

ACTIVATE THE WATER HERITAGE TO BUILD MORE SUSTAINABLE COMMUNITIES (1130)

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Abstract. Today we recognize the finite character of natural resources, and the need for use it in a sustainable way to ensure the survival of mankind. Water is one of these resources essential to life, thus, over time, man developed systems to carry and capture water, however, the modern infrastructures of water supply made these systems obsolete. This article states the need to reuse the ancient systems to capture and store water, moreover it reflects about the benefits of the preservation of this ancient knowledge as part of a development strategy based on the valorisation of local heritage and resources. It focuses on a set of small villages in the centre of Portugal, in a carsic territory marked by water scarcity, depopulation and low density.

Keywords: Water systems, heritage, vernacular architecture, circularity, sustainable development.

1. Introduction

The awareness that water is a scarce resource essential to life has led to the interrogation of how to reuse this resource and how to manage it better. The problem of water is not only the lack of it but more the lack of management, it is essential to know how to manage water throughout its cycle, even in areas of a scarcity of water, it is necessary to know how to conserve it and make the best use of it.

Over the years, water has played a key role in the development of regions and cities and therefore man has developed techniques and knowledge to ensure its conduction and storage (Hein et al 2020 p.2). This knowledge and techniques developed over years and passed down from generation to generation are part of local cultures and their heritage. However, in many cases, modern water supply and distribution infrastructures have made these systems obsolete and many of them lost their use. Nonetheless, their value as heritage is undeniable and some studies have addressed the need to value the heritage of water systems and in some countries, this heritage has been subject to conservation policies and preserved.

Today, with the challenges of climate change and the need to transition society towards greener and bluer systems, the discussion about valorization and the use of these

systems becomes even more important. At least in the countries most affected by the scarcity of water due to climate change.

Portugal is living an atypical drought year, with some areas of the country with very low precipitation values compared to the usual. The South of the country and some regions in the interior of Trás-os-Montes are at this time of spring with water reserves below normal values in the middle of summer (IPMA, 2023; Público, 8 May 2023). This can be particularly problematic in rural and less populated areas and requires a new strategy for water management, with implications for land planning and management of the territory and its settlements.

Moreover, Portugal is a country marked by an unequal urban system distribution, the coast is marked by concentration and the interior is marked by depopulation and abandonment of the territory. At the same time, all over the country there is an accentuated demographic loss, which is only compensated in the Lisbon metropolitan region and the Algarve. This situation is even more serious in the rural regions and most isolated areas. On the other hand, these more depressed areas face every year the plague of fires, a situation that is worsened by years of drought and by the absence of local populations to control and respond quickly to small fires. To address this situation there has been an attempt to develop policies to improve these territories by introducing new activities, including tourism and by the enhancement of local resources and heritage.

Following the European strategies that advocate the reinforcement of territorial cohesion as a way to promote the development of the territory for all and in a sustainable way, it is pertinent to develop new strategies to strengthen the rehabilitation of rural settlements (UN, 2015; CEC, 2008, Alexiadis, 2017). However, the lack of investment in rural territories has led to the closure of some essential services (schools, hospitals and courts). Therefore, it is urgent to rethink how it is possible to improve the quality of life of those who still live in these territories, as well as to introduce new activities that can attract new residents and visitors. One strategy is to enhance the distinctiveness of these areas, like its endogenous resources and their natural and cultural heritage, such as the rural settlements and their vernacular architecture buildings that create the cultural landscape of rural territories. This landscape is the result of a process of transformation by man and of a know-how that has been built over decades and which stands out from newer landscapes due to its harmony with the environment and the sustainable use of resources, namely for the construction of buildings. In a period when attention is being drawn to the urgency of preserving resources, it becomes particularly pertinent to analyse these landscapes and promote their rehabilitation and conservation (ICOMOS, 2017). This requires a work of analyses, surveys and learning to fully understand this heritage and propose informed actions for

its rehabilitation and sustainable development.

This analyse is being developed in the Massif of Sicó in Portugal with the collaboration of the Department of Architecture of the University of Coimbra, which is working with the region to characterize the existing vernacular heritage help to design an integrated strategy for the territory. One of the particularities of this heritage has to do with the karstic soil, which makes this a place where surface water is scarce. Therefore, over the years local communities have developed strategies to collect and store water that today should be valued as part of the local heritage and needs to be included in the rehabilitation strategies This paper aims to draw attention to this distinctive factor and argues for the need to value vernacular architecture and ancient water systems as keys for local sustainable development.

2. Water systems from know-how to heritage for sustainable development

The enlargement of the heritage concept in the last years and the recognition of its importance to the well-being, self-esteem and development of communities demands a new attitude towards conservation policies (CE, 2005; Labadi, 2022). On the other hand, the recognition of the value of landscape as heritage requires that these policies become broader (UNESCO, 2003). The landscape is the result of human appropriation and construction, but it depends largely on each territory's physical features. According to these features, communities have developed knowledge to adapt the site to their needs and one of their main needs was water, therefore the appropriation and transformation of the territory includes the collection, conduction, and storage of water.

If in urban areas this need gave rise to large infrastructure works, such as aqueducts, in rural areas this infrastructure had a much smaller expression. Therefore, and also because of their size, these large aqueducts that supplied the main cities are easily recognized as heritage and are classified as national monuments since the early twentieth century (Lopez-Bravo, López and Adell, 2022). However, in rural areas, it is more difficult to recognize the existence of water infrastructure with heritage value. Nevertheless, we know that the rural environment needed water for irrigation and food, so we still recognize today some equipment related to water collection, such as the “picotas”¹ and the “noras”². But beyond these, there were other smaller works such as

¹ The “picota” is a simple device used to pull water from wells. It consists of two long, hinged pieces of wood, one of which is upright and firmly attached to the ground. The other, perpendicular to the first, weights at one end and a water container at the other. The container is lowered into the well and the weight at the other end helps to lift the container.

tanks and cisterns that fed agricultural fields and dwellings. With the creation of modern water supply and distribution networks, and with the modern electric motors, many of the existing equipments lost their use and many disappeared completely. However, these techniques and devices, similar to the vernacular architecture that built rural settlements, are the result of know-how and practices that are part of the local knowledge and culture, so it is relevant to consider their conservation and protection. Moreover, some of these facilities may be an important contribution to coping with the lack of water caused by climate change and atypical droughts. Thus, once again, heritage conservation and enhancement may contribute to the sustainable development of rural communities.

3. Vernacular architecture and circularity

Architecture and vernacular settlements have been highlighted not only by the recognition of their cultural value but also by their relationship with the natural environment and their balance with the consumption of natural resources. This building practices used local natural materials and renewable energy to environmentally protect the building occupants from climatic changes and to reduce their reliance on other energy resources. Thus, vernacular architecture and urbanism are recognized as sustainable models worth preserving and rehabilitating (Dabaieh, Maguid and El-Mahdy, 2022; Foster, 2020; Fajer Al Tawayha , Luis Braganca and Ricardo Mateus, 2019). Unlike industrialized construction, vernacular building systems use local materials of great durability and versatility, which allows their reuse and rehabilitation, adapting them to today's needs and allowing the conservation of this heritage built over the years. Despite the particularities of each region, the vernacular construction all share the same principles of harmony with the environment, the use of very few materials, natural materials of great durability and adaptability, and a low carbon footprint (Simões, Rui, Inês Cabral, Fernando Cerqueira Barros, Gilberto Carlos, Mariana Correia, Bruno Marques, Manuel Correia Guedes, 2019). In this sense vernacular architecture can be linked to circular and sustainable concepts and because of this is gaining new academic recognition (Sala, Marco, Antonella Trombadore, Laura Fantacci, 2019).

However, today most of the traditional building practices have been forgotten, those who possessed the necessary skills for vernacular construction have disappeared or are disappearing. Thus, it is necessary to study the construction techniques to rehabilitate them, but also to know how to adapt them to allow transformations and adaptations

² “Nora” is a device for collecting water from wells, rivers, or cisterns. It consists of one or more wheels with small containers or buckets that collect and transport the water.

that serve the current needs of environmental and thermal comfort, among others.

4. Massif of Sicó

The Massif of Sicó corresponds to a territory in the centre of Portugal, between Lisbon and Coimbra, that despite being located in the coastal strip of the country is a rural-based territory and like all rural territories faces the abandonment of the population. Besides the difficulties of the rural areas, this territory is very marked by harsh geography which justifies why it has always been a territory of low density. Covering six municipalities (Alvaiázere, Ansião Pombal, Condeixa a Nova, Penela and Soure), the territory corresponds to a karstic massif, of poor calcareous soils and with a great scarcity of water at surface. This territory was developed based on dryland agriculture and the pastoralism of small flocks of goats and sheep (Cunha, 2003). The landscape was very marked by stones on the surface, which required hard work to prepare the land for cultivation and resulted in dry stone walls and shepherd's shelters built in dry stone. This stone was also used for the construction of the buildings of the few settlements that were gradually growing, taking advantage, whenever possible, of implantation near a “dolina”³, where local community could find water, and the half slope or in dry valleys. The small settlements depended on the low agricultural production.

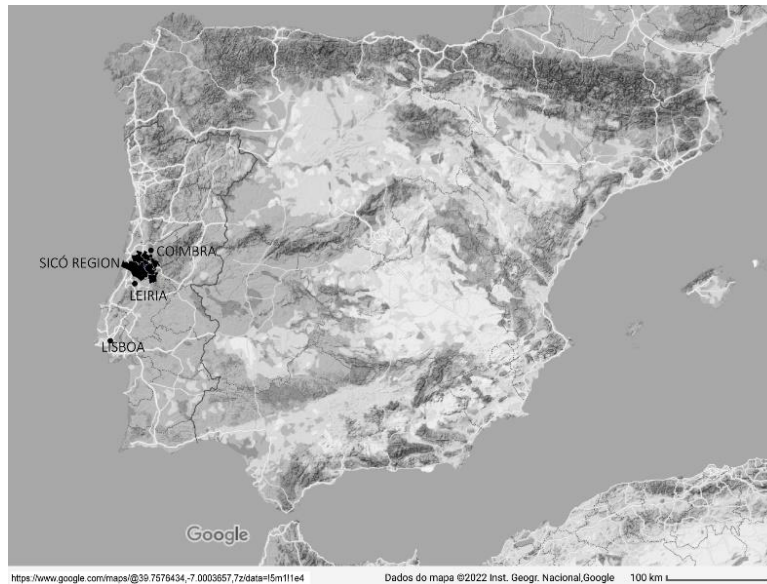


Figure 1. Sicó Region location.

³ “Dolina” is a circular depression which occurs in karst relief and is formed from the depression of soil and rocks in the ceiling of a cave by means of underground drainage. In the case of Sicó they are usually flooded and form lagoons.

Source: Basemap provided by Google Maps online.



Figure 2. Field of stones (Lapiás)
Source: Margarida Relvão Calmeiro.



Figure 3. "Dolina" near Poios Village
Source: Adelino Gonlaves.

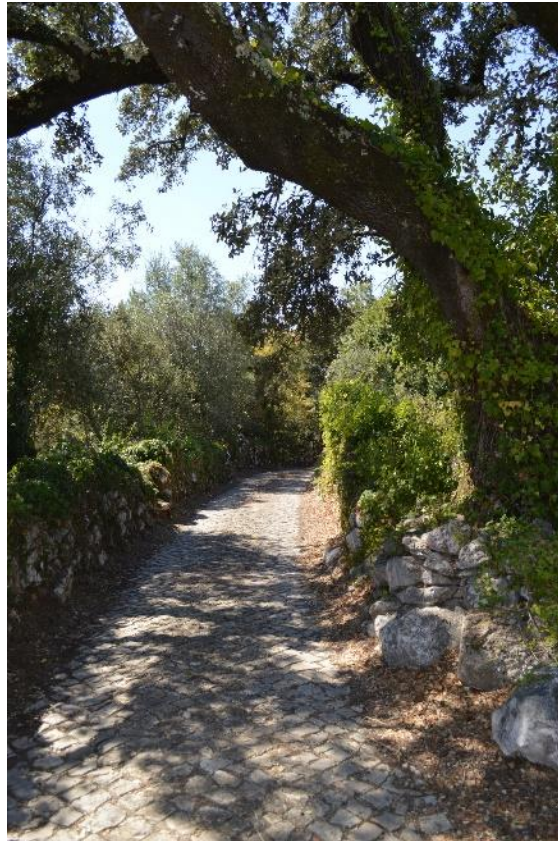


Figure 4. Dry-stone walls

Source: Margarida Relvão Calmeiro.

Despite this apparent hostility to human occupation, the karst spaces contain natural, environmental and heritage resources of high value (Cunha, 2003, p. 3). This justifies that part of this area is classified as a site of the Natural 2000 network (the site Sicó-Alvaiázere) for its biodiversity. Besides the biodiversity, there are also caves and scarps very attractive for climbing.

Despite the difficulty of the territory, this is a strategic area in the connection between the North and South of the country and has been occupied since the Roman period. Today concentrates a rich set of remains of these occupations with emphasis on Roman ruins, and castles of the period of the Christian reconquest (Carvalho, 2020, Seixas, 2015).



Figure 5. Network of Limestone Villages, 1st phase

Source: basemap provided by google.earth.

To promote the development of this territory and to counter depopulation was created in 1988 the Association of Municipalities of Serra de Sicó - ADSico. This association has supported several local development projects proposed by the communities and has developed a set of others, where we highlight three projects related to the enhancement of their natural and cultural heritage. The delimitation of a Protected Landscape Area, to preserve biodiversity and regulate the use of endogenous resources and the preservation of the rich natural heritage. The creation of a Rede de Aldeias do Calcário (RAC) (Network of Limestone Villages). The goal is to promote the rehabilitation of the villages, some of which are practically abandoned, and to promote local tourism. It also intends to create the RAC brand, for promoting local products, practices, and knowledge. Within these practices and knowledge is the construction of settlements and buildings built with local products, limestone and wood, but also the construction of dry-stone walls which divide the properties and a set of agricultural support buildings such as the threshing houses that mark the fields. The recognition of this knowledge gave rise to another project that intends to inscribe the construction of dry-stone walls on UNESCO's world heritage list.

These projects are being developed in collaboration with the Department of Architecture at the University of Coimbra and aim to boost the development of this territory through its resources and its sustainable exploitation. All of them are characterized by the valorisation of local culture, resources and the harmony with nature, in short by their sustainable way.

4.1. Good practices and other village rehabilitation cases

The promotion of networks for the reuse of villages for tourism is a practice that has had good results in Portugal. The most successful examples are the Rede de Aldeias do Xisto (Schist Villages Network) and the Rede de Aldeias Históricas (Historical Villages Network), both in the central region of Portugal, and with a significant impact on the rehabilitation of the almost abandoned villages and the creation of businesses associated with tourism and the enhancement of the local cultural heritage (Carvalho, 2006; Natário, Manuela, Ana Melo, Ricardo Biscaia, Paula Rocha, Carlos Santos, Augusta Ferreira, Dalila Dias, Gonçalo Gomes, Graça Azevedo, Ruben Duarte, Rui Marques 2019). The network of limestone villages intends to follow these examples, setting as its main goal the improvement of the quality of life of those who live here.

The case of the Rede de Aldeias do Xisto can be seen as the most successful example in Portugal. It was initiated in 2001 by CCDR in partnership with 14 municipalities and created a network that rehabilitated 24 villages in central Portugal with the help of the EU Cohesion Fund. The intervention rehabilitated buildings and improved infrastructures in the villages and articulated directly with the local community. All villages presented a rich cultural heritage and a characteristic landscape, but only 13 of the 24 villages had a water supply network, only 10 had a sanitation network and there were only a lodge unit and two restaurants. (Carvalho, 2006, p. 28). The main objective was to "requalify a set of mountain villages" enhancing the endogenous resources and cultural heritage, in order to improve the quality of life of the local communities and allow the creation of 'a network of sites of tourist interest' capable of fostering the development of the economic and social fabric (CCRC, 2001, p. 38) and with this attract new population.

Over 8 years, more than 500 buildings were rehabilitated, the public space was re-qualified and were created networks of basic infrastructure such as sanitation and water supply. In addition, a network of 21 river beaches was created to encourage tourism. And today, after 22 years Aldeias de Xisto have become dynamic tourist attractions and have stimulated the creation of a new economic base for private investment. In fact, if in the first phase the investment was mainly public but since 2009 the principal investments have been private. (Estratégia de Eficiência Colectiva Rede de Aldeias do Xisto, p. 19)

This example inspired the creation of the Rede de Aldeias do Calcário, however, the particularities and natural constraints of the Massif of Sicó must be strengthened. Despite some similarities in shape and size, the limestone's vernacular architecture has particularities and distinctive factors that should be studied and preserved in rehabilitation strategies.

On the other hand, the traditional practices of water storage and the architecture of limestone villages, responsible for the construction of the cultural landscape, can be

drivers for new sustainable rehabilitation strategies, for example, by creating eco-villages or self-sustainable villages. In Portugal, there are some experiences of eco-villages and rural settlements that develop sustainable practices. Some are associated with the Global Ecovillage Network (GEN) (Dawson, 2010), as is the case of the village of Cabrum in Viseu (Grybénaitė, 2016) or Aldeia da Tamera in Beja (Vale Pires, 2012 and Vale Pires and Lima, 2013).

In other cases, there has been the introduction of some community practices and village rehabilitation valuing the ecological construction and more sustainable ways of life characteristic of rural life, such as the production of local food and efficient water management, or even community construction practices. Basically, these are villages with an ecological awareness that aims at alternative ways of living in harmony with the environment, an upgrade back to the origins, and meeting contemporary needs and current knowledge. They are also associated with community tourism and tourism of experience in which those who visit can experience more sustainable ways of life in harmony with the environment, and which basically resume many of the local cultural practices that have been forgotten by contemporary dynamics.

Another example that has inspired the strategies underway in Sicó was the inscription process of the Cultural Landscape of the Pico Island Vineyards in the UNESCO World Heritage list in 2004. This was an exemplary survey of what characterises the cultural landscape: the practices of wine production in “currais”⁴, but fundamentally the way local communities transformed the territory and adapted it. This work is today an example of good practice because it was grounded on the study of the built environment and ways of life of the island in conjunction with local communities. As a result, today, after the Good inscription and after a set of incentives for the rehabilitation of the built environment and the regeneration of the wine production practices, Pico Island preserves its landscape and its vitality, has created jobs and managed to keep those who live here, with a dynamic economy, especially in terms of wine production and tourism (Jorge, 2018, p. 29 and Costa, 2018, p.58-60).

4.2. The villages of Chanca and Casmilo two examples of the network of limestone villages

The village of Chanca is part of the municipality of Penela and is located on the eastern slope of the Rabaçal Valley. This is one of the valleys of the Massif, where a small stream

⁴ Currais are stone walls erected to protect the vines from wind and sea water. There are thousands of small rectangular enclosures all over the Pico Island.

runs on the surface and this valley is one of the most fertile areas of the Massif, which explains its occupation already by the Romans. Marked by the ruins of the Roman Villa of Rabaçal a large Roman country house that preserves several traces that allow us to reconstruct the property and its production.

However, the village of Chanca located on the hillside, does not benefit from the same fertility of the valley and is deeply marked by the stone landscape. Man gradually cleared the fields to cultivate them, and today dry stone walls remain. Near the village, there is a “dolina”, crucial to feed animals and the fields. Besides this water point, there are also some wells for collecting groundwater and many buildings have cisterns for collecting rainwater. In the village, there are several buildings in ruins or in bad state of conservation. But it is possible to verify that most of them are composed of a two floors main volume for housing and a set of other volumes for agricultural annexes and animals. To have access to water, these buildings have a cistern to collect rainwater.



Figure 6. Limestone Building in Chanca



Figure 7. Cisterns for rainwater storage under the stairs in Chanca



Figure 8. System of channel and pipes conducting the water from the roof



Figure 9. Cisterns for rainwater storage under the stairs in Chanca

Another village from the Rede de Aldeias do Calcário is the village of Casmilo. This village is in the Condeixa municipality and is also located in the middle of the hillside and near two dolines, one that is still visible today and another that was covered with earth and therefore only the local community can localize it. Casmilo is a bigger settlement than Chanca and apart from the olive oil production, its main activity was cattle-raising, having still today several flocks. Its proximity to Condeixa and Coimbra has allowed the village to maintain much of its dynamism, although today the population no longer depends on agricultural activities, and mostly works at the municipality's centre or even in Coimbra. However, it is still possible to observe a set of buildings of vernacular architecture that retain their original characteristics. Despite being used today mostly for agricultural or animal storage. Like Chanca, the vernacular architecture buildings are

constructed of stone masonry, laid with argil mortar, interior structure in wood and ceramic tile roof. Most of the buildings have two floors, with the ground floor being occupied by agricultural or animal storage and the upper floor for housing. The masonry of limestone, some balconies and chimneys and some decorative elements next to the windows stand out. Also, in this village cisterns for rainwater storage are common, located under the stairs or in tanks on the outside of the building. The location under the stairs facilitated the construction and extraction of water but required greater attention to the impermeabilization of the walls.



Figure 10. Tanks outside of the building, visible the channel conducting the water from the roof

Despite the potential of these buildings and their ability to accommodate new uses, the lack of dynamism and people have not been able to counteract the abandonment, leading to the disuse and ruin of several buildings and the loss of heritage. The delimitation of the RAC is still in its early stages, as well as the process for the inscription of the art of dry-stone construction on the World Heritage List, but we hope that these initiatives enable the design of a new development strategy that fosters the rehabilitation of the vernacular-built heritage and contributes to the dynamism of these villages. The vernacular architecture built with local materials of great durability and adaptability is particularly suitable for sustainable rehabilitation. The existence of cisterns and water tanks can be an important asset to foster the creation of more sustainable settlements.

5. The rehabilitation of villages an opportunity for sustainable development

The vernacular construction of the Sicó region, as in other regions, is the result of years

of experimentation and learning and therefore responds perfectly to local needs, particularly and crucial to our study to water needs. Although this area was forgotten in the surveys of popular architecture in Portugal in the 1960s (Ordem dos Arquitectos, 2004) the reduced demographic pressure preserved the buildings and most of the settlements and today the Massif of Sicó presents most of the buildings in stone masonry and ceramic roof, thus maintaining their original characteristics.

The building materials are restricted to local materials (limestone, wood and clay), with one or two floors, the first floor being reserved for animals and storage, with a rectangular plan. The walls are made of limestone masonry, with exposed stonework, in the case of residential buildings bonded with clay and lime mortar, in the case of agricultural buildings only bonded. The roofs are ceramic tiles produced locally with local clay. The doors, windows, and wooden beams and floors are made of local wood. We can highlight the recurrent use of porches and exterior stairs, with large blocks of limestone and sometimes chimneys (Mendes Silva, Catarino, Almeida and Mouraz, 2021). The interior distribution is quite modest, with the kitchen assuming a central role in the functioning of the dwelling. The scarcity of water gave rise to the recurrent use of cisterns and water tanks to store rainwater, usually located under the stairs or in an underground volume built next to the main building. The water is canalized by exterior pipes or even grooves in the masonry walls to channel the water from the roofs to these water tanks essential for the functioning of the dwelling. This heritage gains importance not only for enclosing local knowledge and practices and for its value as heritage, but also because of its contribution to a more sustainable development of these settlements. The reuse of these buildings reuses materials but also reuses water capture and storage strategies that can contribute to overcoming water scarcity in times of drought, in addition to contributing to the family economy, since this resource is no longer paid for, as well as to sustainability.

The ongoing strategy for Sicó, is still in its early stages, however the articulation between the three projects: Delimitation of the Protected Landscape Area, Rede de Aldeias do Calcário and the inscription of the Art of Building in Dry Stone to the list of intangible heritage of Humanity have a great potential for the sustainable development of the region. On one hand, they are based on a detailed study of the cultural landscape, the practices and models that allowed the communities to settle here, and on the other hand, they aim to rehabilitate the villages using local materials and restoring some of the traditional practices from the construction to water management and food production. On the other hand, it is being conducted with the involvement and sensitization of local communities, which strengthens local self-esteem, but also allows the creation of jobs.

We believe that if this is achieved, it will be possible to implement a successful strategy to enhance and develop this territory based on its heritage and existing natural

resources, contributing to the strengthening of the communities' self-esteem. It will also contribute to circularity and the reduction of resource consumption by introducing more responsible practices, with less impact on the environment and which can make a fundamental contribution to improving the quality of life and to the sustainability of the territory.

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