodiversity in Cabanaconde

The pre-Inca terraces were built by our ancestors Collaguas and Cabanas. They are distributed from 2,000 MASL *Tapay terraces*, to 3,800 MASL *Tuti terraces*. In this region of pampas and slopes where the terraces are located, thanks to many types of soils and microclimates, the farming families of the Colca Valley have been conserving and revaluing our crops to ensure our daily food supply. Above 3,800 MASL we conserve many species and varieties of native potatoes, quinoa, *ocas*, *mashuas*, *ollucos*, beans, maize.

Each one has its original name and its diverse forms of use. Generally we sow for our own consumption, because to sow in large quantities we lack the market and the diffusion of the importance of these crops in food. For example, quinoa, which has just recently been given value, was previously marginalized like other crops.

From 3,000 to 3,400 MASL we have a production area where *Cabanita* maize dominates, it is the only one in the whole region of Arequipa and of Peru. This variety has genetic characteristics such as its sweetness, its colours, sizes and forms of use. It is perfectly adapted to the temperatures of Cabanaconde, to its soils and to the water with which it is irrigated. It is also the product of a particular management that has been practiced before the Incas, preserving the ancestral wisdom until today. The diversity of 42 ecotypes of this maize has made possible a natural pest control. There are varieties of maize that respond better to sheltered areas, others to temperate zones and others that resist frost, as well as

Figure 6. "What would Cabanaconde be without our Cabanita maize" (Photo Maruja Salas)

varieties that respond to soil types and water scarcity. Maize is the basis of our economy and our diet. People from other towns come to barter, that is, to exchange products such as maize for meat, fruits, vegetables, and so we do not lack anything in Cabanaconde.

We strictly comply with the agricultural cycle that begins in June with the early fallow. Then in mid-August we sow with the best seeds. Each agricultural work is accompanied by a ritual called the *Muju Tinkuy*, the sowing of seeds, which celebrates a *pago*, offering to the earth, honouring the Apus *Hualca Hualca* and *Kallimama.* We have to take care of the planting, doing all the nurturing of the crop. After six months we can already taste what we have sown, the first maize, for which we thank our patron saint the Virgin of the Candelaria. The final harvest is done in May, cutting the whole plant and taking it to the *chalera*s, storerooms, from where we supply ourselves little by little during the year.

Our life, the life of all the people of Cabanaconde is tied to maize, even our way of dressing, our way of speaking, our culinary customs, everything is around this crop. We want to continue planting because it is part of our life. The market does not recognize our efforts to produce healthy, organic products. The State offers us support but only for the so-called profitable crops. We are resisting, but I don't know for how long, because what would Cabanaconde be without our maize crops?

6.3. Bridging epistemologies and crops

The Colca Valley terraces might have sustained at least 71,000 people in 1520 (Cook and Cook 2011). At present time the population of the Colca Valley consists of 80,000 people who still rely on terraced systems for the production of a great diversity of food crops for their subsistence. The production of food crops depends on the understanding of the mountain slopes according to space and time categories. Agricultural work requires a sophisticated knowledge about soil classification in the higher or lower location of the terraces, the size and shapes of stonewalls, the correct orientation according to the sun. The precise timing for sowing and giving the particular attention and care that each crop deserves during the productive cycle is established in local agricultural calendar systems based on agro-astronomic observations in the past and the present. They have been studied as a central cognitive frame for the material and symbolic organization of space and time (Earls and Cervantes 2015; Zuidema 2010). The on-going processes of interpretation of the signs from the environment are still applied in the present agricultural practices by most of the rural communities. Shared values and emotional ties to agriculture in the past and the present nurture agro-biodiversity as the source of food for Andean society in a process of more than 10,000 years (Cabieses 1995, Leon 2013).

Andean societies have a knowledge repertoire of almost 4,400 native plants. They are used for 49 purposes, for example, 782 are food species and 1,300 medicinal species. From all native plants, 182 are domesticated and 1,700 are cultivated and are growing widely in the Andean territory. Approximately a diversity of 175 indigenous domesticated species are still cultivated in the Andean Region (Brack-Egg and Teccsi 2005). Rural communities continue to produce numerous species Andean terraces like maize, quinua, potato, *oca*, *kañigua*, *tarwi*, *olluco*, *mashua* together with introduced cultivars like fava beans, alfalfa, peas and various fruit species. The extraordinary abundance of crop varieties that are found in the terraced fields has called the attention of agronomists who study agro-biodiversity as a process of in-situ conservation of genetic material in a natural population of plants (Tapia 1999).

This wealth of plant resources is the fundamental column of a great diversity of culinary culture, local gastronomies that demonstrate wisdoms and practices (Alvarez 2005, Coe 2004, Canepa 2011) to sustain material life as well as a cohesive symbolic function in society (Salas Carreño 2019). Such abundance of food crops demonstrates local intellectual capacity to understand and establish dynamic and intimate relationship to nature to support their lives with dignity and diversity. The continuity of terraced agriculture poses the moral imperative of Food Sovereignty (Salas 2013) a paradigm directly related to the rights of the farmers to maintain and transform their cultural ways of understanding nature by practicing agriculture for life plenitude. Food Sovereignty entails a major social and political endeavour with thoughtful implications to design joint actions on a basis of common, and transformative knowledge: social equality and cognitive justice.

Figure 7. The Piedra Caja inserted in the stonewalls is the place to celebrate reciprocity rituals to Pachamama (Photo Timmi Tillmann)

7. CONCLUSIONS

In this article we have presented an overview of multidisciplinary achievements of scientific studies about agricultural terraces as well as the knowledge expressed in the local terms used in the rehabilitation of stonewalls, aqueducts, classification of soils and the conservation of agro biodiversity

The understanding of nature and the social practices of agricultural terraces sustaining life has been presented in multiple names that reveal how local people think and process their terraced environment. By mean of intercultural dialogue, a human interface between subjects of knowledge belonging to different epistemological traditions and knowing forms we practiced the opportunity to build epistemological bridges between scientific studies and the local testimonies, a knowledge encounter transmitting messages beyond the factual information.

Finally, we close this article with a reflection of the term *Pachamama,* Mother Earth, whose presence is addressed in the habitual practice of rituals of every transformative actions of agriculture revealing a cognitive and affective integration of nature and local minds.
Different translations tell us that *Pacha* is the notion of space and time: integrity, absolute identity (Taylor 1987:31). *Pacha*: is time, earth, place (Gonzales Holguin 1952 : 268). *Pacha*: is the surface of the earth globe, world and time, and *Pachamama*[1]: the world, space, place where humanity and the family live (Ballón 1992: 41).

According to Mujica (2016) the term *Pachamama* has two roots. *Pacha* is one of the most complex categories in Quechua language. It means space, time and identity. With this one word one can denote the here and now as well as the belonging here. The root *Mama* means origin, life giving, life sustaining. *Mama* is also associated to generating, protecting and nurturing.

Pachamama in the context of the testimonies on agricultural terraces refers to the space, the time and identity of all existing as well as the process of all living beings in one place and time, slopes, stones, water, soils and crops. It can be understood as nature, since it is where one is, who you are and the way you exist. *Pachamama* is the reality that comprises the unity of space and time.

The terms *up there* and *down below* are the fundamental dimensions of space in a mountainous region. They set an order for the construction of walls, the distribution of water with canals, as well as the sustainability of soils and conservation of crops. *Up there* and *down below* encompasses the familiar and endearing space where people lived in the past, in the present and in the future. It designates life and living in an historical process. Slopes, stones, water, soils live as well as plants, animals, human and nature, all have the capacity to survive in time and space where nothing is hazardous. There are established rituals, traditions, behaviours and rules that ensure life continuity celebrating different forms of reciprocity with nature and among humans, all necessary to sustain life.

In daily agricultural life, local people consider potatoes or maize, other crops as well as non - domesticated plants as living beings that have names. But crops can not move, therefore agriculture is understood as a nurturing caring action, of releasing the existing life potential of the plants. Animals and humans can move, eat, reproduce and take care of their offspring. But only humans live with life awareness that everything is alive, that *Pachamama*, nature, exists. If for some reason humans attempt against what exists it would damage the own existence and life. *Pachamama* is the conceptual and practical support and the very existence of life. If we put Pachamama in danger we would be risking our very existence and life. Not taking care of *Pachamama* or not attending her would be self-destructive.

In the words of Flora: "what would be of Cabanaconde without our maize crops?" she is remarking that terraces are transcendental for local life and history. Crops might be exposed to changes and alterations as it has occurred in time, but never missing or neglecting its diversity. The existence and life of people in diversity is the greatest fortune, its loss means a fall in disgrace. The knowledge of the elders whose existence and life applied to the stones, water canals, soils and crops created a multidimensional wellbeing which is worth to pass it down to the future generations.

The future of terraced agriculture envisions intercultural dialogue as a global opportunity for cognitive justice to the makers and inheritors of terraces. They are key actors of the transformations of living landscapes, a source for diverse cultural identities with multiple forms of intimate relationships to nature.

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Endnotes

1 The term Pachamama (framed in the philosophy of El buen vivir, Good Living) in the constitutions of Ecuador (2008) and Bolivia (2009) acquire the normative legal character of subject of rights, a paradigmatic change beyond the scope of this article. (Pinto Calaca 2018)

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Terraced landscapes in Switzerland – an exploratory survey of their occurrence and characteristics

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ABSTRACT

Terraced landscapes are one of Switzerland's characteristic cultural landscapes, but until now there has been no spatially explicit cartographic representation or characterisation of them. We have taken on this challenge. In this article, we primarily describe our methodological approach and the challenges it presents. Secondly, we illustrate the approach and analyses using maps of the areas, types, use and condition of Switzerland's terraced landscapes. We show that a combination of an inventory based on literature, the modelling of potential terraced areas, and a visual mapping based on map data has the potential to capture terraced landscapes as comprehensively as possible. However, some uncertainties remain, partly due to limited resources and computing power, but also due to the pending and very labour-intensive verification in the field.

KEYWORDS

Terraced landscapes, inventory, GIS-based modelling, Switzerland

1. INTRODUCTION

Terraced landscapes are one of Switzerland's characteristic cultural landscapes (Rodewald et al. 2014). They are characterised by a variety of qualities such as high structural diversity, which has been created and is continuously reproduced as a result of human activity in terms of structures (e.g. dry-stone walls, embankments), use (e.g. vineyards, fields, meadows) and cultural specifities (e.g. architectural styles, materials, organisation). The great importance of terraced landscapes for farming, but also for identity formation, recreation, art and culture, and the preservation of biodiversity, means that there is also a great responsibility to preserve such landscapes.

In this sense, the following concerns are central: recognising the diverse qualities of terraced landscapes and raising awareness of them, supporting the concrete use of terraces, (international) networking among stakeholders who have taken up the issue, and promoting rehabilitation measures, such as the restoration of dry-stone walls. An important basis for all these projects is a solid knowledge of the occurrence of terraced landscapes in Switzerland.

With regard to the latter, the Swiss Proterra project (Lingeri et al. 2007; Rodewald 2007) identified 76 larger terraced landscapes in Switzerland and their characteristics. Building on this, the inventory was supplemented and cartographically mapped in a continuous follow-up project (Liechti & Rodewald 2020). The mapping took the form of dot markings, with the size of the dots indicating the type and extent of the terraced landscape and the colouring indicating the type of cultivation. What was not available until now was a systematic survey of terraced areas throughout Switzerland, i.e. a spatially explicit cartographic mapping and characterisation of existing terraced landscapes. We have taken on this challenge.

In this article, we describe our methodological approach to the systematic survey of Switzerland's terraced landscapes and discuss the challenges that arose in the course of this methodological work. The aim is to engage in dialogue with similar projects in other countries, particularly in connection with the International Terraced Landscapes

Alliance (ITLA), which has set itself the task of developing a global database. We also present a few selected content analyses, which should be understood as illustrations of the methodological approach. Concrete verification of the results in the field is still pending. Within the framework of the methodological approach presented here, we were therefore guided by the following research questions: Where are the terraced landscapes of Switzerland located (geographical question) and what approach is suitable for documenting them (methodological question)? How can the terraced landscapes of Switzerland be characterised (content-related question)? What challenges arise from the methodological approach and what are the next steps to be taken (procedural question)?

2. BASICS

2.1. Definition of terraced landscapes

A terraced landscape as defined by Lingeri et al. (2007) is a cultural landscape characterised by man-made terraced areas (German: Terrassenfluren). Terraces, in turn, are sequences of slopes, usually in the form of (dry) stone walls or (wooded) embankments, and terraced surfaces that are or were cultivated in a variety of ways. Terraced landscapes developed over centuries in response to increasing land scarcity driven by population growth. They offered a low-erosion, resource-conserving and favourable method of cultivating slopes (Lingeri et al., 2007).

In line with the typology developed by Lingeri et al. (2007), we distinguish between three types of terraced landscapes: Type I consists of large-scale, uniformly used and compact-looking terraced landscapes, usually covering an area of more than 100 ha. Type II resembles a mosaic of terraced areas amidst other landscape elements that are linked by cultural-historical, usage-related and natural spatial similarities. Normally, at least one larger terraced area is present. Type III, on the other hand, are terraced landscapes with scattered, small-scale terraced areas that are perceived as individual landscape elements but form a terraced landscape due to similar cultural-historical and natural spatial aspects (Lingeri et al. 2007; Liechti & Rodewald 2020).

As our goal was to survey as many terraces in Switzerland as possible, the term "terraced landscape" was defined rather broadly. In a first step, all terraced areas were mapped, regardless of their assignment to a higher-level terrace landscape. Based on municipal and natural spatial boundaries, the terraced areas were then aggregated into type II or III terraced landscapes. Individual terraced areas that could not be connected were designated as individual type III areas and will have to be reviewed and, if necessary, removed from the inventory in the course of further work and validation, as they do indeed constitute a terraced area as such, but cannot be defined as a terraced landscape according to our types.

2.2. State of research

Over the years, various methodological approaches have been developed for the GIS-based detection of terraced landscapes. These methods are based on high-resolution digital terrain models (DTMs), satellite images and remote sensing data such as LiDAR (cf. Sofia et al., 2016; Godone et al., 2018; Capolupo et al., 2018).

The study by Sofia et al. (2016) investigated how the results differ when the digital elevation model (DEM) is created based on satellite data or by means of LiDAR aerial surveying. It was found that DEMs based on satellite images achieve a detection rate of around 80%, while LiDAR-based DEMs exceed this value. However, aerial surveys limit the size of the study area. The characteristics of the terraces, particularly the height of the terrace edges, are also decisive for the detection rate. Prominent terrace edges with a height of more than two metres significantly improve detection. The optimal method and data basis should therefore be tailored to the size of the study area, the characteristics of the terraces and the available resources.

The study by Godone et al. (2018) confirmed that LiDAR data is a suitable method for detecting overgrown terraces, especially in densely vegetated areas. In their study, the study area was specifically flown over to create a LiDAR-based DEM. The same approach was also used in the study by Capolupo et al. (2018), which additionally used historical aerial photographs to document changes in terrace structure over time.

As the aim of our study was to create a national inventory, it should be based on nationally harmonised geodata. The methodological comparison helped us to base our work on the most suitable geodata from the Federal Office of Topography Swisstopo. However, the data basis is only one component of the GIS-supported approach. The processing of terrain, satellite and remote sensing data collected in the field can be based on various topographical features and filters.

One of these features is slope inclination and its variability. Capolupo et al. (2018) processed the data on the assumption that natural areas can be distinguished by their high variability from terraced areas. Terraced areas have a regular structure and, as a result, a lower degree of variability (p. 803f). Object-based image analysis (OBIA) was used to divide the study area into terraced and non-terraced areas.

The study by Sofia et al. (2014) is also based on the same principle of variability. Slope Local Length of Auto-Correlation (SLLAC) is a morphological indicator that distinguishes terraced landscapes from the surrounding natural landscape due to their regular and less variable structure. However, the detection rate depends heavily on the morphology of the area, the minimum height of the terrace slope and the area covered by the terraces in a given area and therefore does not appear to be stable enough to reliably detect terraced landscapes in the heterogeneous landscapes of the Swiss Plateau, the Jura and the Alps.
In the study by Dai et al. (2019), terrace detection was based on their edges, which were extracted using an edge detection operator, the so-called Canny Edge Detector, and high-resolution satellite images. First, the contour direction of the terrace edge was determined using the digital elevation model, at a 90° angle to the flow direction. Edges in this direction were then coded as possible terrace edges.

Due to the heterogeneous topographical conditions in Switzerland and the diversity of terraced landscapes in terms of their cultivation (vineyard and arable terraces, chestnut groves, pastures and meadows) and the type of terrace slope (dry stone wall, grass slope, hedges/bushes), it was concluded that it would be extremely difficult to ensure good quality detection throughout Switzerland. In addition, an automated procedure for detecting terrace structures would be extremely computationally intensive and could not be guaranteed due to the limited IT structure. It was also clear from the outset of the project that the detected structures would require manual post-processing anyway. These had to be aggregated into meaningful terraced landscapes and other characteristics, such as slope type, had to be recorded where possible.

The procedure chosen on the basis of these requirements is described in the following chapter.

3. STEPS FOR SURVEYING AND CHARACTERISING THE TERRACED LANDSCAPES

The procedure for answering our research questions is divided into the following steps: literature research, database construction, mapping and verification based on topography, modelling of the potential terraced areas, and data analysis based on the compiled inventory and the potential terraced areas.

3.1. Literature research

The work was based on research into existing literature on landscapes and, in particular, terraced landscapes in Switzerland. This included scientific literature, planning instruments at cantonal and regional level such as structure plans (German: Richtpläne), landscape development concepts, landscape inventories and landscape quality projects, as well as regional publications such as illustrated books and local history books. For example, it was found that the cantonal structure plans in 5 of 26 cantons contain entries on terraced landscapes. The information obtained was compared with the existing inventory (Lingeri et al. 2007; Liechti & Rodewald 2020) and the inventory was supplemented accordingly with the missing terraced landscapes. The list of all known terraced landscapes, sorted by canton, formed the basis for the subsequent entry into a database.

3.2. Database structure, mapping and verification

QGIS software version 3.22.14 was used to build a database of Switzerland's terraced landscapes based on the supplemented inventory. As a first step, a multi-polygon layer was created to record the terraced landscapes with predefined attributes and domains in order to ensure uniform recording. The QGIS project file was then supplemented with various map services from the Federal Office of Topography Swisstopo, which could then be used to precisely delineate the terraced landscapes.

The maps integrated from Swisstopo are various base maps, such as national maps, orthophotos, and topography and terrain maps. The SwissALTI3D (Swisstopo, 2022a), SwissSURFACE3D (Swisstopo, 2021a) and SWISSIMAGE (Swisstopo, 2022b) models were particularly important for mapping and delineating the terraced landscapes. These were integrated into the GIS via the Web Mapping Service of the Federal Geodata Infrastructure (WMS-BGDI) (Swisstopo, 2021b). SwissALTI3D is a high-resolution terrain model with a mesh size of 0.5 m. It depicts the terrain of Switzerland without vegetation and buildings (Swisstopo, 2022a). The SwissSURFACE3D model is based on LiDAR data and depicts the surface of Switzerland with all natural and artificial elements (Swisstopo, 2021). The orthophoto used is the SWISSIMAGE product with a resolution of 10 cm (Swisstopo, 2022b).

In addition, the vector data sets "cantonal and municipal boundaries" and the raster data set "BLN", which contains the areas of the Federal Inventory of Landscapes and Natural Monuments, were integrated. This served as a source of detailed information on the landscape, its qualities and history, but also on its protection under the Ordinance on the Federal Inventory of Landscapes and Natural Monuments (VBLN). Thanks to the cantonal boundaries, the correct cantonal abbreviation could be assigned to the recorded landscapes. The municipal boundaries were helpful in assigning a suitable name to the terraced landscapes, which was mostly based on the names of the municipalities. Information on land cover was integrated via the SwissTLM3D topographic landscape model (Swisstopo, 2024a).

The individual terraces in the supplemented inventory were recorded as (multi-)polygons and each recorded terraced landscape was assigned a type (I, II or III; according to Lingeri et al. 2007). The dominant use of the terraced areas and any secondary forms of use were recorded as primary, secondary and tertiary uses. Depending on the crop rotation, some terraces are used alternately as meadows and for arable farming. In order to take this form of use into account as well, information from the sectoral plan for crop rotation areas (Federal Office for Spatial Development ARE, 2020) and the associated geodata were consulted (KGK-CGC, 2025b).

In order to map the terraces and distinguish between terraced and non-terraced terrain, the respective area was viewed on the "SwissALTI3D" raster map, the monodirectional topography, at a map scale of 1:4000. As the topographic map does not show any data on soil cover, forested areas were also included in the database. Terraced but overgrown areas thus only became apparent by superimposing the mapped terraced landscapes with the forest data set of the topographical landscape model of Switzerland (cf. Swisstopo, 2024) and were subjected to a more detailed analysis in a later step (cf. Chapter 4). In cases of uncertainty, the orthophoto and the national map were also used for reference. If it was not possible to clearly delineate the terraced landscapes, the lines were drawn based on landscape features such as terrain edges, hedges, watercourses, roads or settlement boundaries. The orthophoto, sometimes in combination with the national map, was used to determine the primary and, where applicable, secondary and tertiary uses. Using this approach, all known terraced landscapes in Switzerland were mapped by hand one after the other. Subsequently, the individual cantonal areas were systematically searched for further terraces using the monodirectional topography SwissALTI3D on a scale of 1:16,000 and based on the potential terraced area analysis (see Chapter 3.3). The additional terraces discovered in this process were also included in the inventory and database and characterised.

3.3. Modelling of potential terraced areas

In order to identify areas in Switzerland where further terraced landscapes can be found, the modelling of potential terraced areas was carried out in parallel with the development of the database. To this end, the literature was searched for factors that favour the existence of terraced landscapes. The following factors proved to be essential and operationalizable for the existence of terraced landscapes: altitude (cf. Rodewald 2006: 376), proximity to settlements (cf. Spanò et al. 2018: 93ff), soil cover (cf. Eisenhut 2007), slope gradient (cf.

Spanò et al. 2018: 82) and, with reservations, aspect (slope orientation). Other possible factors could not be used because either the data was not available at national level, or the analysis would have been too computationally intensive due to the large amount of data (cf. Table 1). The potential terraced areas were calculated using QGIS as well. The collection and processing of the geodata and the creation of the potential terraced areas are described as follows.

Factor	Technical literature / Derivation of limit values	Limit value(s) used
Altitude	Eisenhut (2007): The upper limit for agricultural land is 1,650 m above sea level. Gellrich et al. (2007): The potential for reforestation of agricultural land in the canton of Graubünden is between 1,400 and 2,100 metres above sea level. Slamova et al. (2017): Based on a case study from Slovakia, the average altitude of terraces is 348-816 m above sea level. Rodewald (2006): Occurrence of terraces in the Alpine region up to 1,900 metres above sea level.	1,900 metres above sea level (according to Rodewald, 2006)
Proximity to settlements	Spano et al. (2018): Publication confirms a concentration of terraces near settlements, but without quantitative data.	1,400 metres (from the centre, derived from own data, see below)
Soil cover	Eisenhut (2007): Terraced areas are mostly designated as agricultural land or forest (as a result of reforestation)	Restriction to agricultural land and forested areas
Slope gradient	Spano et al. (2018): The limit value for terracing is between 17° and 50° inclination. Eisenhut (2007): Assumes a slope of < 39°. Capolupo et al. (2018): Confirms slope inclination as a factor, without specifying quantitative data or a limit value.	17° - 50° (Spano et al., 2018)
Aspect (slope orientation)	Eisenhut (2007): Vineyard terraces and terraces in Ticino are mostly south-facing, but arable terraces are less dependent on aspect.	As north-facing slopes are practically never terraced, the north-west to north-east range (315° - 45°) was excluded.
Geometry of plots in the land registry	Spano et al. (2018): Parcels are typically narrow and elongated along the terracing.	Not used, as no data available at national level.
Topographic Position Index	Capolupo et al. (2018): Calculation based on DHM, height of a grid cell compared to average height of surrounding cells	Not used because calculation would be too data-intensive at national level.
Minimum Difference Index	Capolupo et al. (2018): Based on DHM, height of a grid cell compared to minimum height of surrounding cells	Not used because calculation at national level would be too data intensive.

Table 1. Factors favouring terraced landscapes from the literature and limit values used (marked in bold: factors used / italics: factors not used)

To display the slope gradient in a raster layer, the "DHM25 / 200m" data set from Swisstopo was again used as the source file (Swisstopo, 2024b). The slope can be determined using the "Slope" tool in QGIS. This was then filtered to the range between 17° and 50° using the "Raster calculator".

The raster layer for altitude is also based on the "DHM25 / 200m" elevation model (Swisstopo, 2024b). This is a digital elevation model of Switzerland with a mesh size of 200 m. Using the QGIS "Raster calculator" tool, a raster layer was created that divided the entire land area into two classes: areas with an elevation <1,900 metres above sea level were assigned a value of 1, while areas > 1,900 metres above sea level were assigned a blank value, thus extracting the potential area.

The soil cover factor was incorporated using the Swiss land use statistics ("Land Use Statistics Standard – 2018") from the Federal Statistical Office BFS (Federal Statistical Office BFS, 2023a; Federal Statistical Office BFS, 2023b). This data set consists of a network of point vectors that categorise land use for every hectare in Switzerland. The data set was filtered using the "Extract by attribute" tool so that only the main categories 2 and 3 of the land use statistics were taken into account. This corresponds to agricultural land and forested areas. The vector points were then converted into a raster layer using "Rasterise (vector to raster)". Finally, the values for agricultural and forested areas were set to 1 using the "Reclassify by table" tool, while all other areas were assigned an empty cell value.

To calculate proximity to settlements, the "SwissTLMRegio_LandCover.shp" data set was used on the one hand, and on the other hand, the data set created on known terraced landscapes in Switzerland was accessed with the aim of determining the distance of the individual terraced fields to the nearest settlement. The settlement areas were extracted from the land use data (SwissTLMRegio_LandCover.shp) and their centre coordinates were converted into a point (according to Swisstopo, 2024a). The same procedure was carried out for the inventoried terraced landscapes. First, the terraced landscapes, which were available as multipolygons, were converted into individual polygons using the "Polygon parts to separate"-tool and then converted into points that represented the centre coordinates for each terrace. Using the "Distance Matrix" tool, each terrace field now represented as a point could be assigned to the nearest settlement in the form of a centre coordinate and the corresponding distance could be output. The most common statistical parameters and the 90th percentile of the distances were then queried from the table. In 90% of cases, the terraced areas are located within a distance of 1,389.7 m from the nearest settlement area, with a maximum of 6,655.5 m and a minimum of 9.5 m. Using the "Buffer" tool, a vector layer was created for the areas located within a radius of 1,400 m around the settlements, which was then converted into a raster layer using the "Rasterise" tool.

The aspect is also based on the DHM25 digital elevation model, with a grid cell size of 200 m (according to Swisstopo, 2024b). Using the "Perspective" tool, this model can be edited to create a grid layer that outputs the slope orientation in degrees (°) per pixel. Again, using the "Raster calculator", a new layer was created which is limited to the range of 45°-315°, i.e. it filters out the range between north-west (315°) and north-east (45°). Using the "Align raster" tool, the five raster layers created and their technical properties, such as the raster cell size, were aligned and prepared for further calculation. The rasters were also clipped to a uniform size using the national border.

The potential area for terraced landscapes in Switzerland was generated by superimposing the grid layers developed for the individual factors and extracting the resulting intersection. The "Raster calculator" tool in QGIS was used again for this purpose. As it was not possible to determine from the literature to what extent aspect is a factor for terraced landscapes (especially for agricultural terraces), the intersection was calculated once with and once without the aspect layer (see Figure 1).

Within the potential area for terraced landscapes calculated in this way, a systematic search and analysis of the topographic data was then carried out to identify and map further terraced landscapes. This resulted in the complete inventory.

3.4. Data analysis

The starting point for the analysis is the complete inventory of terraced landscapes in Switzerland. This includes an inventory number for each terrace, the name, type, information on use (primary, secondary, tertiary use), the canton abbreviation, the area and, if available, a literature reference and any further comments.

The first step in the data analysis was to correct any geometric errors in the inventory and

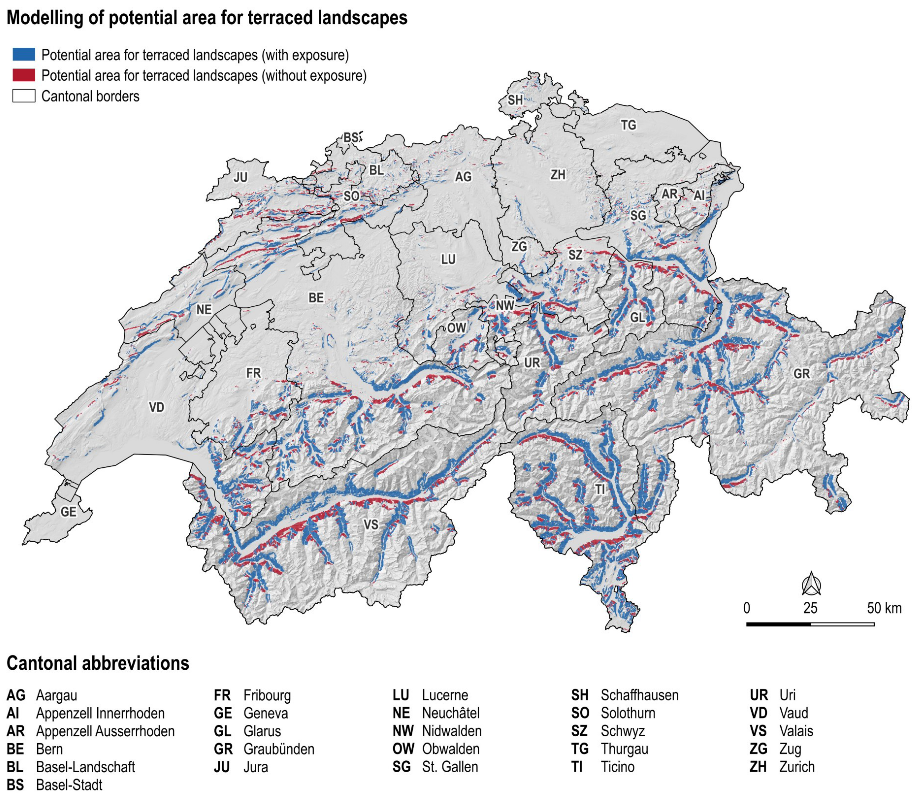

Figure 1. Potential terraced areas as an intersection of the factors: altitude, slope gradient, proximity to settlements, land cover and with or without exposure.

link it to the cantonal data using the SwissBOUNDARIES3D data set (see Swisstopo, 2023). The entire inventory was then exported as an Excel file and the number of terraced landscapes and their total area per canton were calculated using the canton abbreviation and the "COUNTIF" and "SUMIF" functions. The cantonal areas were also extracted from the SwissBOUNDARIES3D data set (according to Swisstopo, 2023) and compared with the cantonal evaluations. For the evaluations by type (I, II, III) and use, the terrace inventory was first converted into points using the "Polygon Centroids" tool, which are located at the geometric centre of the terraced landscapes. The evaluation by type was carried out in Excel using the "COUNTIF" function. The "Type" attribute in was used to prepare the centroid data set for mapping. The primary, secondary and tertiary use attributes were linked to connect the uses and symbolise them accordingly. The statistical evaluation was again carried out using Excel.

In order to record the condition of the terraced landscapes, the degree of reforestation was calculated. To this end, the data set on forest cover from the large-scale topographical landscape model swissTLM3D was used and an overlap analysis with the terrace inventory was carried out (cf. Swisstopo, 2024a). This made it possible to calculate the total reforested terrace area per canton and then to set the proportion of reforested and terraced areas in relation to the total terraced area per canton.

4. CHARACTERISTICS OF TERRACED LANDSCAPES IN SWITZERLAND

The initial results of the data analysis are presented below, whereby the explanations regarding areas, types, use and condition are to be understood as illustrations in function of the methodological approach.

4.1. Areas

A total of 389 terraced landscapes were inventoried across Switzerland (see Figure 2). Together, they cover an area of 39,803 ha. The largest terraced landscape covers an area of 5,764 ha and is located in the Valais, on the southern slopes of the Rhone Valley between Martigny and Leuk. The smallest terraced landscape measures just 9,155 m2 and is located in Mollis in the canton of Glarus. The mountain cantons of Valais, Graubünden and Ticino, together with the canton of Vaud, clearly have the most terraced landscapes in terms of numbers. There are 57 terraced landscapes in Valais, 55 in Graubünden, 49 in Ticino and 48 in Vaud.

Figure 3 shows the terraced areas in relation to the total area of each canton. Here, too, it is evident that particularly for the cantons of Ticino (2.54%), Valais (2.27%), Vaud (1.55%), and Graubünden (1.26%) many terraced landscapes could be mapped. However, the ratio

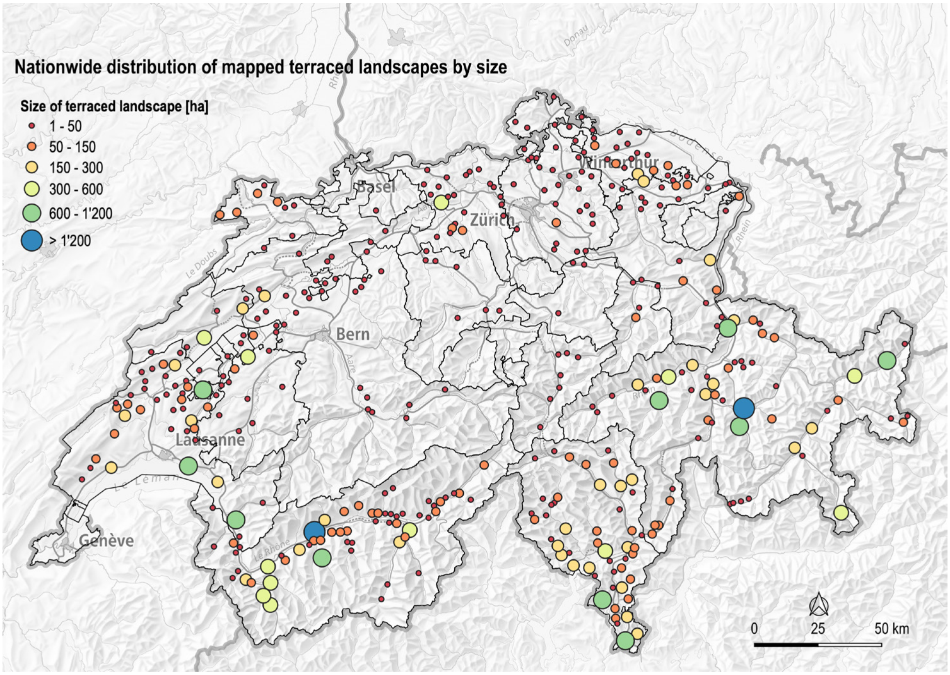

Figure 2. Distribution of mapped terraced landscapes, graded by size.

to the canton's total area is only a rough approximation, as the landscape, especially in the mountains, consists of a lot of unproductive areas such as rocks or glaciers.

Since vegetation capacity and a certain altitude are decisive factors for the occurrence of terraced landscapes (see Chapter 3.3), the next step was to compare the mapped areas per canton with the agricultural land area (German: Landwirtschaftliche Nutzfläche LN) (see Figure 4). To this end, the data set "Perimeter of agricultural land and summer grazing" was obtained via the "geodienste.ch" platform managed by the Conference of Cantonal Geoinformation and Cadastral Offices (KGK-CGC) (KGK-CGC, 2025a). The recorded areas were then linked using the canton abbreviation, statistically evaluated and compared to the calculated total area of terraced landscapes per canton.

Once again, the proportion of terraced landscapes is highest in Graubünden (15.92%),

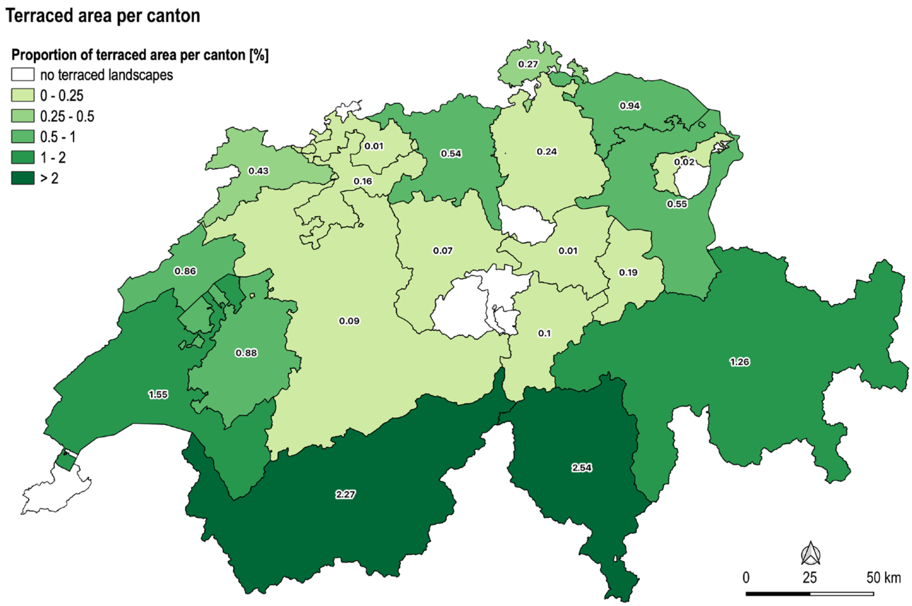

Figure 3. Proportion of terraced land in relation to the total area of the canton in percent.

Valais (7.94%), Ticino (5.78%) and Vaud (4.42%), which underlines the importance of these cultivation techniques for the reclamation of topographically unsuitable land and marginal yields in these cantons.

4.2. Types

A differentiation of the mapped terraced landscapes by type shows that type III terraced landscapes, i.e. terraced landscapes with scattered, small-scale terraced areas that are perceived as individual landscape elements, clearly dominate (Figure 5). Of the 389 terraced landscapes mapped, 317 were assigned to type III, 63 to type II and only 9 to type I. The key figures shown in Table 2 provide an overview of the characteristics of the three types.

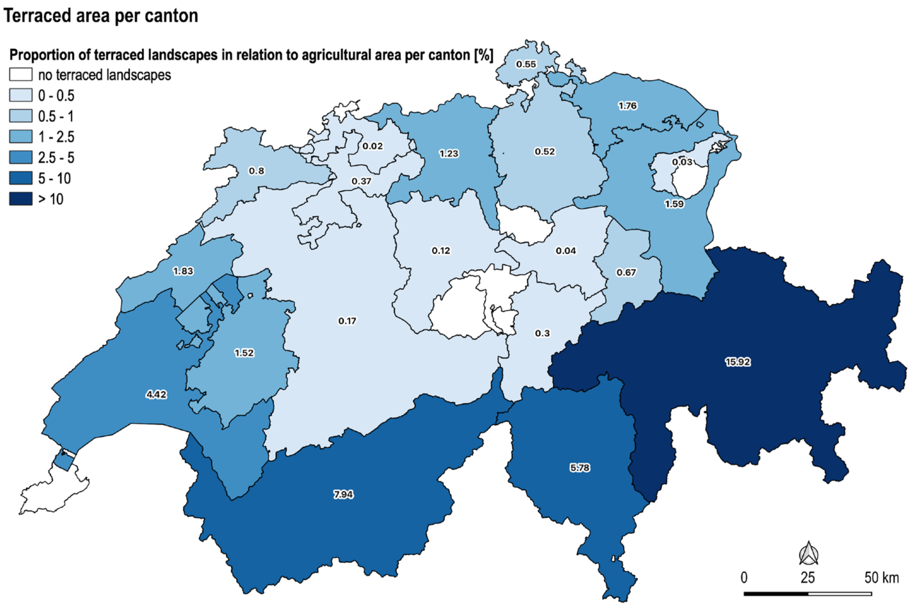

Figure 4. Proportion of terraced land in relation to the canton's agricultural land.

4.3. Use

Depending on aspect and climatic conditions, terraced landscapes offer a wide range of cultivation conditions, which is reflected in the diversity of crops grown. The terraced landscapes mapped could thus be assigned the following uses: arable farming, pasture and meadow use, cultivation of vines, chestnuts or fruit, horticulture, as well as settlement areas and other uses as a collective term for marginal uses.

The nationwide overview of the distribution of terraced landscapes and their use shows

Key figure (number)	Minimum size [ha]	Average size [ha]	Maximum size [ha]
Type I (9)	24.54	1,054.87	5,763.87
Type II (63)	3.35	201.38	1,274.12
Type III (317)	0.92	55.59	976.57

Table 2. Minimum, average and maximum size of types I, II and III respectively.

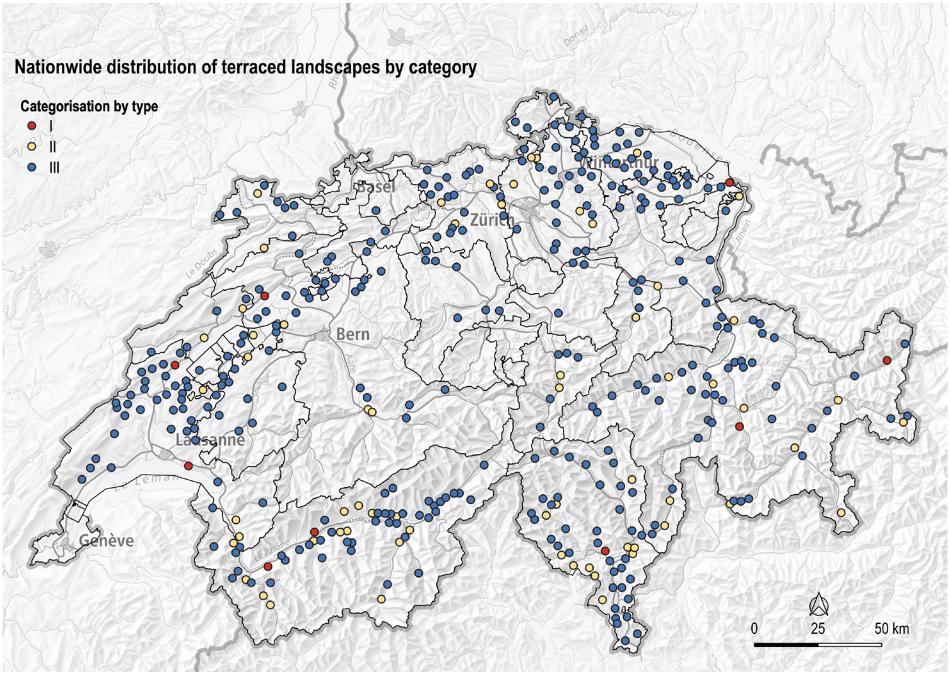

Figure 5. Distribution of terraced landscapes, categorised by type

that a large proportion of these terraced landscapes have been allocated to meadow or pasture use (211 terraced landscapes) (see Figures 6, 7 and 8). The use of terraced meadows and pastures is particularly pronounced in the cantons of Graubünden, Vaud and Valais. In terms of viticulture, a clear picture emerges of the typical wine-growing regions of Switzerland, such as the Rhone Valley (VS), Lavaux (VD), Schaffhausen (SH) and the Zurich wine county (ZH). This is the case even though only terraced vineyards are shown and not all wine-growing areas. Arable farming and chestnut cultivation are usually combined with other uses and are therefore mostly recorded as secondary uses. It is also likely that many chestnut groves have been classified as forest and have not been mapped accordingly.

A combination of primary and secondary uses involving two crops was identified for 103 terraced landscapes. A combination of primary, secondary and tertiary uses was identified

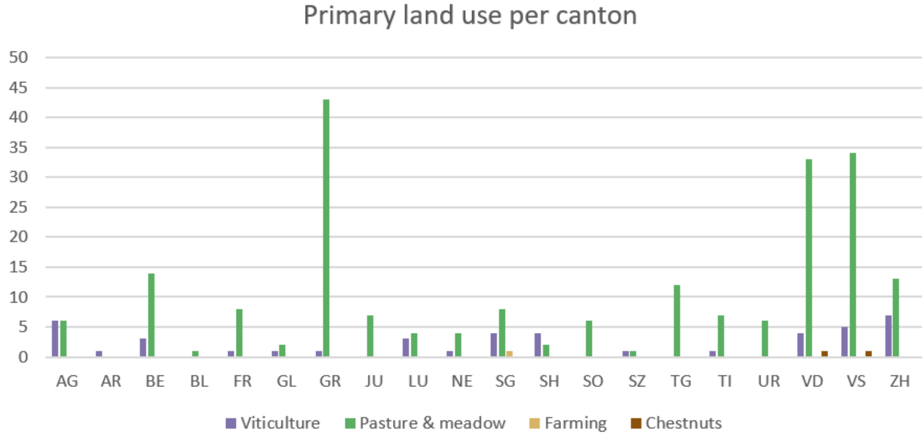

Figure 6. Overview of the primary uses recorded per canton (in number of terraces per canton).

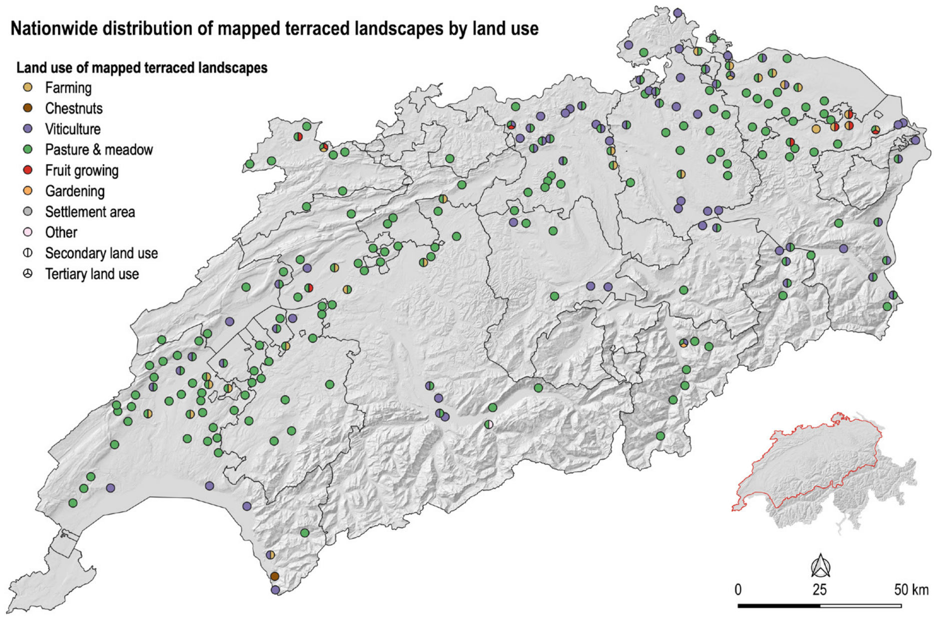

Figure 7. Distribution of mapped terraced landscapes by land use (partial overview, divided into primary, secondary and tertiary use).

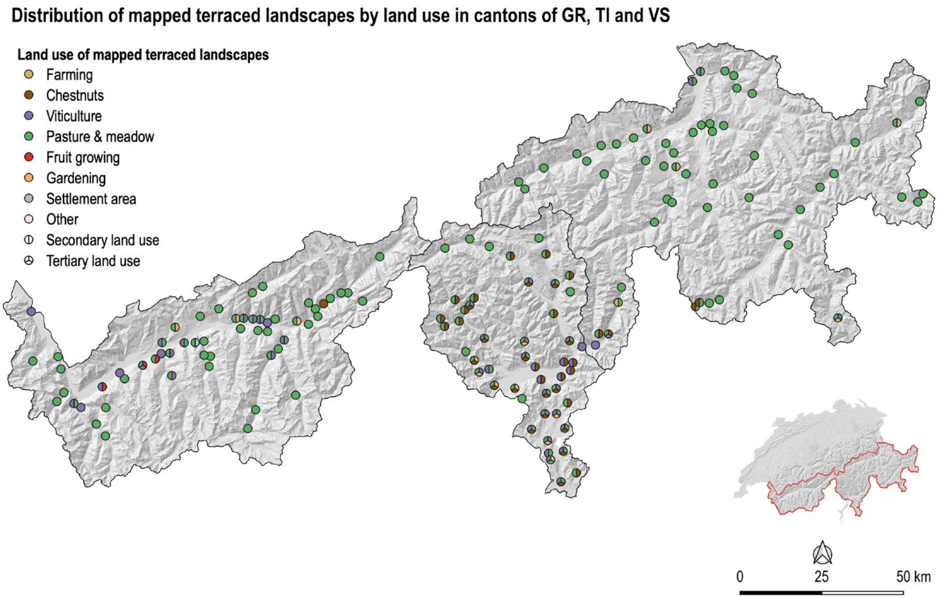

Figure 8. Distribution of mapped terraced landscapes by land use (partial overview, divided into primary, secondary and tertiary use in the cantons of GR, TI and VS).

for 29 terraced landscapes, with this highly diversified cultivation occurring mainly in the canton of Ticino, with 21 terraced landscapes. In the other cantons, only occasional terraced landscapes with three different crops were recorded. The most common combinations of crops are: vineyards/pasture and meadow/chestnut trees (9), pasture and meadow/garden/chestnut trees (7) and pasture and meadow/vineyards/garden (4).

As land use was allocated on the basis of aerial photographs, the apparent use is always a snapshot and depends on the season. An attempt was made to counteract the presumed problem of overrepresentation of meadows and pastures by combining meadows and pastures with crop rotation areas (FFF). Thus, all areas that were mapped as pasture and meadow on the one hand but also designated as crop rotation areas on the other, were

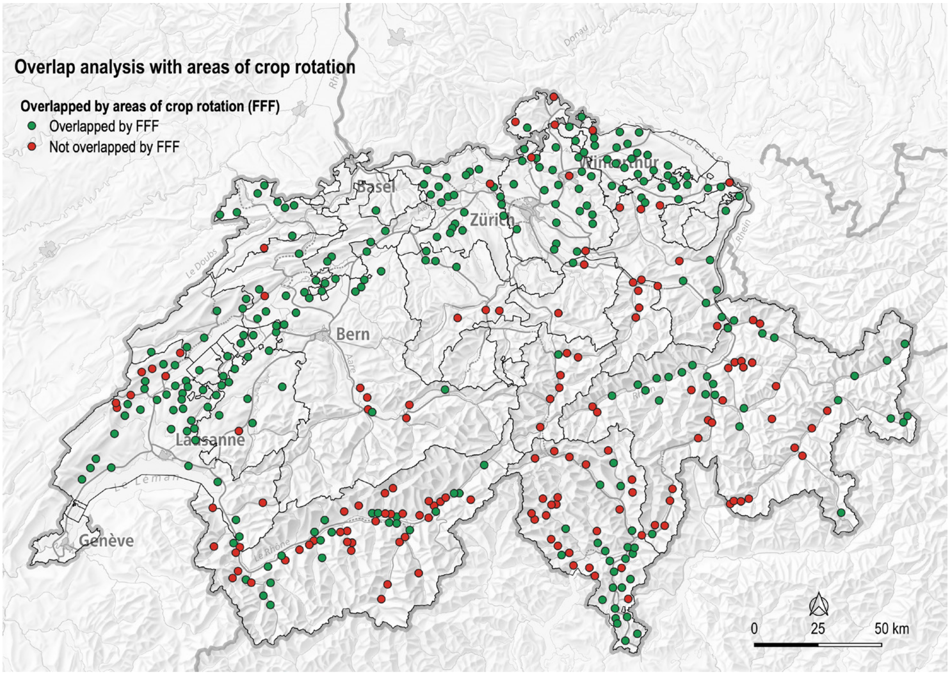

Figure 9. Overview of terraced landscapes overlapped or not overlapped by crop rotation areas (FFF).

assigned to both categories (meadow/pasture and arable farming). This resulted in a higher proportion of potential arable land. The change is exemplary for the entire Swiss Plateau, where crop rotation areas dominate (see Figure 9).

4.4. Status

The maintenance and conservation of terraces is extremely labour-intensive, which is why unproductive sites are sometimes abandoned and become overgrown. However, as the terraced structures remain visible in the geodata and have been mapped, it is possible to estimate the condition of the terraced landscapes. As Figure 10 shows, the process of reforestation appears to be particularly pronounced in Ticino, with a percentage of 27.84%. Such processes usually arise due to the abandonment of marginal locations, known as marginal yield areas. In addition to the expected canton of Valais (10.99%), the cantons of Zurich (11.27%) and Jura (13.16%) as well as the cantons in northern Switzerland in general also show a certain degree of reforestation. Uncertainties in this

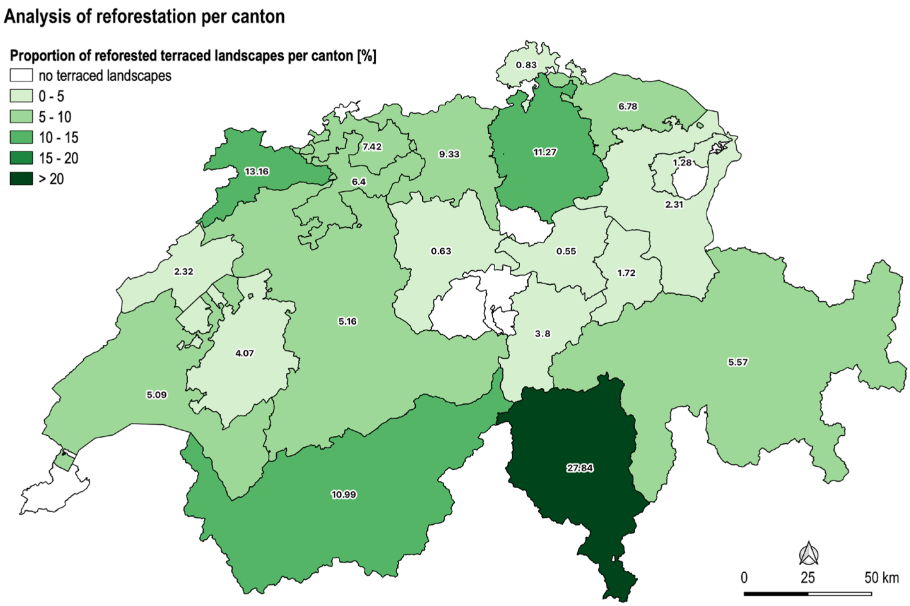

Figure 10. Degree of reforested terraced areas per canton.

calculation arise from cultivation (chestnut groves are probably partly designated as forest) and uncertainties in mapping.

As a further indicator of the conservation status, an overlap analysis of the inventory with agricultural land areas (LN) was carried out (cf. KGK-CGC (2025a). These areas are reported to the cantons as actively farmed areas. As Figure 11 shows, the canton of Ticino ranks last in this evaluation with a value of 35.99%, meaning that many terraced areas are located outside the agricultural land. This could also be an indication of ongoing reforestation processes or of the cultivation of marginal land, where forest and agricultural areas are closely intertwined.

A similar analysis is based on the intersection of terraced areas with cantonal data on crop rotation areas (FFF) (according to KGK-CGC, 2025b) (Figure 12). Crop rotation areas are defined as particularly high-yielding and valuable soils for food security and are mainly located in the Swiss Plateau (Federal Office for Spatial Development ARE, 2020). The correlation between a high FFF value and a low degree of afforestation is less apparent in this analysis than in the overlap analysis with agricultural land. This is probably due to the fact that crop rotation areas are mainly located on flat terrain, as these are the most fertile areas that can be optimally cultivated. In contrast, areas where terraces are created are located on slopes or in steeper terrain. Crop rotation areas and terraced landscapes are therefore largely mutually exclusive by definition. It can therefore be assumed that the areas interpreted as terraced and overlaid by crop rotation areas are well preserved, but that it seems inappropriate to derive general statements about the state of preservation from this.

In conclusion, it should be noted that both the degree of reforestation and the overlap analyses with agricultural land and crop rotation areas can only serve as indicators. More

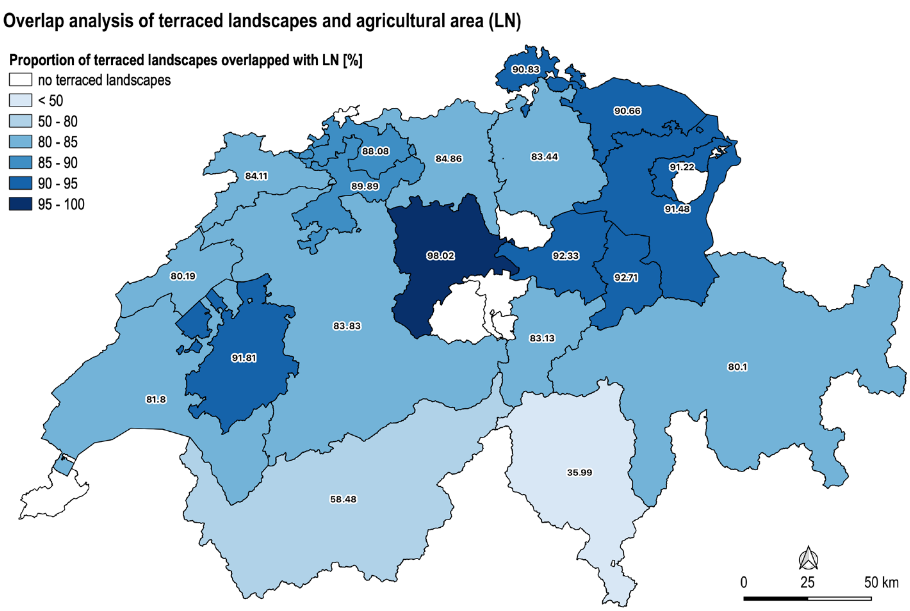

Figure 11. Overlap analysis of agricultural land areas(LN) and the mapped inventory of terraced landscapes.

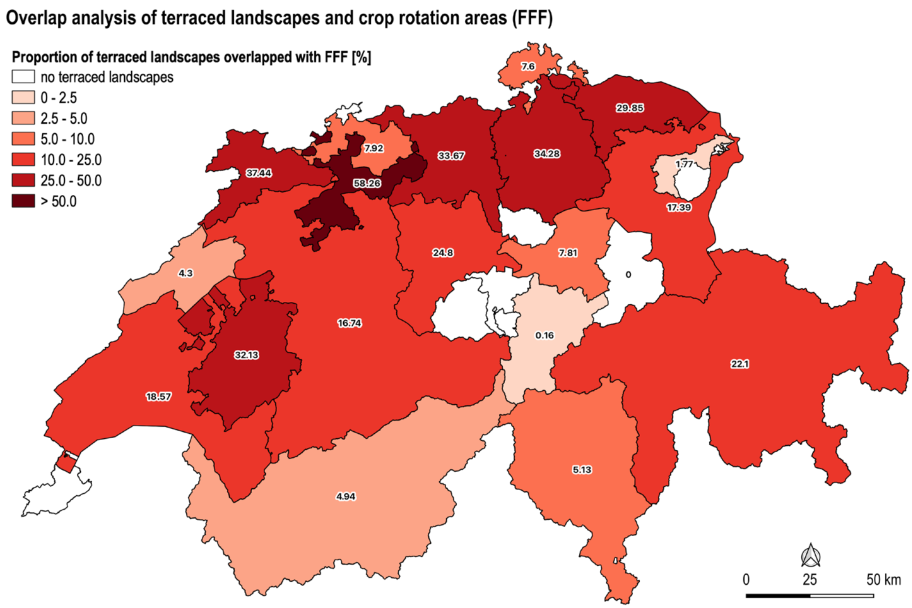

Figure 12. Overlap analysis of crop rotation areas (FFF) and the mapped inventory of terraced landscapes.

thorough investigations require more detailed methods, such as field inspections.

4.5. Potential terraced areas

In order to evaluate the calculated potential terraced areas, an intersection or overlap analysis was carried out between the mapped terraced landscapes or the entire inventory and the calculated potential area. Similarly, each individual factor in Table 1 (altitude, proximity to settlements, soil cover, slope gradient and aspect) was examined to determine the extent to which it overlaps with the areas interpreted as terraced (see Figure 13).

To this end, in a first step, all factors of the potential terraced areas according to Table 1 and the resulting potential area for terraced landscapes with and without aspect were aligned and converted into vector data sets (see Figure 13). The areas of overlap were then calculated in hectares and percentages using the "overlap analysis" tool. The results of this analysis are summarised in Table 3.

The factors "below 1,900 metres above sea level" account for 99.89% of the area mapped as terraced, 98.30% of the terraced landscapes are located near settlements, and 96.77% of the terraced area is located in the area designated for forest or agricultural use. In terms of aspect, excluding the area exposed to the north-west and north-east (315° - 45°) allowed 89.11% of terraced landscapes to be recorded.

Overall, the slope gradient criterion proved to be a limiting factor in the calculation of the potential terraced area, accounting for 40.78%. One reason for this could be the coarse resolution of the data set. With a grid cell size of 200 m, many small structures of the topography are eliminated, and the topography is smoothed overall. However, due to

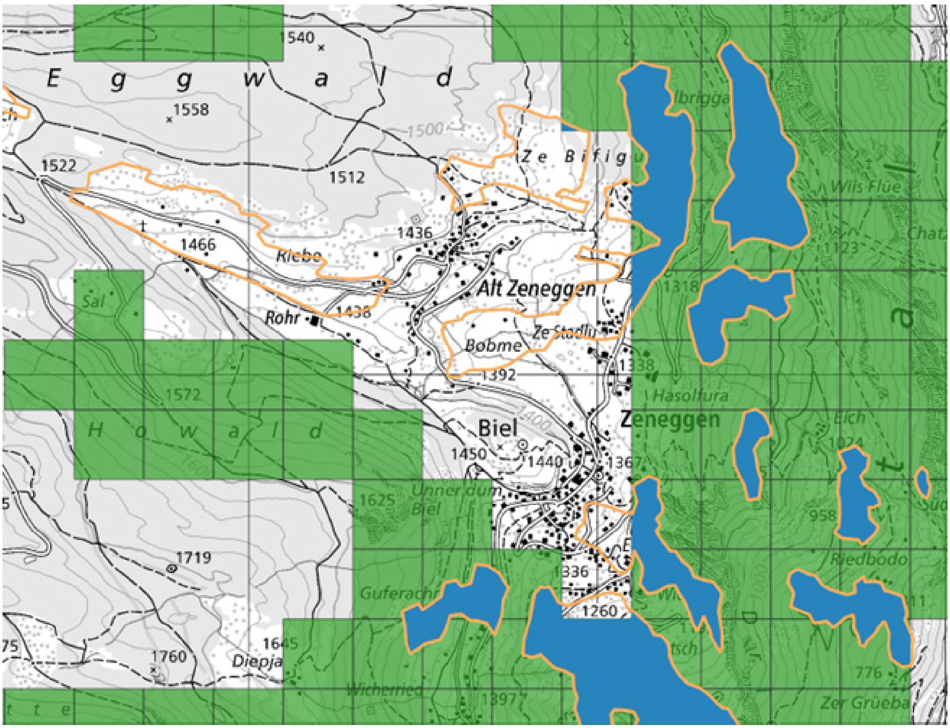

Figure 13. The intersection analysis is based on the overlap of the terrace inventory (orange) and an analysis grid – in this case, the generated slope gradient grid (green). The area that is defined within the terraces and the slope gradient grid is transferred to the intersection layer (blue).

limited processing capacities, it would have been difficult to perform the analysis based on higher-resolution data.
Proximity to settlements, location below 1,900 metres above sea level and land cover with agriculture or forest are factors that applied to almost all terraced landscapes, with the location below 1,900 metres above sea level being derived from the GIS analysis and showing a recovery rate of almost 100%. This value could also be set lower in future modelling.

The cumulative inaccuracies, mainly due to the slope gradient, add up to a value of 38.79 % or, taking aspect into account, 35.91 % of the terraced landscapes, whose location is based on the five factors examined, with the slope gradient and aspect involving a very high degree of variability and inaccuracy (see Table 3). These two factors must therefore be approximated using complex processing methods and transferred to grid cells, while proximity to settlements and land cover can be mapped using accurate vector data.

Depending on the factors selected and their combination, this approach, with its limitation of the study area, appears to have considerable potential for a focused search for new terraced landscapes – also with regard to machine-supported and automated processes.

Factor	Area [ha]	Terraced area [ha]	Proportion of factor in all TL [%]
Terraced landscapes TL (total inventory)	39,802.7	39,802.7	-
Proximity to settlements (1400 m)	2,393,513.17	39,124.64	98.30
Below 1,900 metres above sea level	3,063,484.52	39,759.38	99.89
Land cover Agriculture and forest	3,196,240.72	38,517.96	96.77
Slope 17-50°	1,739,434.14	16,233.50	40.78
Aspect 45-315°	2,926,904.12	35,466.59	89.11
Total potential area (without aspect)	516,353.32	15,439.19	38.79
Total potential area (with aspect)	385,933.82	14,291.54	35.91

Table 3. Results of the intersection analysis with the calculated potential terraced areas

5. CONCLUSIONS AND OUTLOOK

Our survey of Switzerland's terraced landscapes represents an important step towards a systematic inventory. It has been shown that a combination of an inventorying based on literature, the modelling of potential terraced areas, and a visual mapping based on map data has the potential to capture terraced landscapes as comprehensively as possible. However, some uncertainties remain. At the methodological level, limited resources and computing power meant that some compromises had to be made and medium resolution geodata had to be used. At the inventory level, it was difficult to obtain an accurate assessment of the cultivation and precise demarcation of the terraced landscapes based on aerial photographs and other ortho-data. Overall, however, the approach proved successful, and it was possible to carry out a rough distribution and characterisation of the terraced landscapes for the whole of Switzerland.

In a next step, however, it will be necessary to refine the quality of the demarcation and the designation of the use of the terraced landscapes. This also applies to the possible use of the inventory for planning specific terrace-specific conservation measures at cantonal or regional level. Precisely because the approach described here makes it difficult to draw conclusions about the quality and significance of the mapped terraced landscapes, conclusions about their ecological and cultural significance, their role in identity formation and regional identity, and their recreational and experiential value (Rodewald et al. 2014) must be addressed, in addition to taking into account literature and their protection status, at the regional level. For this purpose, as well as for general verification, refinement and improvement of the inventory, in addition to the necessary field work (site visits), the knowledge of local and cantonal experts must also be incorporated.

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Article

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Phd Architect. Her activity focuses primarily on Mediterranean landscape, rural areas and architecture of stone. Born in Rome in 1982, she grew up between the southern shore of Sicily and Pantelleria island. She studied Architecture at the Polytechnic University of Catalonia (UPS) in Barcelona and at Roma Tre University in Rome, where she graduated cum laude with a final thesis on Mediterranean terraced landscapes (Riflessioni su alcuni tratti peculiari del paesaggio mediterraneo was subsequently published as a book in 2013).

From the very beginning, as an architect, she focused attention on cultural landscapes and on the role of contemporary architecture in the protection of built and natural heritage. In 2006 she completed the II level International Master "Architettura-Storia-Progetto" at the Roma Tre School of Architecture (director: Mario Manieri Elia) and, in 2007, a course in Restauraciòn arquitectonica offered by the University of Valladolid (director: Ignacio Bermejo Represa). In 2011, she holds a Ph.D. in Architecture in Venice (Learning from the Mediterranean, International Ph.D. "Villard d'Honnecourt", was in 2016 published as a book Viaggio nel Mediterraneo. La costruzione di un paesaggio attraverso l'iconografia dello spazio architettonico).

Lines of Earth: Architecture and the Spirit of Terracing

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ABSTRACT

Terraced landscapes are living cultural and ecological systems shaped over centuries, integrating geology, climate, and local resources. Their preservation depends on active inhabitation, cultivation, and care. Architecture mediates between historical forms and contemporary needs, addressing functional, ecological, and social challenges while articulating the identities of places and communities.

This paper identifies generative principles—such as water flow, wall orientation, and material logic—that guide interventions enhancing habitability and preserving cultural and environmental integrity. It also proposes archetypes for sustainable, contextually grounded architecture in terraced landscapes, offering a design framework that bridges traditional knowledge and contemporary architectural practice.

KEYWORDS

architecture, rural design, landscape, stones

Introduction

Terraced landscapes constitute a form of living heritage whose preservation cannot rely on restrictive or purely regulatory approaches. As Magnaghi observes, "these are not Etruscan vases or archaeological artefacts which can be preserved in a glass case in a museum or in any kind of enclosure" (2013, p. 131). Rather, their continuity depends on a renewed form of rural awareness—one that requires time spent within terraced landscapes, their inhabitation, observation, and appreciation, and ultimately their active cultivation and care.

Within this perspective, architecture plays a pivotal role, as it can mediate between the inherited forms of the historical landscape and the demands of future transformations. Architecture operates as a temporal device: it carries traces of the past into the present, while simultaneously renewing them through contemporary practices and needs. In terraced environments, this mediation is not merely formal but deeply structural, engaging issues of use, maintenance, and adaptation.

Rejecting the spectacularization that often characterizes contemporary architectural imagery, this paper adopts a Mediterranean-oriented approach in which architecture is understood not only as a means of articulating the identities of places and communities, but also as an operative tool for addressing concrete spatial, environmental, and social challenges. Terraced landscapes are interpreted as spatial frameworks within which new architectural interventions can be integrated to enhance inhabitants' quality of life—improving flexibility, comfort, connectivity, and access to services—while remaining consistent with the underlying logic of the land. In this sense, architecture becomes both a cultural and ecological agent, contributing to the continuity and transformation of terraced landscapes as living systems.

Function

Architectural intervention within terraced landscapes requires a thorough understanding of the functional logic governing these systems. Any new construction is inevitably inserted into a highly refined agricultural and environmental framework—one that has evolved over centuries through the integration of geology, climate, topography, and locally available resources. Terraced landscapes therefore operate as complex and resilient systems, in which spatial form and environmental performance are inseparable.

The apparent visual harmony of Mediterranean terraced landscapes often conceals the intrinsic fragility of their geological and climatic conditions. As Braudel incisively notes, the Mediterranean has never been a freely given paradise, but rather a territory shaped through persistent human effort against steep slopes, shallow and friable soils, and extreme climatic variability (Braudel, 1985, p. 8). Intense rainfall episodes rapidly trigger erosion, while prolonged dry seasons impose severe constraints on cultivation. Mountainous terrains further limit accessibility and arable land, reducing cultivable surfaces to narrow strips of soil carved into otherwise inhospitable slopes.

Each terraced landscape is thus the outcome of a centuries-long process of transformation, in which human communities constructed a primordial yet highly effective form of linear architecture to stabilize and inhabit steep terrains. Through the systematic use of dry-stone walls, impervious slopes were converted into stable, durable, and productive surfaces. These interventions generated distinctive cultural landscapes, capable of expressing the morphological, geological, technical, and social specificities of individual communities. Terracing materializes the terrain itself as a constructed section: a geometric reorganization of relief that effectively translates contour lines into built form, often extending for hundreds of kilometres.

The widespread diffusion of terraced systems across the Mediterranean basin can be attributed to both the prevalence of mountainous topographies and the region's distinctive climatic regime. Despite local variations, the Mediterranean climate exhibits a remarkable degree of coherence, shaped by the alternating influence of Atlantic depressions and Saharan air masses. Long, dry summers dominated by north-easterly winds contrast sharply with autumn and winter periods characterized by intense rainfall, creating cyclical stresses that terraces are specifically designed to mitigate.

Within this context, dry-stone walls perform multiple, interrelated functions. First, they provide effective soil protection against erosive rainfall by reducing slope gradients and slowing surface runoff, thereby limiting soil loss and supporting biodiversity. Second, they enhance water capture and retention. The transformation of sloped terrain into flat or gently inclined platforms increases infiltration capacity and ensures a more even distribution of water across cultivated surfaces. Dry-stone construction further amplifies this function through its permeability and thermal behaviour: the absence of mortar allows walls to act as atmospheric vapour condensers, particularly during hot and humid summer periods. As temperatures rise, water vapour penetrates the stone mass; during nocturnal cooling, condensation occurs and moisture is released into the soil beneath the walls. Empirical evidence supports this mechanism. Research conducted in the Negev Desert has shown that ancient dry-stone structures enabled the cultivation of olive trees and vineyards in conditions of extreme aridity, relying almost exclusively on atmospheric moisture condensation. The orientation of plant root systems toward nearby stone walls further confirms the role of these structures as localized water sources. Such findings have even prompted new interpretations of historical and biblical references to water and fertility emerging "from the rocks," understood as metaphors grounded in practical environmental knowledge.

Dry-stone walls also constitute an integral component of sophisticated water management systems. Terraced plots are interconnected according to gravity and hydrological flow, using contour lines to collect, channel, and distribute rainfall efficiently across the landscape. Wall sections are often trapezoidal, with a wider base and a narrower top, enhancing structural stability while directing water inward rather than downslope. Concave wall tops and carefully oriented stone surfaces further guide rainwater into the soil profile, transforming the wall into a hydraulic device that counteracts erosive forces.

Finally, terraces facilitate cultivation by improving soil structure. Stones removed during wall construction reduce surface obstacles and produce a finer, more compact soil granulometry capable of retaining moisture.

Within this functional framework, inhabited spaces are not external additions but integral components of the system. Buildings participate in water regulation, microclimatic control, and protection from wind and solar exposure, operating in continuity with agricultural terraces in a manner analogous to ecological organisms adapting to their environment.

Form

"The slopes are arranged into terraces, supported by dry-stone walls built with stones obtained from clearing the land of rocks. These structures follow the natural topography and at times become true constructions — spatial frameworks that reconfigure the landscape, which comes to resemble a form of quasi-suburban fabric"
(Sereni, 1961)

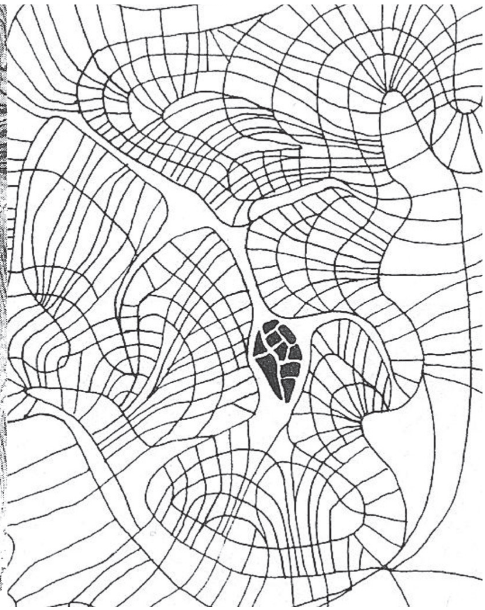

Figure 1. Left. Morphological analysis of a Mediterranean terraced landscape, illustrating slope configuration, terracing patterns, and stone wall layout. These analyses highlight the integration of natural topography, agricultural practice, and human intervention. Source: L'homme et le territoire, in L'Architecture d'Aujourd'hui, n. 317/1998.

Figure 2. Right. This overlay creates complex patterns for a coherent spatial logic.

Dry-stone walls in terraced landscapes adhere to a geometric and rigorous system dictated by agricultural practices, soil characteristics, orientation, and cadastral constraints. Within this system, walls not only delimit space but also shape its perception, constraining polarized structures and defining spatial hierarchies. Understanding the principles governing stone walls requires superimposing an ordered structure, such as enclosed fields, onto the maximum slope lines. This overlay generates complex patterns in which drainage networks, irrigation channels, paths, and natural features converge into a coherent spatial logic (Figs. 1-2).

The constructive and spatial archetype of terraced walls is predominantly compressive. Architecture exploits the hardness, mass, and permanence of stone, which, as Frampton observes, "has left its mark on the world for eternity" (1995, p. 430). Rooted on rocky outcrops and assembled into walls of varying height, stone structures modify the morphology of the landscape, redefining both its material and perceptual qualities. Dom Hans van der Laan emphasizes this transformation: "The first datum is the horizontal and limitless datum of the earth. As we stand vertical in this space, our experience is horizontal and, with only the horizon as a false boundary, it is difficult for us to come to terms with ourselves within this space. To adapt natural space, we create a new space for ourselves by drawing the secondary architectonic datum, the wall from the earth…" (2000). In this sense, walls operate not merely as enclosures but as instruments that orient movement, influence perception, and establish a dialogue between natural and built space.

The experiential effect of a wall is closely related to its height. When lower than eye level, a wall functions as a trace; when higher, it becomes a boundary, producing what Bachelard terms a sense of restlessness, a curiosity about the space beyond, and a perceptual engagement with the void (Bachelard, 1975). Stone walls, therefore, define circulation, create vantage points, and generate a layered perception of the landscape, integrating human activity with environmental systems.

Architectural design in terraced landscapes must engage with these rules, treating them as a grammar to be interpreted within contemporary language. Historical examples

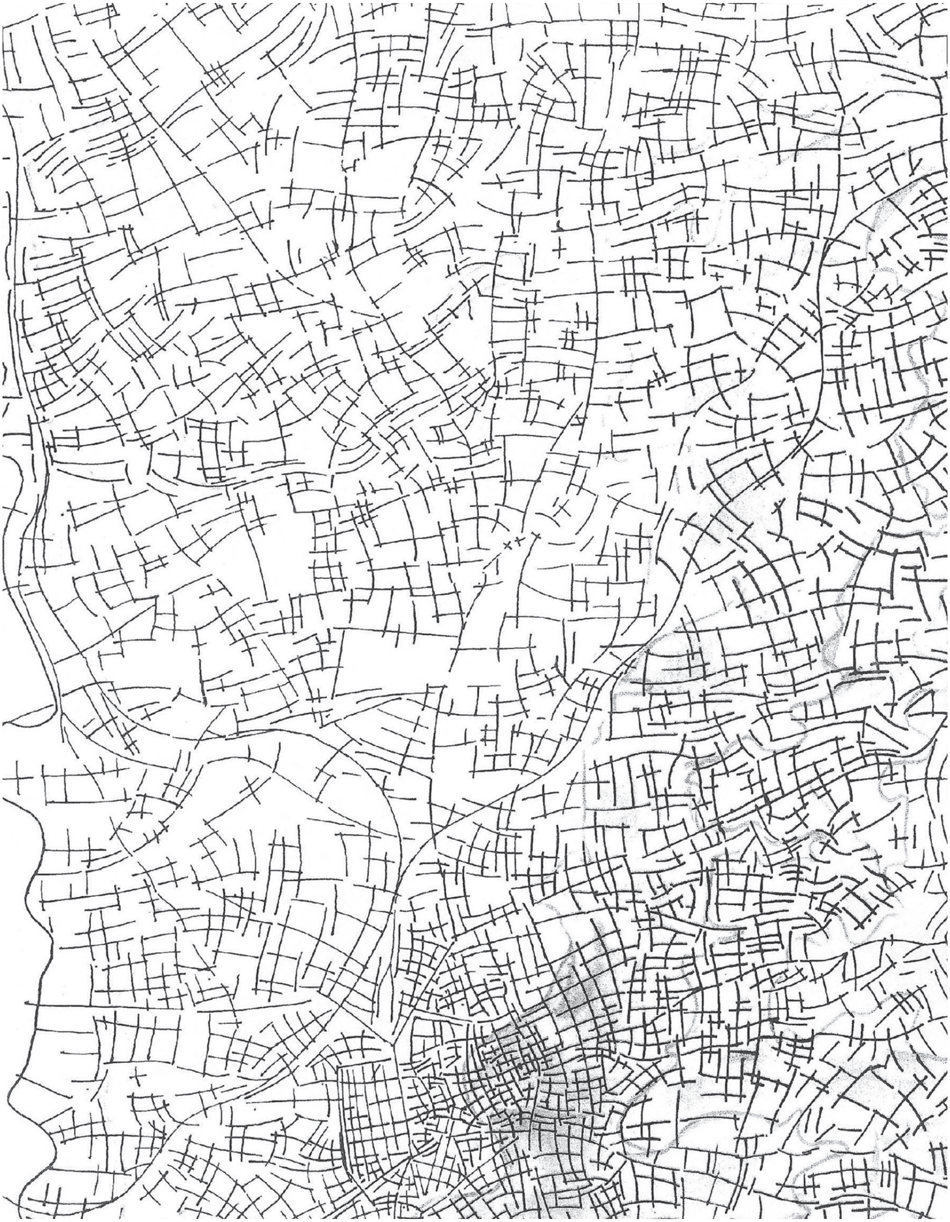

Figure 3. Diagram of "Lines of Force" in a terraced landscape, showing water flow, pedestrian circulation, and wall orientation as a framework for spatial organization and contemporary intervention. Source: L'homme et le territoire, in L'Architecture d'Aujourd'hui, n. 317/1998.

illustrate this principle. Luigi Cosenza and Bernard Rudofsky's Villa Oro (Posillipo, 1937) exemplifies the integration of terraces and building volumes: terraced platforms function as a bridge over the slope, the building is organized on multiple levels, and railings explicitly reference nautical forms (Figs. 4-5). The metric and formal choices emphasize abstract volumetric clarity through the contrast between white plaster and stone podiums, privileging topological research over typological assertion (Irace). Similarly, Alvar Aalto's Iran Museum of Modern Art (Fig. 10) employs the Persian terraced landscape as a model, arranging longitudinal volumes slightly angled to follow natural contours and incorporating a walled, partially covered sculpture garden, thereby amplifying the underlying terraced logic.

From this understanding, generative principles and signs for each terraced landscape can be traced. Water flows perpendicular to contour lines, guided by connecting walls, while pedestrian circulation follows stone walls via stairs and ramps. A useful analytical method involves mapping dynamic walls (water management systems) and static walls (soil and vegetation containment) onto plan representations. The intersection of these systems reveals "lines of force" (Fig. 3), a spatial network that can inform the design of new architectural interventions while respecting the existing terraced logic.

Ecology and storytelling

In terraced landscapes, walls and buildings are constructed through the accumulation of stones sourced on site. The process of extraction, transport, and transformation is minimized: the primary operation consists in selecting and positioning the stone. Construction thus becomes simultaneously a process of recovery—reclaiming inert material—and a strategy of site renovation. The soil assumes multiple roles: quarry, cultivated field, enclosed garden, and foundation for habitation. In contemporary architecture, where materials often appear thin, light, and detached from their origin, the mass and weight of stone restore a tangible sense of materiality.

The assembly of dry-stone walls follows a combinatorial logic that relies on traditional construction techniques, varying across regions and cultures. Stones of differing sizes and

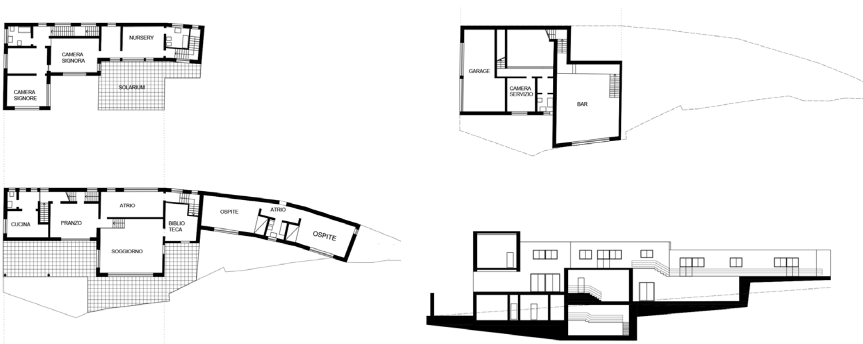

Figure 4. Top. Luigi Cosenza and Bernard Rudofsky, Villa Oro, Posillipo, 1937. Terraced platforms, multi-level volumes, and railings inspired by nautical forms demonstrate the integration of architecture with natural slopes and topological design. Source: Buccaro A., Mainini G., Luigi Cosenza Oggi 1905–2005, Napoli, Clean Edizioni, 2006.

Figure 5. Floor plans and cross-section. The three floor plans illustrate the interior progression from the ground level up to the top level, while the single cross-section emphasizes the building's relationship with the sloping site.

shapes are carefully juxtaposed to minimize voids, generating walls whose architectural specificity and expressiveness derive primarily from the inherent qualities of the material rather than surface treatment or decorative arrangement. A fundamental requirement for these walls is substantial thickness—typically 60 to 100 cm—which imparts mass, structural stability, and spatial depth to the architecture (Figs.11-12).

Figure 6. *Top. Katerina Tsigarida, summer house, 2003. Simplified stone volumes, voids, and minimal window fixtures illustrate contemporary integration with terraced landscapes while maintaining local material logic. Source: divisare.com.*

Figure 7. *Bottom. Interior–exterior transition and material logic. A view from beneath the timber open roof illustrates the extensive use of local stone for the structural pillars and terrace flooring, mirroring the rugged, sloped terrain of the surrounding landscape.*

Figure 8. Top. Decaarchitecture, Ring House, 2015. Pure stone volumes and terraced organization demonstrate spatial continuity with the landscape and adherence to ecological and morphological principles. Source: divisare.com.

Figure 9. Bottom. Stone facade and landscape continuity. The facade utilizes textured stone masonry that mimics the geological character of the arid mountains in the background.

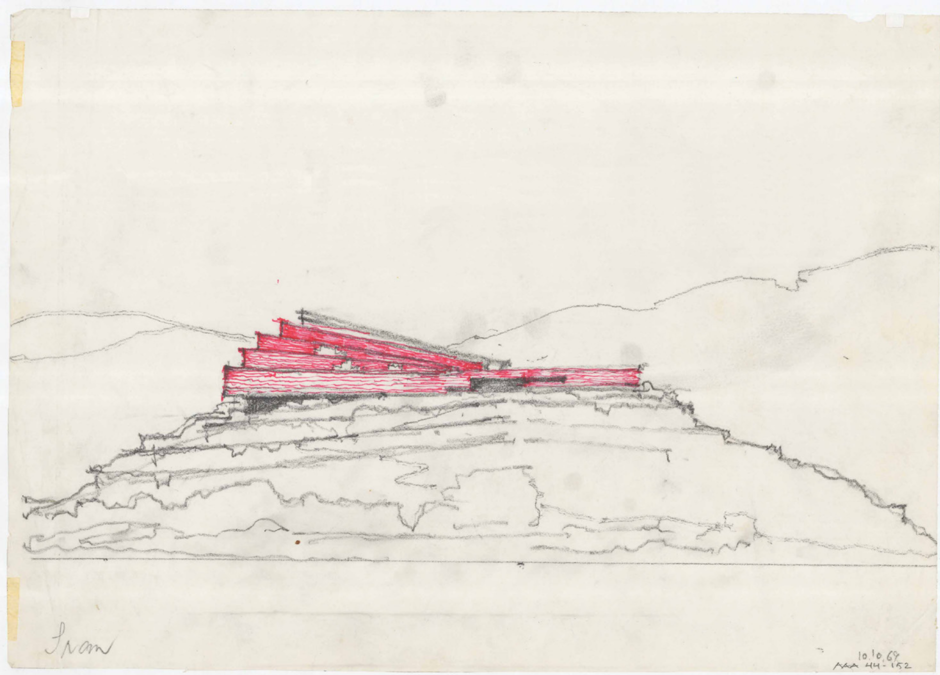

Figure 10. Alvar Aalto, Iran Museum of Modern Art, Shiraz, 1969. Clustered longitudinal volumes, slightly angled, and the walled sculpture garden reflect inspiration from Persian terraced landscapes, translating traditional forms into contemporary museum design. Source: © Alvar Aalto Museum.

Architecture that employs local stone becomes a narrative of the landscape itself. As Michelucci recounts regarding the Church on the Highway (Fig. 13):

"When I built the church on the Highway, I called various workers from various regions, I took them to the place where the stone was and I said: 'This is the stone you have to work, make me a wall one meter high!' … Someone couldn't. They did not know the material and could not interpret it. They attempted to polish the stone, unaware that striking it with a hammer revealed its natural forms. From that action emerged the living wall" (Michelucci, 1990).

By employing stone in its natural, structural state, architects root buildings in their context

Figure 11. Marco Zanuso, house in Sassari, 1960. The design demonstrates integration of building volumes with sloped terrain, emphasizing terracing principles and the dialogue between architecture and landscape. Source: atlantearchitetturacontemporanea.cultura.gov.it.

and in the collective memory of the community. Nietzsche emphasizes the material's potency: "Stone is more stone than before" (1878). Contemporary architecture often obscures this quality by enclosing stone in metal frames, slicing it into thin panels, or embedding it in superficial façades. Terraced landscapes demand a return to material-driven design, privileging mass, masonry, and spatial logic to create architecture defined by the interplay of solids and voids, light and shadow.

This approach promotes highly sustainable construction and fosters a lifestyle integrated with the environment. The Mediterranean climate, characterized by extremes and pleasant conditions, encourages the design of open, permeable spaces that disrupt strict geometrical order. Recent projects illustrate this principle: Katerina Tsigarida's work in Andros (2003) (Figs. 6-7) and Decaarchitecture's project in Crete (2015) (Figs. 8-9) employ simple stone volumes, voids, and minimal window fixtures, integrating architecture seamlessly

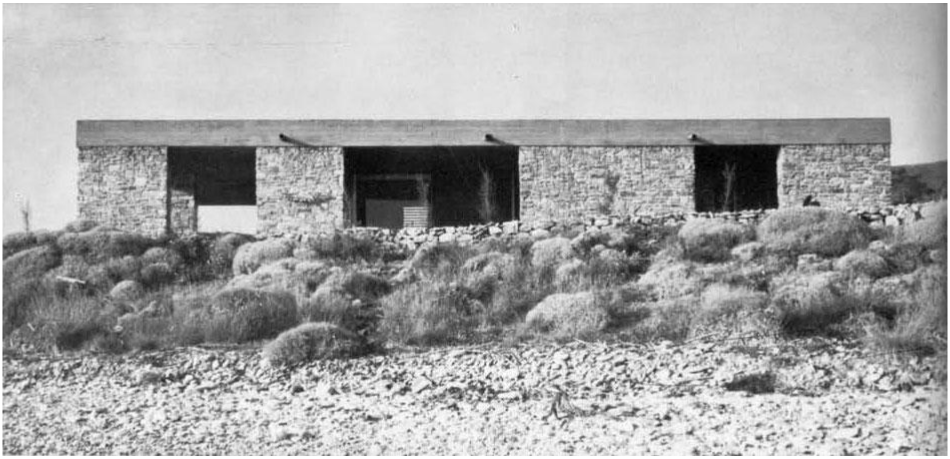

Figure 12. Aris Konstantinidis, weekend house in Anavissos, 1962. The project exemplifies contextual design within a terraced Mediterranean landscape, combining local materials, volumetric simplicity, and sensitivity to microclimatic conditions. Source: doma.archi.it.

with the terraces. Buildings constructed with local stone possess strong narrative and representational capacities. As Pikionis reflected:

"Yet there were moments when I felt as if my spirit had become one of the innumerable, nameless stones buried in the deep foundations, the massive walls, the architraves and vaults of the buildings I contemplated" (1958).

Through these practices, architecture acts as both an ecological and cultural agent, mediating between natural and built environments, preserving local knowledge, and narrating the historical, material, and social identity of terraced landscapes.

Conclusions

A terraced landscape can survive only if people continue to walk, cultivate, harvest, consume, and live within these mountainous rural environments. More than seventy years after the initial mass migration from the countryside to the city, a slight reversal of this trend is emerging, likely influenced by recent experiences such as the pandemic and by a renewed awareness of the value of local traditions and community-based life in shaping

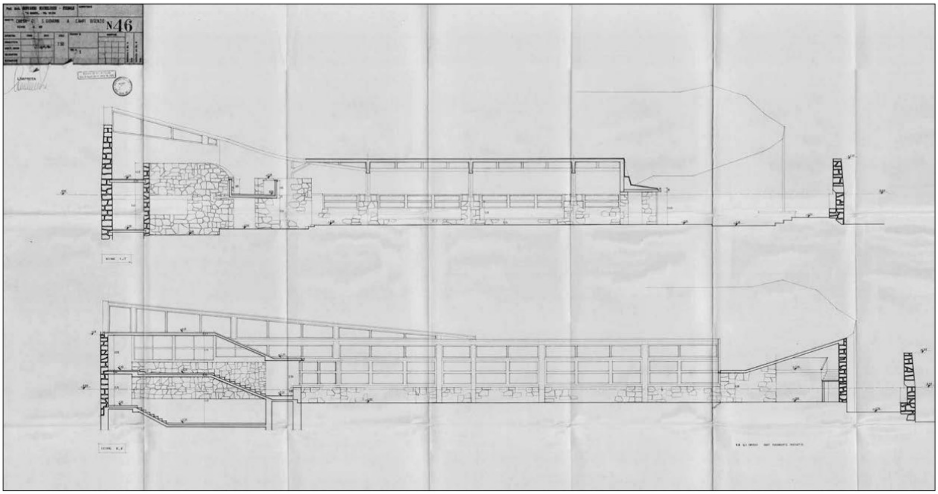

Figure 13. G. Michelucci, Church of San Giovanni Battista (Church on the Highway), 1960–1964. Stone walls and terraced construction illustrate the use of local materials, traditional techniques, and the creation of a "living wall," emphasizing materiality and narrative embedded in the site. Source: A. Merlo, Non disegnata ma modellata. Il rilievo della chiesa dell'Autostrada di Giovanni Michelucci, Dipartimento di Architettura dell'Università degli Studi di Firenze, 2020.

quality of life. Supporting this transition requires that economic and social development be accompanied by a conscientious transformation of the territory, integrating social activities, infrastructure, and new employment opportunities into rural spaces.

Architectural thinking must therefore be deliberate and contextually informed, producing an architecture capable of engaging in a dialogue with the landscape. Projects must respond to community needs—including schools, housing, and services—while preserving local identity. To achieve this, design must be grounded in a comprehensive understanding of the local territory, including land use, landscape regulations, agrarian plots, water management systems, traditional construction techniques, locally available materials, and the specific patterns of everyday life. Architectural interventions can thus serve as instruments for narrating the Mediterranean terraced landscape, highlighting its spatial configurations, morphological features, and traditional cultivation practices.

The distinction between architecture and terraced landscapes lies fundamentally in temporality: buildings endure across long spans of time, while stone walls are subject to continual change. The challenge for contemporary architecture is to operate at this boundary, reconciling the human need for secure shelter with the inherent precariousness of existence. Architecture must engage with the temporal dimension of terraced landscapes, preserving memory and cultural continuity, an idea beautifully symbolized by Hermes in Greek mythology, who represents transitions and the passage of time.

As Aris Konstantinidis observes:
"The true work of architecture is not a monument, but a receptacle of life, a construction that lives close to its creator, following him in the various, fast-changing functions of his life, to each of which it lends a certain form, a form that is never final or finished, but that is completed as time goes by, flowering again and again into daily perfection" (1975).

In this sense, architecture in terraced landscapes becomes both an agent of cultural continuity and a framework for contemporary life, integrating ecological, social, and material concerns into a coherent and enduring spatial narrative.

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Article

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Land of Terraces: From the Landscape of Necessity to the Need of the Landscape

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ABSTRACT

The construction of these extraordinary territorial structures, whose main purpose was the cultivation of the land and the production of food, involved both prodigious physical work and a remarkable task of design and construction exactly embedded in the slopes of the mountains. The passage of time, which acts like a gigantic eraser, and the loss of the original reason that led to them cause these terraced landscapes to fade. If it was human need – essentially related to food production – that created them, we should look for new reasons, new functions and new formulas to reactivate and conserve them.

Beyond the obvious aesthetic and landscape perspective (emotion), terraced landscapes and agroecosystems and other historical productive structures generated by peasant communities can play a decisive role as both a productive and heritage resource, both at the service of a new peasant economy and at the service of the conservation of complex heritage facts.

KEYWORDS

Evolution of rural-urban relationship, terraced landscapes, La Gomera, peasant territorial management, radical reform

1. INTRODUCTION

The terraced landscapes were described by the Canarian geographer Leoncio Afonso as the "landscapes of hunger". The construction of these extraordinary territorial structures, whose main purpose was the cultivation of the land and the production of food, involved both prodigious physical work and a remarkable task of design and construction exactly embedded in the slopes of the mountains.

Behind the terraces are assembled human need and peasant culture. The current perception that the tourist as an outsider has of these cultural landscapes tends to put aesthetic perception as the main stimulus, the emotion produced by the beauty of the agrarian landscape built by humans, rather than the reflection of the historical and anthropological reasons that created them. The current emotional relationship that tourists have with historic peasant landscapes contrasts with the physiological relationship that their builders had with the territory. The passage of time, which acts like a gigantic eraser, and the loss of the original reason that led to them cause these terraced landscapes to fade. If it was human need – essentially related to food production – that created them, we should look for new reasons, new functions and new formulas to reactivate and conserve them, because the enjoyment of the landscape is also a human need. Seeking ways to satisfy human needs together — those of the body and soul, those of the individual and those of the community, those of culture and nature, those of integral development and heritage conservation — with those of the physiology of the territory is what moves us to recreate and make viable a new way of thinking in favour of terraced landscapes and, by extension, to the intelligent, functional, resilient and stable landscapes of nature and peasant culture.

2. THE HISTORICAL RELATIONS BETWEEN THE COUNTRYSIDE AND THE CITY

By looking at functional evolution, and combining the ideas of Lewis Mumford (2005, 2012) and Henri Lefebvre (1972), it is possible to establish a schematic sequence of the different phases through which the city passed, as well as its crises from the origin to the present.

From the functional point of view, the city was assuming and developing different tasks, starting with the original, the religious and that of a meeting place for the cohort of villages that populated the territory; which was succeeded by the political function, to normalize and order the joint action of the different groups and human communities in the territory beyond the limits of the village; the commercial facilitated in the Mediterranean Sea by the boom and development of navigation and finally the Industrial and its current sequel the megalopolis.

In any case, the city did not evolve by discarding the previous functions but by incorporating them, assuming them, adapting them if anything to the time, but without renouncing them. The city today preserves the features of this historical evolution and thus the religious centre, the governmental authority, the commercial space or the manufacturing activity and the workshops are present in the contemporary urban structure as essential parts of it, as the vestiges of its evolution, almost in the same way that our brain preserves the reptile brain or geology the record of tectonic and geomorphological events that shape it to the territory. The village, however, maintained during the long period of time from its origin, with the advent of the Neolithic Revolution until the consolidation of industrial agriculture in the twentieth century, a single function: the management of the surrounding nature to produce food extensively, essentially using local inputs and combining agricultural techniques in a systemic and systematized strategy livestock and forestry. The end of this essential function in the management of the territory is the main cause of the abandonment of the countryside and the contemporary depopulation that is behind, or in front of, one of the determining factors of the great rural fires. The outline of this functional evolution of the city is represented in the following diagram (Figure 1).

As can be seen, in the history of relations between the city and the countryside we find three critical moments:

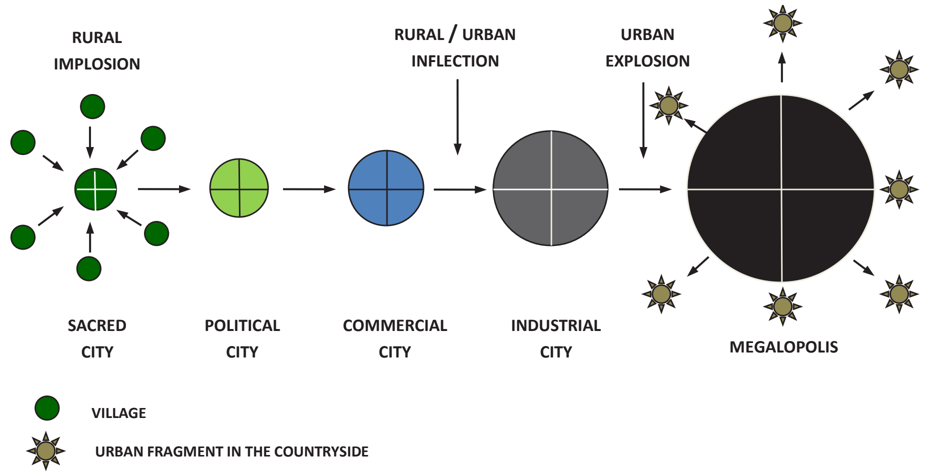

Figure 1. *Diagram illustrating the functional evolution of the city and the progressive loss of its territorial management role—a process closely associated with rural abandonment, contemporary depopulation, and the conditions contributing to large-scale rural fires.*

1. The birth and origin of the city by rural implosion. For Lewis Mumford, the city is formed from an "implosion" of energies of a rural nature caused by "multiple diverse elements of the community scattered throughout a large system of valleys that were mobilized" for its foundation (2012: 61). Strictly speaking, the first germ of the city is the village, and it is the meeting of several villages that gave rise to the city. We could say that the city was born and learned from the village and that in its DNA there are vestiges of that first vital impulse. As much as history, and the different subsequent versions of the city, were moving away from that village origin, in Lewis Mumford's opinion "without that long period of agricultural and domestic development, the surplus of food and labour that made urban life possible would not have been achieved. And without the foresight and conscious moral discipline that Neolithic culture introduced in all spheres, it is doubtful that the more complex social cooperation that developed in the city would have appeared" (2012: 25).

2. The rural/urban inflection. After the Neolithic Revolution, the next great revolution of humanity was the industrial revolution that gave rise to a new type of city and, above all, to a radical change in its relations with the countryside. The countryside

will become the large-scale supplier of labour to the city, and this will lead to a gradual depopulation of large rural areas – which in the case of Spain began in the first decades of the TWENTIETH century – and an increase in the concentration of production, both in agriculture and in the media. which will pass into the hands of agrarian industrial capital – agribusiness and agribusiness – to the detriment of small producers. The industrialization of the countryside will also lead to the extinction of the peasant, his communities, his culture, his value system and his agroecosystems. And in this context also of the terraced landscape, as demanding in labour as in time and hardness of work.

3. The urban explosion. After centuries of urban accumulation, and the recent annulment of the peasant economy, the city has ended up exploding, generating hyper-technological urban environments and, in relation to the culture of the land, a-cultural, to the point that "we live, in fact, in a universe immersed in an explosion of mechanical and electronic inventions, the parts of which move away, increasingly, of its human centre" and of the territory, causing the technological explosion "to produce a similar explosion of the city itself: the city has exploded, scattering its complex organs and organizations throughout the entire landscape" (Mumford, 2012: 61). The birth of megalopolises and the growth of cities have not yet stopped and, at the same time, there is a phenomenon of diffusion, invasion and distortion that floods the countryside with structures, laws, thoughts and urban fashions that are superimposed – to the point of sometimes erasing them – on the vestiges of the pre-existing "rustic civilization" to which Miguel de Unamuno referred. Henri Lefebvre expressed it in a synthetic and forceful way: "the city asserts itself, then it explodes" (1972: 114). And today, the tourists who visit rural landscapes are also, for the most part, representatives of that urban explosion and of an increasingly decontextualized vision and perception of the historical facts that confer the identity of the places they visit, thus contributing to their trivialization, gentrification and forgetfulness.

In short, the Industrial Revolution and its aftermath broke with the historical relations between the countryside and the city, between urban culture and peasant culture, which for millennia, from the first Neolithic to the generalization by maturation of the Industrial Revolution (mid-twentieth century), was established on the following scheme (Figure 2):

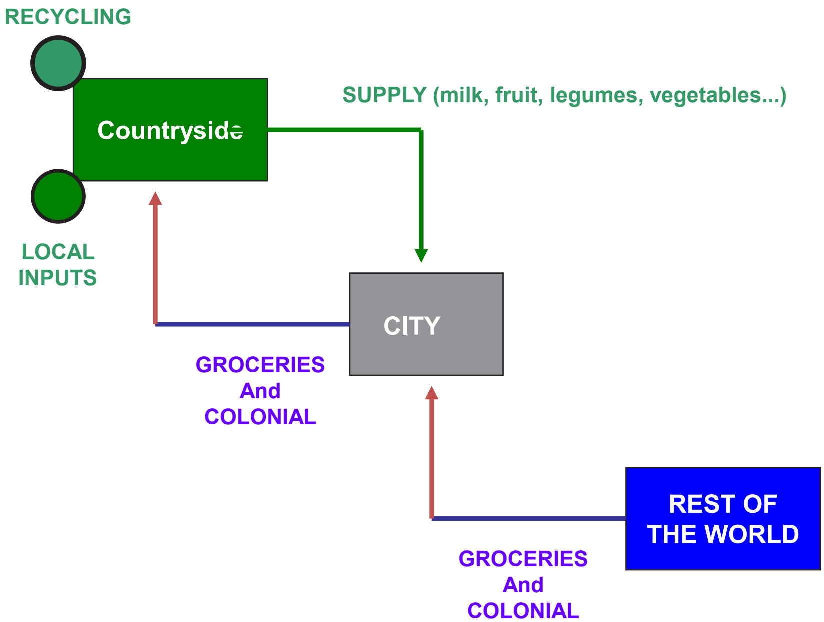

Figure 2. Rural-urban relations: original, historical and pre-industrial relationship (from the origin of the city to≈ 1960)

Around each city a group of villages, or scattered hamlets, was responsible for the main food supply of the city. The market, or food market, occupied a central space in the city, generally close to religious representation – church or cathedral – and local or regional political power.

Around the food market were established the shops linked to non-local food: the grocery and colonial shops in charge of supplying food from abroad, from the distant overseas colonies to the relatively nearby production centres of the rest of the region or other regions.

This model of agri-food production and consumption that linked the countryside – mainly peri-urban and secondarily regional – with the city was gradually extinguished with the generalization of company commissaries and, subsequently, supermarkets linked to multinational food companies, so that in the seventies of the last century this model was practically liquidated and was replaced by the current agro-industrial model of production and consumption. based on shopping malls, supermarkets and, increasingly, outsourcing in food preparation.

3. CURRENT RURAL-URBAN RELATIONS

The current relations between the countryside and the city are based on two circumstances: first, the absolute ignorance that urban society has of the countryside and agriculture and the hegemony of urban thinking over any other type of thinking; second, the absolute domination of intensive agriculture and food distribution linked to large commercial areas controlled by multinational companies.

The following diagram (Figure 3) represents the characteristics of the current model of relationship between the countryside and the city in relation to food supply:

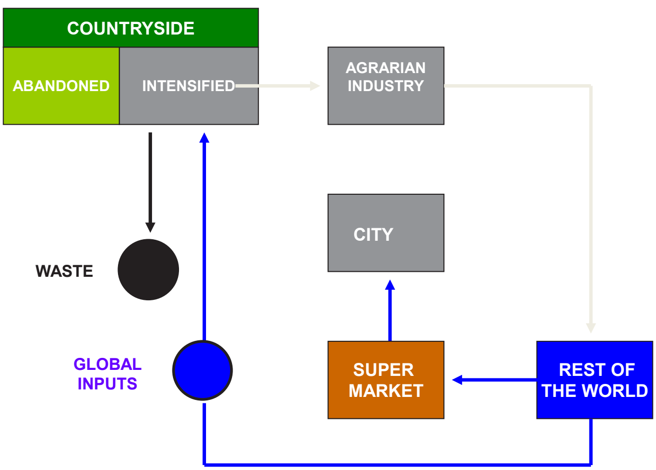

Figure 3. Rural-urban relations: current or industrial relationship (from≈ 1960 to present)

Unlike the previous model, the peri-urban and regional countryside no longer directly supplies the city. The villages and hamlets of the rural area near the city have ceased to have that function. The old peasant agriculture is transformed and replaced by agricultural holdings specialized in monocultures that supply the agricultural industry and whose products can arrive – or can come – through food distribution and trade, anywhere.

The second characteristic of the current model is that the countryside is divided in two: the one most conducive to agrarian industrialization intensifies and specializes in monocultures and the one that could not be intensified, the rural territories and villages furthest from the city located in territorial areas with special physical, orographic or bioclimatic difficulties, was gradually abandoned and depopulated.

Public policies on the rural environment were also divided into two: on the one hand, agricultural policies, designed to increase agricultural production through equipment, infrastructures and aid for mechanization and investment, directed their efforts towards intensified territories; and, on the other, the conservationist policies that, from the eighties of the last century, directed their efforts towards peasant territories that had gone into decline with the objective of "nature conservation".

However, the conservation policy made four structural errors: a first error of nomenclature – they used the concept of "natural space" instead of the one that would have been more appropriate: territories of nature and peasant culture that had gone into decline – a second error of methodology — they began to talk about protection, most of the time paralyzing, instead of reactivation/functional updating of the local peasant culture so that it would manage the territory again; a third error of strategy – they based the conservationist intention on biological succession instead of on biological renewal, typical of the interaction culture – community – nature developed and refined over centuries by peasants; and a fourth error of perspective: the territory and ecosystems that they wanted to conserve – in reality agroecosystems – were the historical result of the peasant economy and without a new version of the relevant local economy – inspired rather than replicated – in the agroecological peasant economy, it would not be possible to conserve the landscapes, agroecosystems and topo-biodiversity and these, in the absence of management, would enter – in fact they have already entered – into ecological drift, causing the advance of the forest on the old fields of cultivation and pastures increased the forest area of scrub and woodland and with it the risk of large fires.

From the urban point of view, another change will take place: the city will lose the historical function of exchange with the countryside, the relationship between agricultural producers and urban consumers, which occurred in the market or food market in favour of the location of shopping centres and large stores on the outskirts of cities and connected to the ring roads. Local food consumption would be replaced by globalised industrial food.

4. THE FUTURE RELATIONS BETWEEN THE COUNTRYSIDE AND THE CITY

In an approach to the agriculture of the future, with the aim of restoring the lost relationship and adapting it to the contemporary, we can identify three rural areas – the peri-urban, the intensified agrarian and the peasant – with three functions and, therefore, three different territorial and agrarian policies.

In peri-urban rural areas, it would be a matter of promoting local agriculture through an urban agriculture strategy and planning, as is being addressed in many cities, especially in small and medium-sized cities that have not built extensions or infrastructures – or at least only partially – on the rich agricultural soils of meadows and farmland of the urban periphery.

In the intensified rural sector, it would be a matter of reducing its environmental impact by countering an eco-intensification that reduces and alleviates the negative effects of industrial production in monocultures and economies of scale.

Finally, in rural areas of a peasant nature, to which terraced landscapes belong, it would be a matter of reactivating a function linked both to agricultural and forestry production with high added value and to landscape management and planning within a new economic logic inspired by the agro-ecosystem principles developed by peasant ancestors but logically with the necessary updates of contemporary society. The following diagram (Figure 4) represents this trilogy of rural territories and their new relationships with the city:

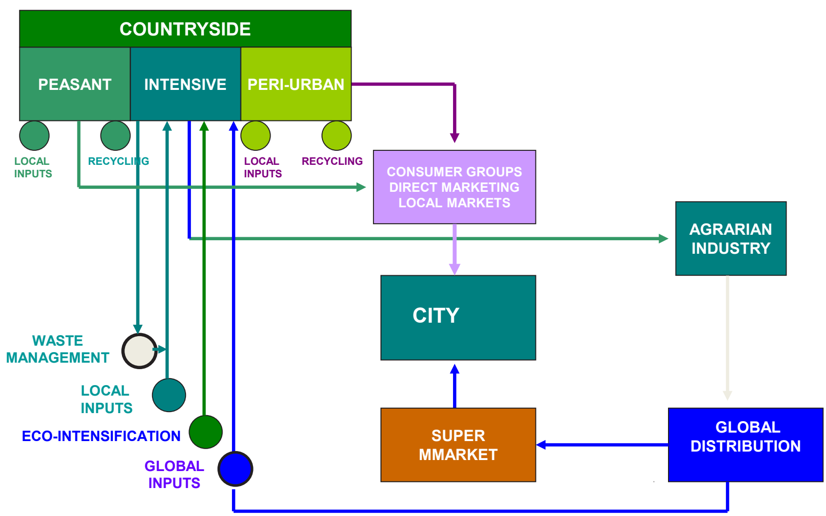

Figure 4. Rural-urban relations:agropolitan or post-industrial relationship (XXI century)

5. TWO PEASANT MODELS OF AGROECOLOGICAL MANAGEMENT ON THE ISLAND OF LA GOMERA

The observation, recognition – in the double sense of knowing and giving value – and updating the agroecological systems of peasant ancestors must be completed with the search for an update of their economic viability, which requires taking advantage of their unique ecological potential to improve a differential economic value in the market and, at the same time, seeking mechanisms to remunerate the provision of ecosystem services and from which the rest of the population benefits. society. Without an up-to-date and rewarding economic activity, the conservation of the natural/cultural heritage of the territories managed by peasant ancestors will be in question.

On the island of La Gomera (Canary Islands, Spain) we find two good examples that serve to explain, in terms of possible economic/ecological profitability, the idea of functional reactivation of the territories of nature and peasant culture: the use of guarapo in Cubaba and the oasis agriculture of Gueleica.

Cubaba's agroecosystem

Dehesa systems are one of the best examples of the success of peasant cultures in the complex and concerted management of the environment by promoting a balanced synthesis between multiple livestock and forest use and the conservation and enrichment of the productive potential of the ecosystem, thus ensuring its permanent conservation.

Although the best known are the holm oak (quercus ilex) pastureland systems of the southwestern quadrant of the Iberian Peninsula, there are numerous local models that combine the arrangement of trees in "hollow forest" with livestock or agricultural uses: the guarapo palm groves in La Gomera, the orchards in Asturias, the chestnut groves of the northwest of the peninsula, the pollarded beech forests in the Basque Country, etc., are also pastureland systems.

A Canarian peasant (magician) perched on the top of a palm tree in Cubaba (La Gomera) performs the "curing" operations for the extraction of guarapo – the sap of the tree – with which what is popularly known as palm honey is made. The guarapeo of the Canary Island palm tree (Phoenix canariensis) and the integral use of the palm groves, the fruits to feed the animals and the stalks or branches for the construction or the manufacture of tools, constitute a unique and complex peasant culture of the midlands of the island. (Photo J. Izquierdo).

In the management of the agroecosystem of Cubaba, the interstices between the palm trees are not used for livestock but for agriculture through a system of terraces, as can

Figure 5. Farmhouse, terraces and pastures of guarapera palm trees in Cubaba. (Photo J. Izquierdo).

be seen in the photograph. Small livestock, mostly goats, use and graze the surrounding forest and are the main suppliers, along with pigs and chickens, of animal protein for the community's consumption. Palm honey extracted from guarapeo was the main commercial resource of this production system.

The agroecosystem of Gueleica

Some forms of agriculture, such as the example of family farming in oases in Gueleica, in the lower midlands of the island of La Gomera, led to the creation of a rich ecozone and a notable increase in biodiversity in areas of extreme aridity. This small nucleus of traditionally managed hamlets – which we would now call sustainable, agroecological, multifunctional and with integrated and cyclical production between inputs and products – was organized around a minimal upwelling of water with which they worked, by means

Figure 6. A Canarian peasant (magician) perched on the top of a palm tree in Cubaba (La Gomera) performs the "curing" operations for the extraction of guarapo – the sap of the tree – with which what is popularly known as palm honey is made. The guarapeo of the Canary Island palm tree (Phoenix canariensis) and the integral use of the palm groves, the fruits to feed the animals and the stalks or branches for the construction or the manufacture of tools, constitute a unique and complex peasant culture of the midlands of the island. (Photo J. Izquierdo).

of terraces, an orchard with fruit trees, a cereal crop, a pasture of guarapera palm trees and a herd of goats. The peasant management of Gueleica, now abandoned, was vital for the conservation of wildlife, topo-biodiversity and some endangered species.
Gueleica. In the semicircle, the place occupied by the upwelling of water that allows the practice of oasis agriculture and organizes the agroecosystem of integral use, agricultural and livestock, from which the local birdlife and other wild species also benefit. (Photo J. Izquierdo).

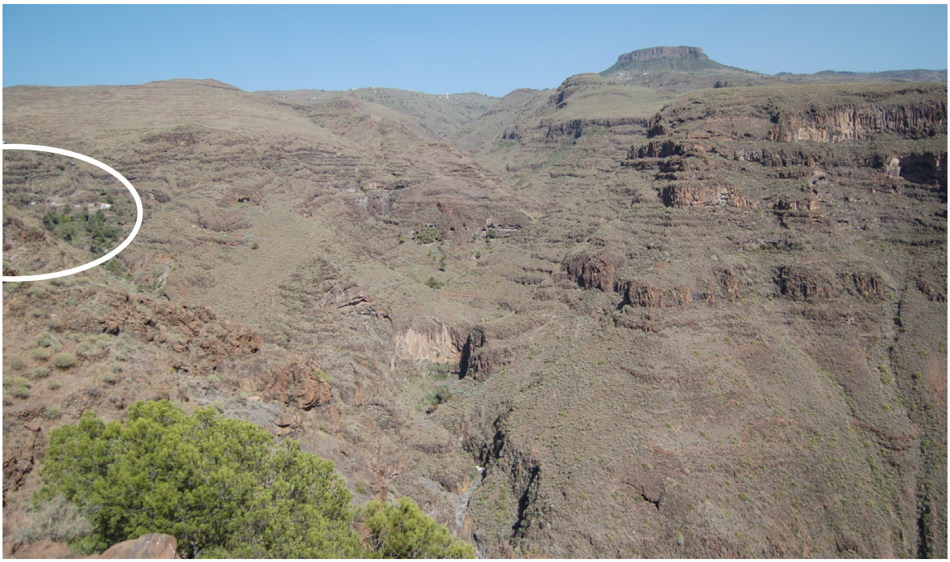

Figure 7. In the upper left frame, the location of Gueleica is indicated in the territorial context. (Photo J. Izquierdo).

6. FINAL NOTE

Probably the idea that the canonical peasant management of the territory, exemplified in this article in the cases of Gueleica and Cubaba, and in many other places in the Canary Islands that still preserve the structures, models and vernacular systems of peasant management of high heritage value, is probably the best and most pertinent strategy

Figure 8. Gueleica. In the semicircle, the place occupied by the upwelling of water that allows the practice of oasis agriculture and organizes the agroecosystem of integral use, agricultural and livestock, from which the local birdlife and other wild species also benefit. (Photo J. Izquierdo).

for the joint conservation of both wild fauna and flora and agricultural and livestock biodiversity as well as culture local island.

The current nature conservation policy has disregarded the complex vision provided by the local agroecological history and the integral perspective of the territory and has become sectorialised, verticalized and specialized, ignoring the historical, economic and cultural circumstances, or rather agro-cultural circumstances, which explain the presence of this or that species and the integral conformation of the landscape.

It is a static and markedly bureaucratic policy with scientific support, most of the time, defined, framed and limited by the reductionist and vertical perspective of the specialist in this or that species and, therefore, lacking the necessary systemic vision that would allow the conservation of the complex ecological contexts without which the conservation of this or that species is not possible. Either the system and its essential agroecological processes are preserved or the parts that compose it are extinguished.

Beyond the obvious aesthetic and landscape perspective (emotion), terraced landscapes and agroecosystems and other historical productive structures generated by peasant communities can play a decisive role as both a productive and heritage resource, both at the service of a new peasant economy and at the service of the conservation of complex heritage facts.

The territorial planning promoted by peasant communities throughout history, through an adjusted and institutionalized use of agricultural, livestock and forestry techniques, has reached the present day in those places barely influenced by industrialization. These peasant geographies, these ancient European cultural landscapes that have survived industrial intensification, constitute valuable agroecosystems in danger of extinction in the twenty-first century. Conserving the peasant nature of the territory requires the design of innovative policies that prevent its disappearance due to drift, neglect or abandonment.

The policies of nature conservation and the promotion of agricultural activity urgently require a radical reform, a Copernican turn: it is no longer a question of presenting to society the achievements of the government of the day that has declared half a dozen new protected areas or continuing to try to increase agricultural income in an undifferentiated way by area or number of head of livestock, but to remunerate, as far as this is concerned, the provision of agroecosystem services of high heritage value.

It is a matter of turning our eyes, in the case of the most unique and exemplary agroecosystems, to peasant management or, rather, to a contemporary version of intelligent historical peasant management, preserving its substance and updating its forms. Preserving the what and changing the how. In short, and in addition, it is a matter of seeking solutions to the main problem of nature conservation in Spain: the abandonment of strategic territories of peasant nature and the general drift of agroecosystems.

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