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Intervention in Portuguese Historic Villages Facing Desertification and Climate Change

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Abstract

The 12 Historical Villages of Portugal, located on the border between Serra da Estrela and Spain, are a remarkable piece of Portuguese history. However, these villages have been deeply impacted by the increasing issue of depopulation, aging, and abandonment. While this phenomenon is not limited to these villages, there are certainly unique factors that contribute to the tension between maintaining the historical significance of the villages and addressing the everyday needs of the local. In the particular context of the buildings that still withstand, mostly in the central areas of the villages, many of those who insist on remaining in this territory end up abandoning the stone houses inside the villages and migrating to new buildings built in their surroundings.
Despite its valuable symbolic capital (for its environmental, landscape and heritage potential), the tourism sector is clearly not the sole answer as its revenue to the local economy proves to be insufficient for the essential material, social and economic balance that attracts and fixes the population.
The issue of unattractiveness in these villages is multifaceted. A key factor contributing to this problem is poor housing conditions, which fail to provide residents with the comfort they deserve. This lack of comfort also results in misguided interventions that mischaracterize the existing heritage, leading to a further devaluation of the symbolic capital of these communities.
Considering this context and in articulation with the SDG11, it is imperative to establish solid bases for interventions in existing buildings that allow reconciling the need for adequate comfort levels with the protection of the landscape and heritage legacy, which incorporate innovation in terms of sustainability of materials and energy expenditure, with an alliance of ancestral knowledge with innovation in efficient water management, but also that pay attention to environmental, social, economic sustainability with beneficial impact on society and territory. These bases must also incorporate an adaptation to climate change that affects both the landscape and the comfort conditions inside the existent buildings.

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1. Introduction

Central Portugal's rural landscape is characterized by a series of small villages that have maintained their traditional characteristics. Twelve of these communities have the denomination of "Historic Villages" (DN2/1995) and have been the subject of renovation actions in the1990s following Decreto 23/1996 (D 23/1996). "In fact, the improvements carried out in the 15 Churches, in the 8 Castles and fortress walls and in the 24 buildings, of recognized architectural value, illustrate the various changes undertaken: along with pure actions of enhancement and restoration of monuments, with or without the introduction of modern components and materials, to the simple conservation of the ruins, with the aim of creating symbolic and/or fantastic scenic ensembles, There are initiatives for the restoration/modernization of buildings with the incorporation of new functionalities, allowing, at the same time, to value, reuse, enliven, give life and monetize a heritage that belongs to everyone's history" (Boura, 2004). According to Boura (Boura, 2004) and taking into account the associated legal basis (D 23/1996) together with available information regarding the various projects that were implemented in these villages (Lousada, 2008; Rapagão & Fernandes, 2000), there was a first phase regarding direct intervention in the urban context and in the existent buildings, creating a uniformity within each village. These interventions were led by Portuguese architects and performed on the façades and roofs (including windows and doors) and also on the context of electrical and water systems and external pavements.

However, most of the traditional building materials are still in place and a current reflexion taking into account conservation/rehabilitation of these villages with a focus on sustainability aspects is now being undertaken. Looking at sustainability in a holistic way, encompassing the use of buildings and public participation, this paper will focus on the sustainable aspects linked to traditional building materials. Sourcing of local materials was a basis for vernacular architecture, meaning that local available stone was used for building structures, pavements and, sometimes, roofs. Materials of natural origin such as wood or vegetable fibres were also employed, due to easy availability. The intervention that will take place in these villages will take into account the preservation and/or reuse of these materials, highlighting the importance of conservation/rehabilitation actions as sustainable procedures in themselves. Energy incorporation in these materials, CO2 incorporation, thermal behaviour (inertia and transmission) and effect on indoor air quality are some of the main parameters that will be taken into account in the analysis of existent materials. For the choice of new materials, further factors such as LCA, ecological footprint and local provenience will be incorporated in the decision-making process.

2. Characterization of the actual state

2.1. Location

As pictured in Figure 1, the Historic Villages are located between the Spanish border and one of the main mountain ranges in Portugal, Serra da Estrela. This gives these villages specific characteristics, as they had to adapt to a difficult landscape with a significant temperature variation and a certain level of isolation due to the difficulty in surpassing the mountains, despite their proximity to Spain.

Fig. 1. Location of Historic Villages a) in Portugal b) in the region of interior Central Portugal
(a) http://floradaserra.blogspot.com/2010/08/aldeias-historicas-de-portugal.html, b)https://www.amazonasemais.com.br/outros-destinos/portugal/aldeias-historicas-de-portugal/attachment/mapa-aldeias-historicas-portugal/)

2.2. Building materials

Village houses (Figure 2) in this area are usually built with local stone (mainly granite and sometimes schist) for external walls and timber in roof structure, partitions, flooring and door and window frames. Lime and/or earth mortars (Figure 3) were commonly used for rendering of external and internal surfaces, depending very much on economic possibilities of the house owners, and other materials such as corn stalks, hay and canes were also used for partition structures in many cases.

Fig. 2. Typical street with original elements (Castelo Novo, Portugal)
Fig. 3. Traditional building materials (external earth mortar)

2.3. Heritage - monuments and conurbations

This area, with innumerous fortresses (Figure 4), religious monuments and preserved villages is rich in heritage buildings and conurbations. In this context, there has been an increase in terms of the classified heritage in the Historic Villages (AHP).

Fig. 4. An example of classified heritage in Almeida (fortress) in Portugal.

While the classification status of a building, its inclusion within a designated heritage area, or its ongoing classification process should not act as a hindrance to initiating modifications, it is essential that any alterations are carried out with utmost consideration for preserving its original essence. The execution of any construction, regardless of its perceived scale, should be undertaken in collaboration with architectural, engineering, and archaeological experts. Their specialized insight is vital in recommending techniques that harmonize with the existing structure and promote its long-term sustainability. In addition, professionals should prioritize the use of locally sourced materials and skilled labor proficient in working with traditional construction elements. This approach may ensure that when new materials or construction methods are required, they seamlessly blend with the historical aspects of the building.

3. Historic Villages and Desertification

Demographic dynamics of the last decades have proven hard for this geographic area. Since the 1950s, the territories farthest from the cities and the Portuguese coast lost population consistently, as a result of migration to other countries or to urban centers in the national territory. This migration, in addition to an inevitable impact on demography, compromises the existence of the villages, as well as the transmission of knowledge related to the construction and maintenance of built spaces, through traditional techniques.

From the analysis of the population data of the parishes in which the AHPs are inserted (Table 1), it can be seen that all of them show a decrease in population in the last decade, with the populations of Piódão and Sortelha being the ones that suffered the highest impact, 33% and 28% of decrease, respectively. The parishes that decreased their population the least were the Union of Parishes of Trancoso and Souto, Maio and Marialva, with a reduction of 6.7% and 5%, respectively. This trend reflects a regional pattern, as all municipalities also showed a reduction in their population, with an average reduction of 13.3%. However, the population reduction of some parishes is even more accentuated than that of the respective municipalities, with the greatest reduction being observed in the municipalities of Almeida (19%) and Figueira de Castelo Rodrigo (18%).

Table 1. Population evolution in AHP (INE 2021)

Village	Demographic trends at parish level
Almeida	Almeida lost 13% of its population. The age groups that decreased the most were between 0 and 14 and 15 and 25 years old (25%). In the parish, the population over 65 decreased by 13%.
Belmonte	Belmonte lost 9.4% of its population compared to 2011. The age group that decreased the most was 15 – 25 years old, with a decrease of 26%; the population over 65 increased by 8.7%.
Castelo Mendo	The parish lost 21% of its population. The age groups that decreased the most were between 0 and 14 years old (75%) and 15 and 25 years old (46%); The population over 65 has not increased.
Castelo Novo	Loss of 21% of its population. The age groups that decreased the most were 0 to 14 years (75%) and 15 to 25 years (46%); The population over 65 has not increased.
Castelo Rodrigo	The population of the parish decreased by 9.5%. The age group that decreased the most was from 14 to 25 years old, with 33.7%, while the one that decreased the least was over 65 (4,5%).
Idanha-a-Velha	The population decreased by 14%. The population from 0 to 14 years old increased by 56% while in the municipality it decreased by 14%. The population over 65 years old decreased 23%.
Linhares da Beira	The population decreased 18%. The population groups that decreased the most were between 15 and 24 (53%) and between 0 and 14 (50%), while the population over 65 decreased 19%.
Marialva	The population decreased by 5.5% that of the county decreased by 11%. The population group that decreased the most was from 15 to 24 years old, (81%). The group over 65 remained static.
Piódão	The population decreased by 33%; the group that decreased the most was that over 65 (46%).
Sortelha	The population decreased by 28%; the group that decreased the most was between 15 and 14 with 60%, followed by the group of 25 – 65, with 28%.
Monsanto	The population decreased by 14%. The group that decreased the most was between 15 and 24 years old with 44%, while the population between 0 and 14 years old increased 56%.
Trancoso	The population decreased by 6.7%. The group that decreased the most was from 0 to 14 years (28)%. The population group over 65 increased by 17%.

This critical situation of demographic loss greatly contributes to the degradation of the built heritage that is mostly uninhabited and abandoned, steadily leading to a its loss. Although some villages are used for touristic purposes, this is not extensive to all, nor does it solve the problem at its core. According to World Heritage Site Managers, preservation of both tangible and intangible heritage implies a sustainable balance with tourism without neglecting in any way their heritage´s original function (Durrant et al, 2023).

4. Historic Villages and Climate Change

4.1. Energy Poverty

Vulnerability to energetic poverty is a problem affecting buildings throughout the totality of the Portuguese territory (Horta et al, 2019). As reported in Figure 5 (Gouveia et al, 2019), it is clear that energy poverty greatly affects the region under focus in this study (as per Figure 1). Dwellings with a historical and architectural heritage, in this context, find themselves in a state of heightened vulnerability. Within the AHP context, this contextual consideration extends beyond the historical town centers, encompassing newly developed residential areas. The relatively compact dimensions of vernacular structures and their high thermal mass represent favorable factors in addressing energy poverty, provided these attributes are coupled with effective heating solutions.

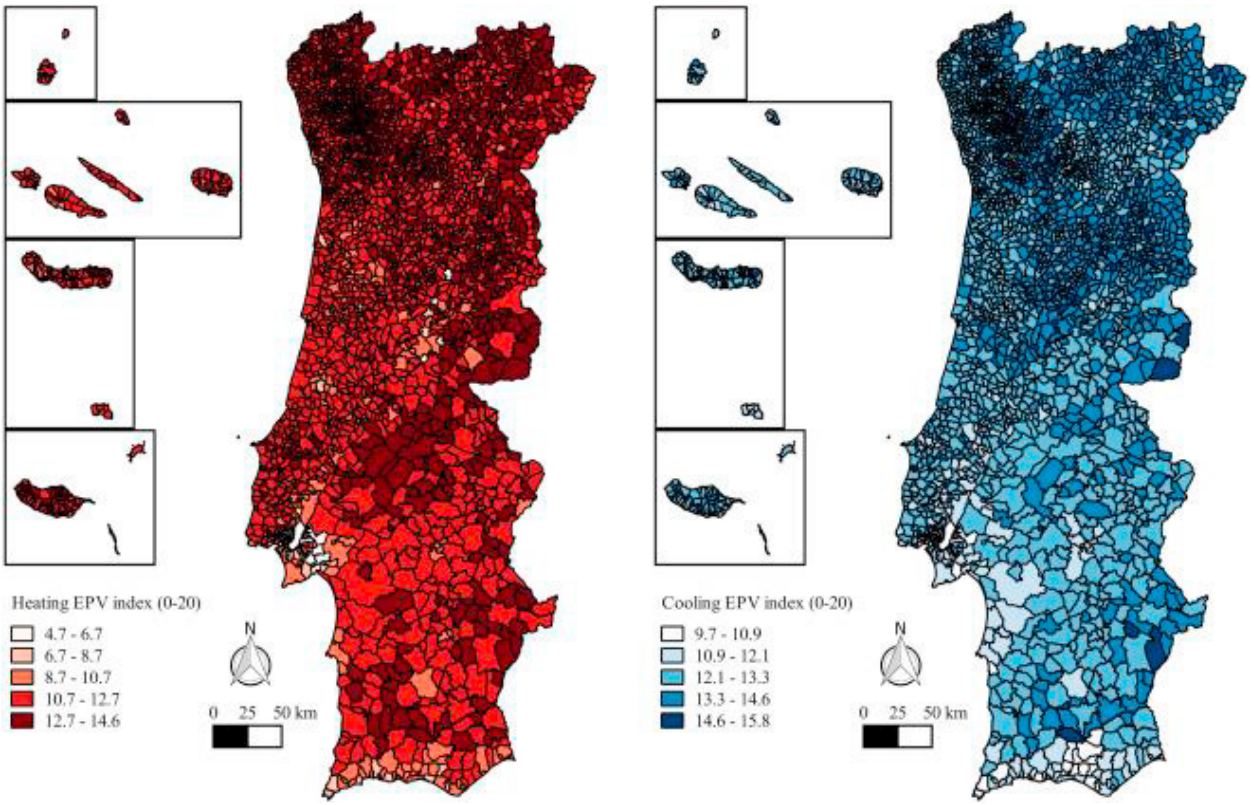

Figure 5 – Vulnerability to energy poverty (Gouveia et al., 2019)

4.2. Climate Change

The effect of climate change is and will be felt in the region of Central Portugal. This influence, following the European Environmental Agency´s projected impacts, consists of a multitude of effects upon this region, among which:

- Higher temperatures and heat waves;
- Drought and extensive impact on biodiversity;
- Increased Wildfires;
- Subsequently issues of territorial and populational relevance, such as:
- Increase in water demand for agricultural use
- Increase in energy demand for cooling

This prospect will definitely impact actual and future users of the existent buildings and, in this context, the anticipation of possible effects together with the new notions of comfort are crucial for an adequate intervention outcome. This point of view has been recently dealt with by the scientific community (Blavier et al, 2023, Sesana et al, 2020) but needs to be specifically addressed in the context of AHP. This will imply a careful balance between preservation and innovative adaptative measures, that must incorporate energetic behaviour of these buildings intertwined with a sustainable approach.

5. Intervention aspects

It is clear that a rehabilitation action in itself is a sustainable process as it does not create additional expenditure of resources (both in terms of extensive use of materials and consumption of energy for demolition and new construction). Additionally, it promotes the maintenance of functional materials and architectural elements that can meet the necessary performance requirements; it is also a cultural action encompassing the relevant aspect of valuing endogenous heritage. In this framework, it is essential to privilege maintenance actions that increase the useful life of buildings in parallel with the implementation of improvements to ensure interior comfort in order to guarantee occupants' quality of life.

Comfort is a vast concept that encompasses indoor temperature and humidity, absence of noise, and air quality, among others. However, it has been mostly treated in terms of thermal conditions, linked to energetic efficiency solutions (Jiang et al, 2023; Stanojević et al, 2021), hindering a more holistic approach that may actually tackle these issues whilst respecting a built value. The materials and construction solutions used in intervention situations contribute to these factors in a determinant fashion. Building ventilation solutions, the thermal conductivity of materials, their heat storage capacity and delay in heat dissipation, the permeability of materials to water vapour, their impact on air quality, among other factors, are technical characteristics of materials that need to be taken into account and their juxtapositions should be the basis for sustained choices. Definitely, the determination of solutions for an adequate intervention is a task with multiple aspects, involving technical criteria, sustainability assessment, heritage preservation incorporation as a basic need and, very importantly, the input of the resident population.

6. Conclusion

The AHP have a strong presence in Central Portugal. Their monumental and vernacular heritage as well as the heritage value of the conurbations is undoubtful. There has been a strong depopulation trend in the area, which is situated between the mountains of Serra da Estrela and the Spanish border especially felt by the small villages and there are recent interactions due to a possible increase in tourism, creating a double-sided impact, as well as further strain brought about by the prospect of climatic change.

It is fundamental that the intervention that will take place in these villages will take into account the preservation and/or reuse of existent materials, highlighting the importance of conservation/rehabilitation actions as sustainable procedures in themselves. Only through physical intervention procedures can a greater attractiveness of this territory be achieved, reversing the strong depopulation trend that is an actual reality. The focus on sustainability in these

interventions should occur in a holistic way, including the (re)use of buildings and the need of public participation, but also, and fundamentally, encompassing the sustainable aspects linked to traditional building materials.

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