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Characterization of the dry stone heritage of the Barrocal region (Algarve, Portugal)

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Abstract. The paper aims to value the diverse and important dry stone heritage located in the Barrocal area (Algarve, Portugal). The dry stone construction technique and the set of constructions that derive from its application are present in all parts of the world where stone is present. Throughout the Iberian Peninsula and specifically in the territory of Portugal, there are different dry stone constructions that make up the rural landscape. They are an example of the work in the field and the use of local natural resources during different generations. The recognition by UNESCO as Intangible Cultural Heritage of Humanity (2018) highlights the importance of maintaining a construction technique that, transmitted orally, is materialized in different constructions according to the constructive heritage and the stone typology of the nearby environment. The study focuses on a specific partially cultivated area of the Barrocal where different types of construction of dry stone elements exist. Starting from the contextualization of the studies carried out throughout Portugal, the predominant dry stone constructions of the Barrocal, the area with the greatest presence of a variety of types of the Algarve, are being identified, recorded and analysed. The work provides a classification of the present constructions in the area linked to their use and provides data on the construction characteristics and the typology of the stone. The knowledge of these constructions makes it possible to explain the economic and social context of a certain period and to plan reactivation measures for other economic sectors not linked to tourism. The Algarve, one of the most touristic areas of Portugal, has focused most of its economy on beach tourism, leaving the cultural and dry stone architectural heritage almost unnoticed. The constructions and the dry stone construction technique are a way of preserving the rural landscape and the cultural memory so that the benefits related to ecology and biodiversity are observed through this document.

1. Introduction

The Algarve region, located in the south of Portugal, is the area which receives most tourists in the country and has focused the greatest part of its economy on beach tourism, often without taking into account a cultural and sustainable tourism. The focus of much of the economy on tourism has meant a progressive abandonment and a devaluation of other income sources sectors such as agriculture. Consequently, the progressive abandonment of cultivation implies an abandonment and the ignorance of the dry stone's construction technique and its constructions.



The general objectives of the present work are to identify, analyse and value the dry stone's vernacular heritage present in Portugal, focusing the attention on the Algarve region, and more specifically in the Barrocal. The dry stone is the construction technique that only uses the stone as a construction material without any other bonding material.

The construction heritage, the needs to be resolved and the stone typology present in the environment have characterized the constructions of each specific place. For this reason, in a few kilometres of distance, are found construction and formal varieties. The fact of focusing on the Algarve area's dry stone can be transformed into a tool to revalue agriculture, rural heritage and to promote cultural and sustainable tourism.

1.1. The dry stone's heritage in Portugal

The vernacular heritage of Portugal is made up of a set of constructions and construction techniques. These constructions are designed and executed with the purpose of solving the needs of shelter, of preparing and taking advantage of natural resources in order to survive.

Focused on the study of the dry stone heritage of Portugal, it can be observed that, throughout the territory, there are examples that use the construction technique of dry stone to solve different needs. The dry stone constructions are a sample of the knowledge acquired and accumulated over the years. According to the needs to be solved, the geological characteristics, the topographic characteristics and the economic and social context, the constructions take different forms and are predominant to a greater or lesser extent.

One of the first references that are found in the 20th century on dry stone's constructions is from the hands of the archaeologist Virgílio Correia (1888-1944) who in 1915 publish a study entitled "As Cabanas da Assafarja" [1] in which are described the different types of shepherd's houses made with dry stone. In addition to identifying construction typologies located in the Assafarja area (Coimbra, Portugal), he talks about the dry stone's construction technique, also called *pedra solta*. In addition to a descriptive treatment of the place and the characteristic constructions, he shows the formal appearance through the drawings he commissioned from Alberto Sousa (1880-1961). The drawings visually show the constructions' conservation state, in addition to one of the first graphic testimonials of the dry stone's representation of the 20th Century in Portugal.

In 1988, the book "Construções Primitivas em Portugal" [2] identifies, localises and analyses the different primitive constructions that, in a vast majority of cases, use the dry stone's technique for their formation with the aim of obtaining shelter. In the chapter 2. Construções de planta circular (Constructions with round plan) in section B - Construções de planta circular (ou quadrada) inteiramente em pedra (falsa cúpula) (Constructions with round (or square) plan, wholly made in stone (false dome)), he shows how the dry stone's technique, using the false dome, allows to cover the interior spaces using only stone.

Making an analysis of the north to the south of Portugal, it can be identified that the constructions, studies and initiatives that have been developed around dry stone constructions are different. The studies and research deal with the heritage of dry stone and the characteristics of the construction technique from different points of view, depending on whether they are isolated constructions or wall faces. With the different views and approaches to this heritage it is highlighted that the knowledge and interest in this technique and heritage can be approached from different disciplines. The dry stone constructions in the north of Portugal used for the livestock have suffered a progressive abandonment because they are in remote places and those that are in more populated areas are destroyed due to pressure from tourism and new constructions [3].

In central Portugal, dry stone walls have been studied and contextualized in the district of Castelo Branco, in the municipality of Sertã [4]. Here, the different types of walls and the reasons for their construction and their importance at the environmental level have been identified, avoiding the deterioration of the fields. The study highlights the importance of spreading this heritage to enhance knowledge among people and at the same time a sense of intensity with it.

In the south of Portugal, specifically in the Algarve area, there is a study on vernacular architecture in the Barrocal area of the Algarve [5]. This study includes dry stone constructions, especially walls. These are classified according to their functions and formal characteristics. Also in the south there is another study that aims to enhance the walls of the Barrocal area in Algarve as a related and characteristic heritage of the place [6]. Due to the few studies on dry stone heritage in this place, the article delves into the construction processes of the walls, the spatial distribution, the hydrological, ecological, economic and social functions.

From an administrative point of view, dry stone constructions in the Algarve area appear in tourist guides that show itineraries to make routes around different areas of the Algarve [7], [8] Although they are not explicit dry stone guides, the constructions, mostly centred on walls and paths, are part of the natural environment.

1.2. The dry stone heritage in the Algarve and the Barrocal

The Algarve is the southernmost area of Portugal (Figure 1.) with an area of 5,412 km² and 438,406 inhabitants [9]. The capital of the region is Faro. The Algarve region, although is surrounded by the Atlantic Ocean, has a great influence of the Mediterranean Sea. It is characterised by a great landscaping diversity and a mild weather throughout the year.

From the legislative point of view, Algarve forms the district of Faro, subdivided by 16 municipalities: Albufeira, Alcoutim, Aljezur, Castro Marim, Faro, Lagoa, Lagos, Loulé, Monchique, Olhão, Portimão, São Brás de Alportel, Silves, Tavira, Vila do Bispo and Vila Real de Santo António. On the other hand, geographically, it is divided into three strips: the Litoral, the Barrocal and the Sierra (Figure 1). The Litoral is the area that borders the sea and the one that concentrates the greatest economic activity in the region, with tourism being the economic engine. The Barrocal is the area located between the Litoral and the Sierra and the main agricultural exploitation area of the Algarve area. The Sierra is the largest area, with approximately 50% of the surface of the Algarve.

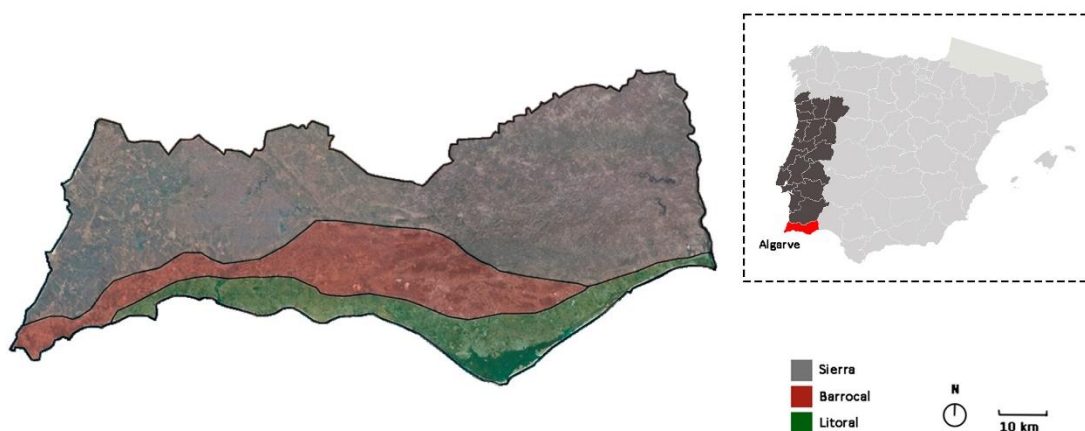


Figure 1. Algarve region location (Source:[10], authors)

The Barrocal is the area of the Algarve with the major presence of dry stone constructions. The geographical area of the Barrocal is characterized by dry farming cultivations such as the fig tree, the almond tree, the carob tree and the olive tree. This agricultural landscape is combined with Mediterranean forest vegetation [11]. The terrain of the Barrocal is characterized by a layer of argillaceous earth, of approximately 10 or 20 centimetres on an extensive limestone rock. In this area, a karst processes took place in which aquifers with various depths were formed, which generally reach hundreds of meters.

The predominant dry stone constructions in this area are the walls used to delimit properties, anchor the land, store stones or retain and channel water. There are also other types of buildings such as farmhouses, threshing floors, lime kilns, among others. The state of conservation of these constructions varies according to the agricultural activity that the farm or plot has had.

Property limit. In the same way that happens in the Litoral area, the walls that delimit properties are continuous and mostly measure between half a meter and one meter in height. Due to the topography of the land, with unevenness between the different mountain ranges that characterize this area, the walls that do not border on roads are in good condition as long as the land has had a minimum maintenance.

Terraces. In the Barrocal area, the walls used to anchor the terrain predominate. The dimensions of these depend on the surface of the farm and the unevenness of the land. The state of conservation of these walls depends on the use and maintenance that the land has had until today. There are walls in perfect condition, walls that have collapsed and walls that are overgrown by the vegetation.

Storage. The stone stockpiles in the Barrocal area are perpendicular and parallel to the unevenness. Because it is an area with a layer of topsoil with little thickness, throughout the area you can find stone stockpiles between one and two meters high and between one and three meters wide. The state of conservation of these depends on the use or disuse that the farm has and on the knowledge about the dry stone construction technique that those in charge of the land have.

Transition between levels. The transition between levels which are located in the Barrocal area are the stairs. These stairs are built into the walls. The steps measures depends on the characteristics of the stones in the area. The width was the minimum possible so that a person could pass and avoid losing space to be able to cultivate.

Water retention. The Barrocal is a very dry area, with episodes of very intense rain. It is for this reason that in different locations in the Barrocal area there are walls perpendicular to the unevenness to avoid torrents and encourage water to seep into the ground. These are continuous walls that measure between one meter and one and a half meters. The state of conservation depends on the state of maintenance that the land has had.

Channeling of water. Due to the lack of water on the surface of the Barrocal, any water that may exist is channelled to take advantage of it and prevent its force from damaging the cultivated fields during episodes of intense rain. The walls are continuous and as far as possible parallel to the unevenness of the terrain. The canalizations are made up of two facing walls with a height of between half a meter and one meter.

Isolated buildings. Different isolated constructions are located in the Barrocal area. Most are in a poor state of conservation since many of them have been disused, although the land has continued to be cultivated. In this area there are cabins, farmhouses, lime kilns and threshing floors.

2. The Barrocal. Dry stone construction and technique

The Barrocal is the area of the Algarve (Figure 2.), as detailed above, with major presence of dry stone constructions. In order to be able to fully analyse the dry stone constructions of the Barrocal, a delimited study area has been chosen. The criteria in choosing this area have been: previous knowledge of the place, diversity of dry stone constructions, state of conservation of the present constructions, availability of people with knowledge of the territory. Taking into account the named criteria, the chosen area has been a delimited area in the “Serra de Monte Figo”.

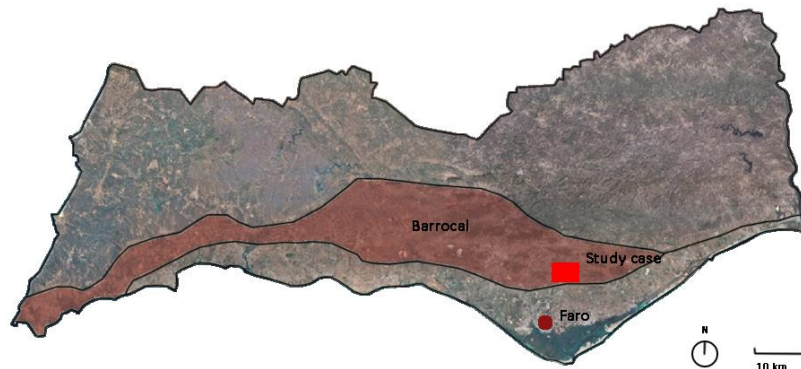


Figure 2. Algarve region location. (Source:[10], authors).

One of the significant data in the trend of progressive abandonment of the fields in rural areas is the decrease of the population [11]. The consequence of the progressive abandonment of the fields is the loss of knowledge of the construction technique of dry stone and the knowledge of the different constructions that have adapted and modelled the territory. These dry stone constructions are linked to the surrounding environment such as: the characteristics of the topography of the area, geology, hydrography and agriculture. According to these characteristics, linked to the construction heritage of the area, the construction typologies will be one or the other.

In the field of study, four construction typologies of dry stone have been detected. The state of conservation of these depends on the use and maintenance they have had over the last 50 years. While the walls have been preserved, the other constructions have progressively deteriorated until they practically disappear. Due to the great number of constructions that exist and the lack of use, conserving them is an expensive and difficult task. It is for this reason that having an exhaustive record of constructions allows setting priorities when investing in conservation and dissemination.

2.1. Property boundary

Unlike other areas, in the Barrocal area the territory is highly fragmented into different farms with different ownership. For this reason, there are walls that limit the properties throughout the territory. In addition to the walls, one of the indicators that limit the properties are vertical stones of about 40 centimetres of straight worked edges (Figure 3.).

2.2. Terraces and water retention

In order to be able to make the most of the land and make it suitable for cultivation, throughout the study area the walls that anchor the land predominate. Depending on the slope of the terrain and the topographic characteristics, there are walls of different lengths and heights (Figure 3.).

2.3. Storage

In the field of study, different walls destined to the accumulation of stones have been observed. An orderly pile of the stones shows that the accumulation is well arranged and that it is easy to find the stone sizes when necessary (Figure 3.).

2.4. Channeling of water

The dry stone constructions used as channelling water are walls that accompany droughts and that direct the water between cultivated lands. They are used to prevent erosion of the fields and to direct it towards specific areas or points (Figure 3.).

2.5. Threshing floor

The threshing floors are workspaces related to agricultural tasks. Mainly they were flat, circular and cobbled spaces. The main task that was developed was the threshing of the wheat. They are usually located next to houses or warehouses to store the product obtained. The surface had a slight slope to avoid water stagnation and puddles. To save the slopes and isolate it from the runoff of the rains, some threshing floors are surrounded by a perimeter wall. They were mostly built in high places to take advantage of the wind and thus better separate the grain from the chaff once beaten. In the field of study, six threshing floors that are in a state of abandonment have been located. From these threshing floors, the one in the best state of preservation has been chosen and the measurements have been analysed using the digital photogrammetry tool (Figure 3.).

2.6. Lime kilns

A lime kiln is a type of construction that made it possible to obtain calcium oxide, known as lime, by heating the calcareous stone. The mixture of lime with sand, gravel and water were used as a binding material for the stones in the walls of houses and their coverings. The kiln was built on a slope in the ground to facilitate access to all parts of the kiln. The measures of the oven change depending on the needs, although the general structure is always the same. Two lime kilns have been located in the study area. Of the two kilns, only the part called "pot" is preserved (Figure 3.), which was the circular-shaped part of the kiln where the stones were deposited that would later be calcinated in order to obtain lime.

2.7. Corral

Within the scope of study a dry stone walled corral has been located. The corrals were intended to protect the sheep. They were constructions made up of four perimeter walls that were accessed through a wooden opening. Due to disuse, the construction is in a very poor state of conservation and remains unnoticed in the environment (Figure 3.).

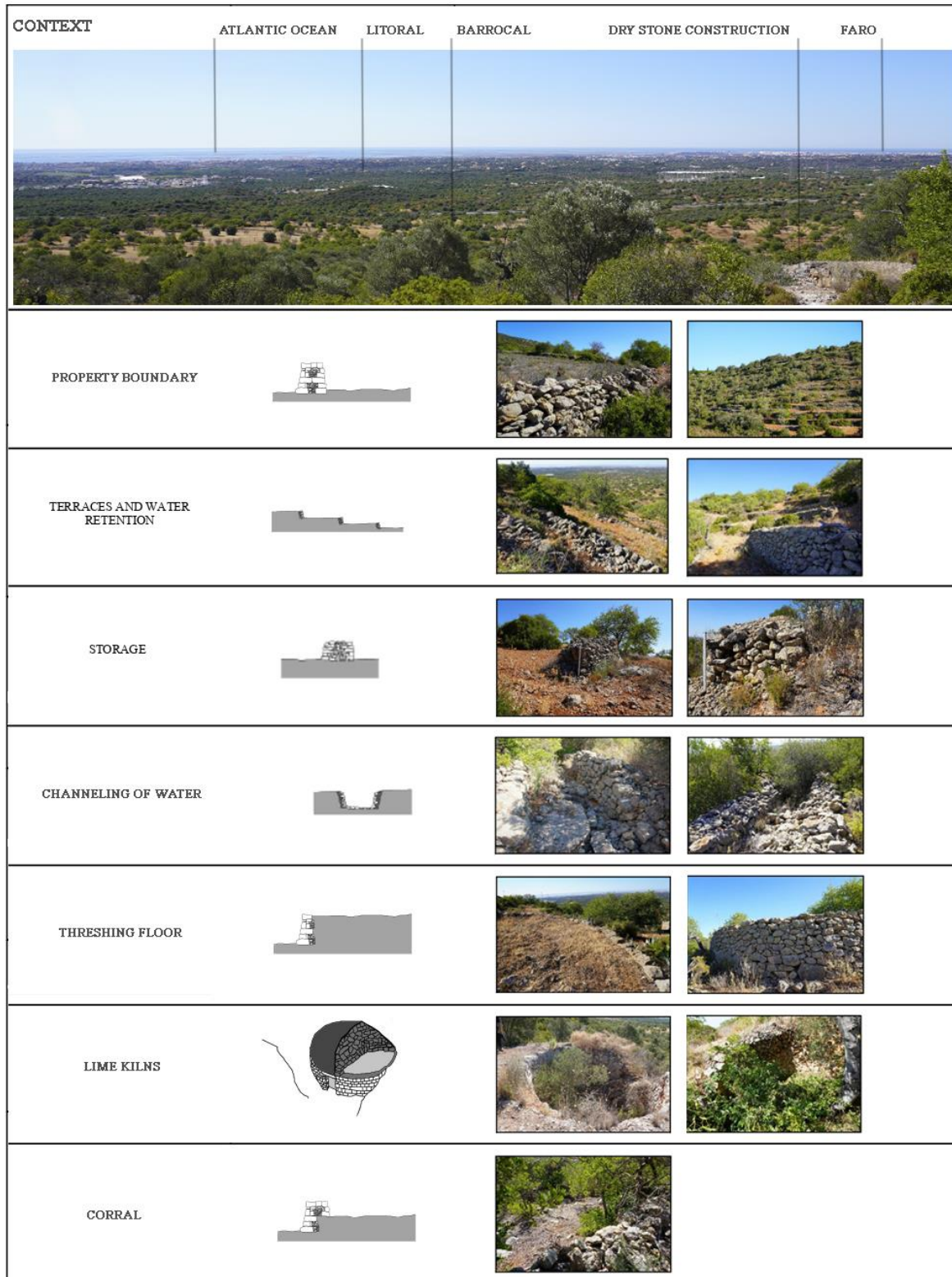


Figure 3. Dry stone constructions characteristic of the study area (Source: authors).

3. Results and discussion

From the declaration of the dry Stone technique Intangible Cultural Heritage of Humanity by UNESCO (2018), the actions surrounding the dissemination and conservation of the buildings have been valued. Prior to the declaration, the actions at the international and national level that were made around the constructions and the constructive technique were present in the countries that participated in the unitary candidacy presented to UNESCO. Thus, in countries such as Cyprus, Greece, Croatia, Slovenia, Switzerland, Italy, France and Spain, professionals have been trained through schools, studies and inventories have been carried out, training courses and educational materials have been carried out for different audiences, among other actions. In the case of Portugal, the fact of not participating in UNESCO's candidacy is, a priori, a sign that at the State level, an action plan has not been developed in this regard. As a consequence, the actions developed around the promotion, conservation, restoration and dissemination of the technique and of the constructions are very few. In addition to the studies and actions carried out in section "2.1. Introduction to the heritage of dry stone in Portugal", two actions have been located: one in the preservation of dry stone walls in the Monchique area to favour the infiltration of water in the subsoil and another in the construction of retaining walls in buildings of new construction.

Once identified and registered the dry stone constructions along the Barrocal, it has been observed that most of the dry stone constructions are in poor condition. Many constructions are hidden by vegetation due to the progressive abandonment of work in the fields. In areas where there is still cultivation it was observed that the walls were maintained, but the other constructions were abandoned, replaced or have disappeared.

Since it is a heritage that shapes the landscape, explains the history and culture of the place and it is the fruit of oral memory transmitted over many generations, measures must be taken in this regard to preserve and promote it. If the dry stone heritage of the Algarve is not known, it will be very difficult to promote measures and raise awareness of the social, cultural and ecological advantages that are involved. It is for this reason that three conservation and promotion measures have been proposed. The proposed measures are not and should not be the only ones. These measures are:

- The realization of dry stone courses
- The elaboration of didactic resources
- The execution of a virtual platform

Once the need to preserve and to promote the technique and dry stone constructions has been identified, the applied conservation criteria must be established: what should be conserved, how it is conserved and what kind of problems these constructions present. Unlike other built heritage, vernacular heritage does not have defined action guidelines on how to act globally in a rural context or at the level of each case in a particular way.

Due to the large number of constructions that exist throughout the territory, whose vast majority is abandoned and in poor condition, it is impossible to plan a reconstruction or maintenance of all the constructions. In order to develop an action criterion in this regard, it is necessary to study the typologies and characteristics of the constructions in each area, since the problems and needs can be diverse. The dry stone heritage is very specific to each one of the areas and the criteria must take into account each specificity. The study of the constructions in a specific area makes it possible to identify the typologies, identify the state of conservation and to detect the conservation problems, which can be: the abandonment of fields, the replacement of constructions by other mechanisms or the use of other materials such as concrete.

Assuming that not all dry stone constructions in an area can be preserved, priority must be given in which areas and typologies where it is necessary to apply the criteria of reconstruction, recovery and

conservation. The established priorities may be linked to the uniqueness of the constructions, the proximity of the population centres or the generation or recovery of new dynamics around the fields that have been abandoned. The reasons for investing resources and efforts in the recovery and reconstruction of dry stone buildings must be linked to permanent or intermittent use throughout the year. The linked use will favour its conservation. Once the constructions that need to be intervened in an area of action have been identified, the action criteria must be defined. The operations that take place around dry stone constructions must use the dry stone construction technique both to give a unified criterion to the constructions and to maintain the knowledge of the construction technique. It is necessary to highlight that any intervention in dry stone constructions is part of the vernacular heritage of the intervention area.

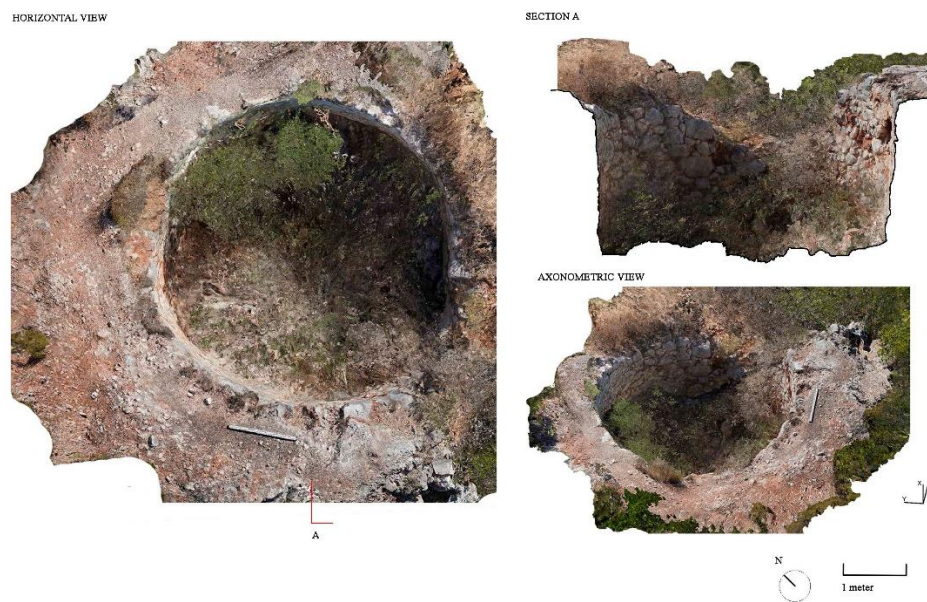


Figure 4. Photogrammetry Lime kilns model (Source: authors)

4. Conclusions

The diverse and relevant dry stone heritage that exists in Portugal in general, and in the Algarve in particular is mostly unknown both regionally, nationally and internationally. Although research and some actions have been carried out in this regard, it is currently not one of the priorities within the majority of sectors that deal with both tangible and intangible heritage. The construction technique and stone constructions are a fundamental tool to revitalize areas that want to promote quality cultural tourism. Both the technique and the constructions explain the history and customs of a place. According to the type of stone, the constructions are of one or the other type and their properties and characteristics are changing. The sets of buildings form the humanized rural landscape, the result of the immense work of generations and generations to take advantage of the resources of the environment and obtain food and benefits.

In order to value the dry stone heritage and recognize it as an element of identity and promotion, it is necessary to know it. Although it is a heritage that is widely available to all, due to ignorance it is ignored. It is for this reason that one of the objectives of this work has been to identify and record the different construction typologies located in the Barrocal. The use of digital photogrammetry (Figure 4.) in the surveying of three construction typologies has allowed us to define the current state of a representation of dry stone constructions and to obtain accurate dimensional measurements of each element. The registered constructions are different to reflect the different data that can be obtained by

applying precise tools. The data obtained allow to know the characteristics of the constructions and, consequently, particularities of the construction technique.

Systematically applying the registry of dry stone constructions in the Barrocal or in the Algarve would allow developing a rigorous inventory of the typologies present, evaluating the state of conservation and thus having sufficient criteria to invest in the recovery of the most relevant constructions. Finally, the conservation and dissemination measures have to be the beginning of a national dissemination plan to study, conserve, develop and disseminate the tangible and intangible heritage of dry stone.

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