

# URBAN AND ARCHITECTURAL INTERVENTIONS IN EARTHEN-BUILT HISTORIC CENTRES. THE CASE OF DACHRA EL-HAMRA IN EL-KANTARA, ALGERIA

**Wahiba Moussi**

LACOMOFA Laboratory, Department of Architecture, Faculty of Architecture and Urbanism, Civil Engineering, and Hydraulics, University of Biskra, Biskra, Algeria

**Sami Zerari\***

Department of Architecture and Industrial Design, University of Campania "Luigi Vanvitelli", Aversa, Italy; Department of Architecture, Faculty of Architecture and Urbanism, Civil Engineering, and Hydraulics, University of Biskra, Biskra, Algeria

**Khaled Selatnia**

Department of Architecture, University of Constantine 3, Constantine, Algeria

**Mostefa Medouki**

Built Environment Resilience Lab (BERLab), Department of Architecture, Faculty of Architecture and Urbanism, Civil Engineering, and Hydraulics, University of Biskra, Biskra, Algeria

**Keywords:** Algeria, FSDRS, Dachra El-Hamra, historic centre, urban and architectural interventions

## 1. Introduction

The principles and methods of intervention on cultural heritage are deeply interrelated and intrinsically complex, reflecting the multifaceted nature of heritage itself. Cultural heritage includes not only tangible elements such as architectural structures, historic sites, and artifacts but also intangible aspects like traditions, practices, and knowledge systems. This diversity adds layers of complexity to any intervention, requiring a careful balance between preserving authenticity, respecting cultural significance, and adapting to contemporary needs [1–3]. The proximity of the principles and methods stems from their common objectives: to safeguard heritage while ensuring its relevance and accessibility for present and future generations [4].

Urban interventions in the historic centres of the Maghreb, notably in Algeria, Morocco, and Tunisia, face major challenges. They aim to preserve these centres in the face of natural and human threats, as well as existing legal constraints [5–6]. These interventions require the establishment of appropriate regulatory frameworks and strategies that enable sustainable urban expansion while promoting community participation and sustainability [7–8].

Intervention in traditional urban centres in Algeria is crucial for preserving the nation's rich cultural and architectural heritage. These historic centres, often referred to as ksour, medinas, or kasbahs (traditional urban settlements), are not only architectural treasures but also the heart of the social and cultural identity of their regions [9]. They reflect centuries of history, blending Berber, Arab, Ottoman, and colonial influences.

---

\* Corresponding author: sami.zerari@unicampania.it

However, these heritage sites face significant challenges due to urbanisation, neglect, and environmental degradation, which threaten their structural integrity and cultural value. By employing traditional construction techniques, modern technologies, and the promulgation of new heritage management policies, the Algerian government seeks to protect these historic centres from further decline while respecting their historical authenticity. The conservation of these sites is crucial not only for maintaining Algerian identity but also for promoting cultural tourism, fostering economic development, and ensuring the transmission of traditional knowledge to future generations.

Dachra El-Hamra in El-Kantara is an example of a traditional earthen settlement; it was officially designated as a safeguarded sector on May 15, 2013. This is one of three measures for the protection of cultural heritage, depending on its nature, provided by Algerian Law No. 98-04 on the protection of cultural heritage.

The official designation of Dachra El-Hamra was intended to regulate urban transformation, protect its traditional architectural fabric, particularly its earthen constructions, and ensure sustainable and regulated management of future interventions. However, before this legal recognition, the site had already been the subject of urban and architectural intervention projects between 2001 and 2012. These interventions, carried out in response to threats of deterioration or collapse, raised several issues, particularly in terms of technical choices, respect for traditional know-how, and institutional coordination related to operational management of intervention projects. Their implementation before the establishment of an official protection framework calls into question the overall coherence and effectiveness of the safeguarding strategies applied to this heritage.

In recent years, Dachra El-Hamra has been the focus of several architectural studies [10-14], which have explored its historical and architectural significance. However, these studies overlook the conservation strategies and restoration efforts undertaken to preserve its architecture. This gap underscores the need for targeted research on the interventions implemented before and after its designation as a safeguarded sector.

Based on these considerations, several research questions arise: What were the objectives, outcomes, and limitations of the urban and architectural interventions implemented in Dachra El-Hamra between 2001 and 2012? To what extent did these interventions contribute to preserving or transforming Dachra's heritage character when assessed against relevant international conservation standards and recommendations?

## 2. Objective and reason for selecting Dachra El-Hamra as a case study

The primary objective of this article is to identify and assess the urban and architectural interventions undertaken in Dachra El-Hamra within the scope of *le Fonds spécial de développement des régions du Sud* (FSDRS) programme (in English: Special Fund for the Development of Southern Regions). This involves not only cataloguing the specific restoration actions implemented but also evaluating their impact and alignment with broader conservation principles. Through this evaluation, the study also aspires to provide insights into potential future conservation strategies that can be applied to similar heritage sites in Algeria.

There were three decisive reasons for selecting Dachra El-Hamra as a case study. The first was the practical feasibility of the investigation, including the possibility of conducting interviews with the relevant stakeholders, observing the architectural features, documenting past interventions, and assessing the current state of the buildings. The second reason was related to the heritage value of Dachra El-Hamra. Classified as a protected sector in 2013 [15], it is a representative example of traditional earthen architecture in Algeria and has not been the subject of in-depth studies. The third reason

was motivated by the fact that Dachra El-Hamra offers a rich context for questioning the coherence and evolution of preservation strategies. It illustrates the challenges related to coordination between institutional actors, legal constraints, and the participation of local communities in heritage protection.

### 3. An overview of the safeguarded sector in the framework of Law No. 98-04

Algerian Law No. 98-04 on the Protection of Cultural Heritage represents a significant milestone in the country's approach to heritage conservation, marking a notable advancement in the legal framework related to the preservation of cultural heritage. This law broadens the traditional notion of heritage, providing a more comprehensive and inclusive definition that goes beyond monuments and historical sites to encompass a wide range of tangible and intangible cultural assets.

Article 3 of the law classifies cultural property into legally defined categories, including: 1) immovable cultural property; 2) movable cultural property; 3) intangible cultural property. Moreover, Article 8 of the law specifies that the tangible cultural heritage includes historic monuments, archaeological sites, and urban or rural complexes. It also outlines three specific measures for the protection of this heritage, whatever its legal status; it may be subject to one of the following protection regimes, depending on its nature and the category to which it belongs: 1) inclusion in the supplementary inventory, 2) classification, 3) creation of safeguarded sector.

In Algeria, 27 urban and rural centres have been officially designated as safeguarded sectors [15] due to their significant historical, cultural, and architectural value (Table 1). Thus, these sectors are subject to additional legal provisions aimed at preserving their cultural and architectural integrity. Among these areas is Dachra El-Hamra (the Red village), its designation was announced in the Official Journal of the Algerian Republic No. 26, on May 15, 2013. Article 2 of Executive Decree No. 13-185 of 25 Joumada Ethania 1434 AH (corresponding to May 6, 2013) [16], concerning the creation and delimitation of the safeguarded area of Dachra El-Hamra; the official statement (originally issued in French) reads:

*"The safeguarded sector of the village known as 'Dachra El-Hamra', named for the colour of its soil, is considered an example of authentic Arab-Berber architecture. This is based on its construction typology, door design, street layout, house organisation, use of local building materials, and architectural character, which harmonise with the natural environment, local traditions, and customs" [16].*

Each safeguarded sector must be equipped with a PPSMVSS (Plan Permanent de Sauvegarde et de Mise en Valeur du Secteur Sauvegardé), translated as the Permanent Plan for the Safeguarding and Enhancement of the Safeguarded Sector. This instrument serves as the principal management and regulatory tool for the protection, conservation, and development of safeguarded sectors in Algeria. Its establishment and implementation are governed by Executive Decree No. 03-324. The PPSMVSS establishes regulatory guidelines for the preservation and enhancement of buildings and urban environments located within safeguarded sectors. These sectors include traditional settlements – like casbahs, ksour and villages – that are primarily residential and valued for their historical, architectural, and cultural coherence. The PPSMVSS is drawn up in three phases, with the first two carried out simultaneously: phase 1: diagnosis and, if necessary, emergency measures plan; phase 2: historical and typological analysis and preliminary draft of the PPSMVSS; phase 3: final draft of the permanent plan for the preservation and enhancement of the protected areas.

Thus far, five safeguarded national sites have already benefited from a PPSMVSS,

which have been approved by an executive or inter-ministerial decree, while others are currently being created and are expected to be launched soon (regarding Dachra El-Hamra, the PPSMVSS is currently in preparation).

*Table 1. List of safeguarded sectors in Algeria [15]*

| N° | Wilayas     | Safeguarded sectors                       | Date of designation          | Approval of PPSMVSS                     |
|----|-------------|-------------------------------------------|------------------------------|-----------------------------------------|
| 1  | Algiers     | The Casbah Algiers                        | 11/05/2005                   | Executive Decree n°12-133 du 21/03/2012 |
| 2  | Constantine | The old city of Constantine               | 05/06/2005                   | Interministerial order of 04/05/2014    |
| 3  | Ghardaïa    | The old city of the M'Zab Valley          | 05/06/2005                   |                                         |
| 4  | Boumerdes   | The old city of Dellys                    | 19/09/2007                   | Interministerial order of 16/03/2016    |
| 5  | Chlef       | The old city of Ténès                     | 19/09/2007                   | Interministerial order of 01/06/2021    |
| 6  | Tlemcen     | The old city of Tlemcen                   | 02/12/2009                   |                                         |
| 7  | Tlemcen     | The old city of Nedroma                   | 02/12/2009                   |                                         |
| 8  | Tizi- Ouzou | The village of Ait El Kaid                | 02/12/2009                   |                                         |
| 9  | Mila        | The old city of Mila                      | 02/12/2009                   | Interministerial order of 01/06/2021    |
| 10 | El Oued     | The Ksar of Tamerna                       | 02/12/2009                   |                                         |
| 11 | El Oued     | The neighbourhood of Echeche and Messaaba | 30/03/2011                   |                                         |
| 12 | Laghouat    | The old ksar of Laghouat                  | 30/03/2011                   |                                         |
| 13 | Ouargla     | The ksar of Ouargla                       | 30/03/2011                   |                                         |
| 14 | Ouargla     | The Ksar of Témacine                      | 15/05/2013                   |                                         |
| 15 | Bejaïa      | The old city of Bejaïa                    | 15/05/2013                   |                                         |
| 16 | Biskra      | Dachra El-Hamra                           | 15/05/2013                   | In process                              |
| 17 | Annaba      | The old city of Annaba                    | 15/05/2013                   |                                         |
| 18 | Oran        | The old city of Sidi El Houari            | 08/02/2015                   |                                         |
| 19 | Bejaïa      | Qalaa des Beni Abbas                      | 12/08/2015                   |                                         |
| 20 | Mostaghanem | The old city of Mostaghanem               | 12/08/2015                   |                                         |
| 21 | Adrar       | The old city of Tamentit                  | 04/05/2016                   |                                         |
| 22 | Médéa       | The old city of Médéa                     | 16/12/2018                   |                                         |
| 23 | Djanet      | The Ksar of El Mizane                     | 08/02/2021                   |                                         |
| 24 | Djanet      | The Ksar Azzelouaz                        | 08/02/2021                   |                                         |
| 25 | Djanet      | The Ksar Adjahil                          | 08/02/2021                   |                                         |
| 26 | Ghelizane   | Ghelizane                                 | Not officially announced yet |                                         |
| 27 | Ain Defla   | The old city of Miliana                   | Not officially announced yet |                                         |



#### 4. Conservation of earthen architecture

The formal diversity of vernacular architecture is an expression of the ingenious responses of people with very different attitudes and ideals to their varied environments. According to Rapoport, the responses developed and implemented vary from place to place because of changes and differences in the interplay of social, cultural, ritual, economic, and physical factors [17]. Traditional vernacular built environment is the ideal environment for people who express themselves in the buildings and the habitat [17]. The vernacular building is built by the inhabitant for himself, following popular tradition, and contrasts with the prestigious building, which is rather the work of a specialist and represents the culture of the elite. Oliver [18] argues that all forms of vernacular architecture have been produced to meet specific needs, following the social values, economic conditions, and lifestyles of the cultures that are their repositories. These forms can be transformed over time to adapt to changing circumstances and needs [18].

Earthen architecture is a significant component of vernacular architecture because these structures reflect deep-rooted connections between human settlement, environmental conditions, and cultural identity; they are considered an essential part of vernacular heritage. It can be fundamentally defined as all architecture built with earth-based materials such as adobe, rammed earth, cob, and compressed earth blocks [19-20]. It is one of the most ancient and widespread building traditions, having been practiced for over 10,000 years and found on all continents, particularly prevalent in arid and semi-arid regions, notably in the Mediterranean basin. These structures reflect deep-rooted links between human settlement, environmental conditions, and cultural identity [21-22]. During the earliest international meetings on the subject, such as those held in Yazd in 1972 and 1976, the general term "earthen architecture" was used alongside several alternative terms. These included mud architecture, unbaked earth architecture, raw earth architecture, and clay architecture. It was explicitly recommended during the 3rd International Symposium on Mudbrick Preservation in Ankara in 1980 that the term "earthen architecture" be adopted to represent architecture built with earth. This was partly because some of the alternative terms carried negative connotations or were not correctly applied [19, 21]. Earthen architecture encompasses various techniques such as adobe (mud bricks), rammed earth (pisé), cob, and wattle and daub, among others, reflecting its adaptability and cultural significance. Between 1972 and 2008, earthen architecture evolved from a "simple subject of interest" to a "discipline in its own right". This evolution is supported by many organisations.

The conservation of earthen architecture has been progressively shaped by a series of international charters and conventions, each contributing to a more comprehensive understanding and set of recommendations for its preservation [21]. The Venice Charter [23] established foundational principles for conserving historic monuments and sites as shared human heritage, and while it does not explicitly mention earthen architecture, its broad definition includes these structures, setting a lasting standard for authenticity and responsibility. Building on this, the Washington Charter [24] expanded the focus from individual buildings to entire historic centres and urban areas, underlining the need to preserve traditional materials and techniques, which naturally applies to earthen buildings within historic settlements.

The ICOMOS Charter on Built Vernacular Heritage [25] further advanced this by defining vernacular architecture, recognising that everyday structures – often built with earth – hold cultural value worth safeguarding. It emphasised understanding local building traditions and regional materials like adobe or rammed earth, setting out practical conservation principles that respect both cultural significance and real-world challenges. On the other hand, the ICOMOS Recommendations [26] addressed the specific technical challenges that historic structures present, especially when modern codes do not suit traditional materials. They

provide vital guidance to ensure structural analysis and restoration respect historic fabric and cultural meaning, giving designers and engineers clear principles and methods to follow. In parallel, the Gaia Project, launched in the 1980s by CRAtterre-EAG and ICCROM, was one of the first global initiatives focused entirely on earthen architecture. By blending scientific research with local know-how, it empowered communities to care for their own heritage, laying the groundwork for the UNESCO World Heritage Earthen Architecture Program (WHEAP), which has since built on this by promoting training, research, and recognition of earthen architecture's cultural, ecological, and economic value [27].

Finally, the latest ISCARSAH Guidelines [28] reinforce these core ideas: conserving earthen architecture demands minimal, compatible, and reversible interventions that address its unique vulnerabilities – especially water damage and seismic risks – while respecting traditional materials and skills. Together, these principles ensure that earthen heritage is protected sustainably, strengthening resilience and preserving the vital knowledge that communities pass down through generations.

## 5. Methodology and data collection

To achieve the objectives of this study, the methodology employed was grounded in a qualitative approach. The data collection was based on in-situ visits, documentary and archival research, including materials from the municipal archives of El-Kantara and documentation provided by the Directorate of Culture and architectural firms, which oversaw the interventions. Additionally, the Authors conducted semi-structured interviews with officials and key actors involved in the restoration of Dachra El-Hamra in El-Kantara.

### 5.1. In-situ visits

In-situ visits carried out in Dachra El-Hamra between 2021 and 2022 provided an opportunity to directly observe local architectural features and enabled direct observation and documentation of restoration activities conducted under the FSDRS programme. These observations were recorded in the form of detailed descriptive notes and supplemented by systematic photographic documentation in order to preserve an accurate record of the original features and modifications made. This methodical approach has resulted in the creation of rich and structured data, which is essential for evaluating the quality of the architectural interventions carried out.

### 5.2. Documentary and archival research

This stage involved collecting visual and written documentation in order to trace the interventions carried out in Dachra El-Hamra. The investigation relied primarily on the municipal archives of El-Kantara and the Directorate of Culture of Biskra, which provided key insights into the administrative and technical history of the architectural interventions. Additional documentation – such as detailed plans, technical reports, and descriptive records – was provided by several architectural firms based in El-Kantara.

Table 2. Semi-structured interview guide

| Thematic areas                             | Open-ended questions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Types of interventions</b>              | <ul style="list-style-type: none"> <li>• Could you describe the nature of the restoration work carried out in Dachra El-Hamra?</li> <li>• What were the main priorities of these interventions – structural consolidation, conservation of materials, or adaptive reuse?</li> <li>• How were the original materials treated or preserved during the restoration process?</li> <li>• If the reuse of the buildings was considered, what purposes were proposed, and what criteria guided those decisions?</li> <li>• In your opinion, which type of intervention would be most appropriate for Dachra El-Hamra?</li> </ul>                                                                                                                                                                                                                                                                                                                |
| <b>Challenges and constraints</b>          | <ul style="list-style-type: none"> <li>• What types of challenges did you encounter during the restoration process?</li> <li>• Did climatic or environmental factors (e.g., humidity, temperature fluctuations, salt damage) pose challenges during the restoration?</li> <li>• How did the availability – or lack – of skilled traditional craftsmanship affect the project?</li> <li>• How did you balance the need for modern functionality with the preservation of historical authenticity?</li> <li>• Were there specific structural or material issues that complicated the work?</li> <li>• Were there any regulatory or administrative hurdles when securing permits or approvals?</li> <li>• How did heritage protection laws or guidelines influence your restoration strategy?</li> <li>• What strategies did you use to overcome these technical, financial, or regulatory obstacles?</li> </ul>                            |
| <b>Stakeholder involvement</b>             | <ul style="list-style-type: none"> <li>• Who were the main parties involved in the restoration process of Dachra El-Hamra?</li> <li>• What role did local authorities play in planning, approving, and overseeing the restoration project?</li> <li>• How did heritage experts contribute to defining restoration priorities and selecting appropriate methods?</li> <li>• In what ways was the local community engaged in the restoration process?</li> <li>• What role do residents play in conserving the site's tangible, intangible, natural, and cultural heritage?</li> <li>• Can you describe the contribution of local artisans to the intervention? How did collaboration among these different stakeholders influence the overall restoration strategy?</li> <li>• Were there conflicts or differences in priorities between stakeholders? If so, how were they addressed or resolved?</li> </ul>                             |
| <b>Sustainability and future prospects</b> | <ul style="list-style-type: none"> <li>• What strategies have been planned for the long-term upkeep and maintenance of the restored site?</li> <li>• How have traditional techniques been integrated into future maintenance or restoration plans?</li> <li>• What modern methods or technological innovations have been used to ensure the sustainability of the interventions?</li> <li>• Are there any intervention plans in place to assess the long-term condition of the building?</li> <li>• What challenges do you anticipate for the future conservation of the site?</li> <li>• Are there additional restoration projects or phases planned for Dachra El-Hamra?</li> <li>• How do you plan to engage and train local residents, craftsmen, and experts to ensure sustainable, long-term maintenance? And are there educational or awareness programmes planned to promote the value of Dachra El-Hamra's heritage?</li> </ul> |

### 5.3. Semi-structured interviews

In order to gain deeper insights into the restoration process, the decision-making framework, and the challenges encountered during the interventions, semi-structured interviews were conducted with officials and key actors involved in the restoration of Dachra El-Hamra and the local residents. These interviews were conducted in the interviewers' offices or on-site between 2021 and 2022. Each interview lasted about one hour and was structured around open-ended questions in order to encourage detailed responses. The interview guide focused on four thematic areas critical to assessing conservation outcomes: 1) Types of interventions, 2) challenges and constraints, 3) stakeholder involvement, 4) sustainability and future prospects (Table 2). All individuals were informed of the research objectives, their rights, and confidentiality measures. Informed consent was obtained orally before data collection in accordance with standard research ethics protocols.

By incorporating diverse perspectives, these interviews provided context for understanding how interventions in Dachra El-Hamra reflect wider conservation practices and governance in Algeria.

## 6. Presentation of Dachra El-Hamra

### 6.1. Location and history

The settlement known as Dachra El-Hamra – literally “the Red Village” in Arabic – is one of the constituent villages of El-Kantara, and is administratively part of the Biskra province, South-eastern Algeria. It is an oasis [29] in the south-western Aurès region, 52 km north of Biskra and 62 km south-west of Batna (Figure 1).

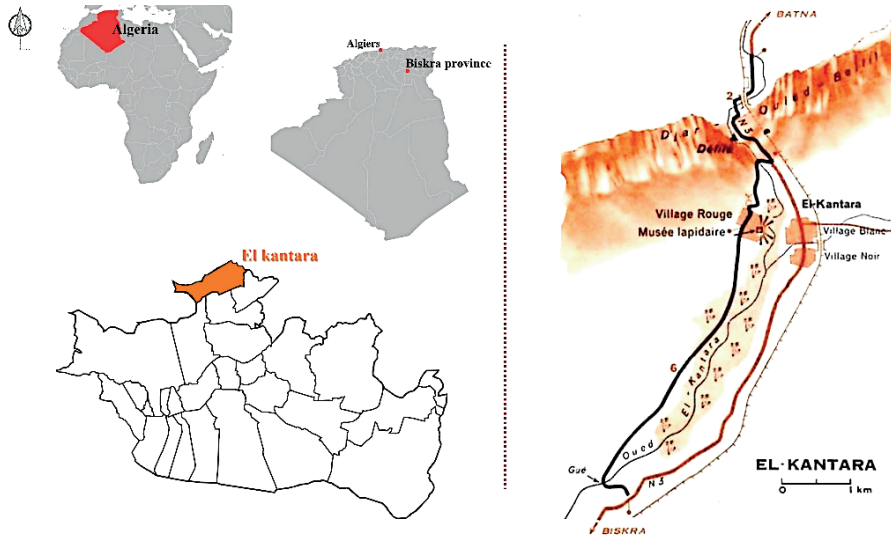


Figure 1. Location map of El-Kantara in the Wilaya (province) of Biskra [30].

El-Kantara in Arabic means the bridge. It is named after the Roman bridge which crosses the El-Kantara Gorge and was built by the Romans. This bridge was restored in 1862 by French military engineers. However, there is no description or painting of the bridge in the Roman era, and according to Gsell [30], the French restoration was not identical to the initial construction; a number of stones were replaced with new blocks, while the others were carefully scraped, and all the joints redone, so that the monument has lost its ancient appearance [31].

The El-Kantara oasis comprises three villages: Village Rouge, on the right (west) bank of the Oued El Haï, which crosses the oasis from north to south; Village Blanc on the left bank; and Village Noir slightly south of Village Blanc along the same bank (Figure 2 and Figure 3).

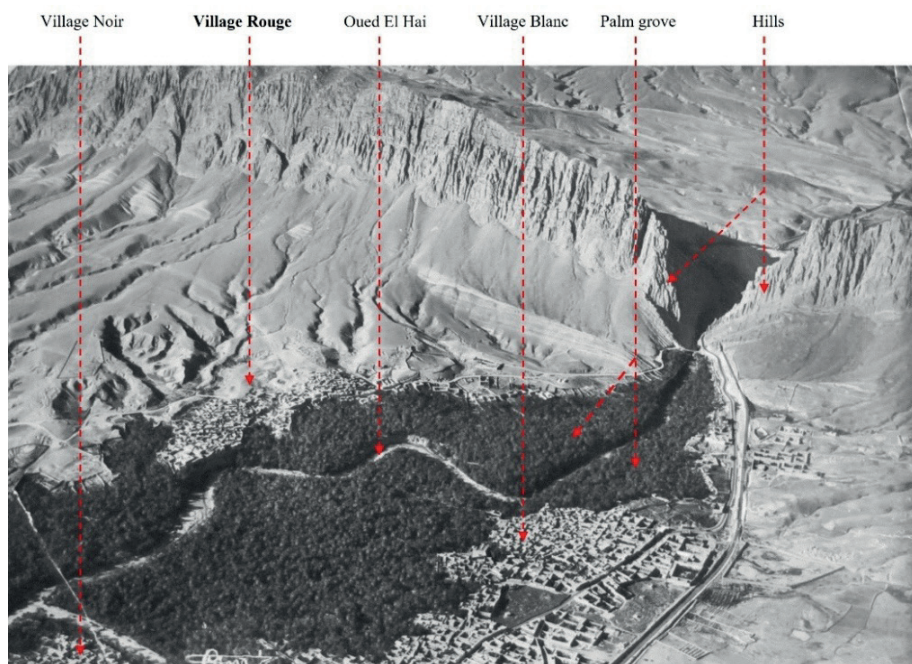


Figure 2. Aerial view showing the landscape components of El-Kantara City, Biskra, Algeria [32].

El-Kantara's landscape is a representative example of oasis settlements, representing a harmonious integration of natural and human-made elements. The oasis is characterised by a distinctive trilogy – palm grove, habitat, and water source – as described by Ouaret Ladjouze [29], embodying the essence of sustainable living in arid environments. The palm grove acts as a vital ecological and economic resource, offering shade, sustenance, and agricultural productivity. The traditional habitat reflects centuries of architectural adaptation to the harsh desert climate, harmonised with the surrounding landscape through material and spatial choices. Lastly, the water source is central to the ecological and social systems of the oasis, supporting not only the ecosystem but also the social and cultural practices of its inhabitants [33-34].



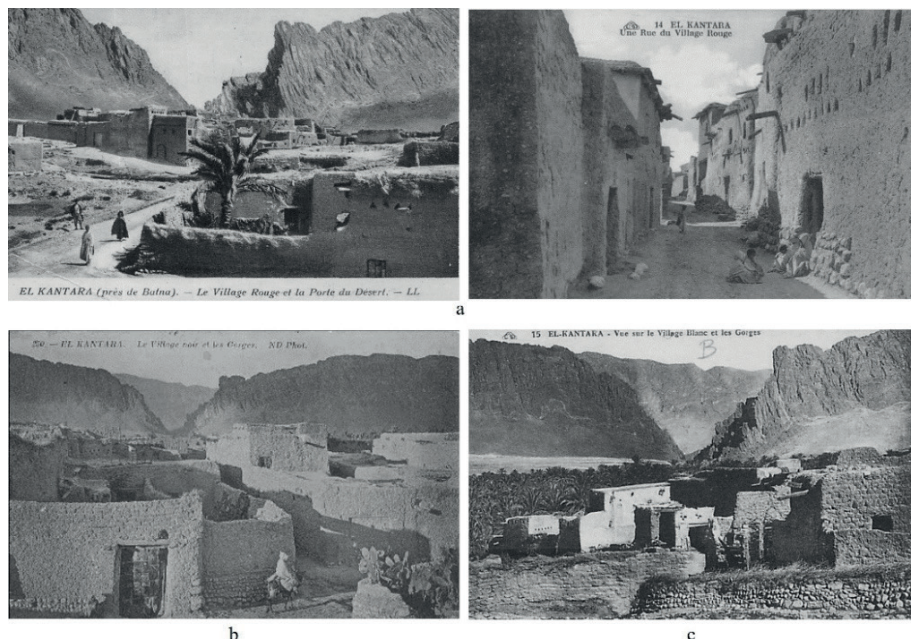


Figure 3. a) Old postcards showing Red Village [35-36]; b) old postcards showing Black Village [37]; c) old postcards showing White Village [38].

El-Kantara was a crossroads of civilisations and cultures throughout its long history, shaped by the passage and influence of various peoples and empires. Its strategic location, nestled in a gorge that connects the northern fertile plains of Algeria to the arid expanses of the Sahara, made it a significant point of transit and settlement for centuries. El-Kantara was traversed successively by the Romans, Vandals, and Arab Muslim groups, each leaving distinct historical traces [39].

During the Roman period, El-Kantara or the *Galceus Herculis* of the Romans [40], was an integral part of their extensive network of roads and fortifications, serving as a vital link for trade and military movements [41]. The Romans, recognising its strategic importance, established settlements and infrastructures that facilitated control over the region and integration into the broader Roman Empire. Remnants of their presence, such as ruins and inscriptions, testify to the role El-Kantara played in their administrative and economic systems [42-43].

Following the Arab-Muslim conquests in the 7th century and the successive arrival of Arab tribes in Algeria, El-Kantara witnessed a profound cultural and religious transformation. The region became part of the cultural networks of Islam, marked by the spread of Arab Islamic culture, language, and practices. According to oral tradition, due to the site's access to water and its strategic geography, some of the Muslim families formed a small community that gradually evolved into what became known as Dakhra Dhahraouia, the initial core of El-Kantara. Indeed, the development of this initial core was guided by natural boundaries, notably the Oued El Hai; an intermittent watercourse and palm groves; some family branches then established settlements nearby, such as Graggar and Bour Abbas, as the population grew. These patterns of settlement expansion shaped the spatial configuration of the region, consolidating the community's cultural and historical legacy.

After the French colonisation of Algeria in 1830, the colonial authorities positioned themselves strategically along the border of El-Kantara, by establishing a military post to control movement through the gorge. Thus, El-Kantara became a focal point for the construction of essential transportation infrastructure, including roads and a railway connecting Batna to Biskra. In addition, the French colonisers established an ex-nihilo village to accommodate the colonists at the entrance to El-Kantara, near the gorge. This village included the train station, the Hotel Bertrand, the post office, and the gendarmerie (Figure 4), as well as a number of Neo-Moorish style houses [10]. This village was named El Quaws (which literally means “arcs” in Arabic) by the local inhabitants, in reference to the predominance of using arcs in colonial buildings.

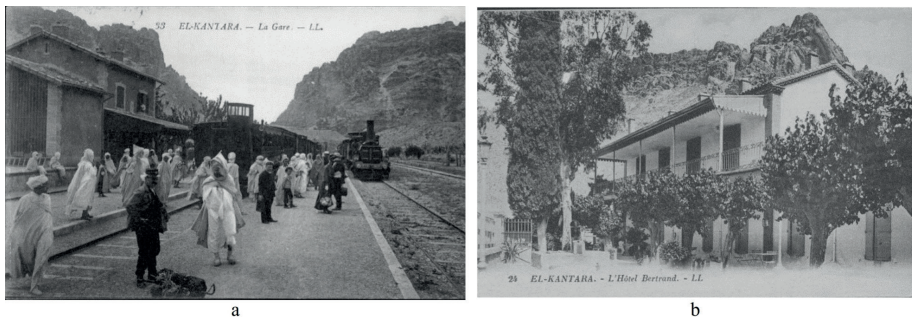


Figure 4. Old postcards showing a) the railway [44]; b) Hotel Bertrand in El-Kantara [45].

In addition, the French administration renamed the three historic villages – Dachra Dhahraouia, Graggar, and Bour Abbas – as Village Rouge, Village Noir, and Village Blanc. This new toponymy, imposed by the colonial authorities, aimed to simplify and exoticize local names to make them more accessible and attractive to European travellers, while asserting administrative control over the territory. Old, illustrated postcards distributed at the time explicitly show these names, helping to popularise them among foreign visitors and explorers (Figure 3). In addition, *Les Guides Bleus Illustrés: Constantine, Biskra, El-Kantara, Timgad, Touggourt* [40], published and printed by Imprimerie Hachette, mentioned and used these names in its descriptions, emphasising their official character and their role in promoting tourism in El-Kantara. These iconographic and editorial testimonies constitute valuable historical sources for understanding the discursive and visual construction of these places in the colonial imagination, as well as the lasting impact of these names on collective memory and local intangible heritage.

According to oral traditions, these names refer to the distinctive colours of the earth used to construct the buildings in each village, reflecting the natural hues of local materials. However, in the absence of official documents or historical evidence attesting the toponymy of these villages, this hypothesis remains speculative and is mainly based on oral traditions passed down within the local community, with the exception of the Village Rouge. Indeed, Article 2 of the Executive Decree No. 13-185 of 25 Jomada Ethania 1434, corresponding to May 6, 2013, indicates that this name is directly linked to the colour of the earth used in its construction. It can be, therefore, concluded that the Arabic name of the village Rouge originated during the colonial period, when the name Village Rouge imposed by the French administration was translated and adopted locally as Dachra El-Hamra.

In addition to major infrastructure projects, such as the Batna-Biskra railway line, train station, the Bertrand Hotel, and the post office, French colonisation also left a significant tangible mark on El-Kantara, notably through the creation of the open-air Lapidary Museum (Lapidary Museum).



This Museum was established by the archaeologist Gaston De Vulpillières (1883-1933), who had lived for several years in Dachra El-Hamra. Beginning in September 1921, he devoted the last decade of his life to founding this museum, patiently gathering architectural fragments, reliefs, and inscriptions through extensive in-situ research and long negotiations with local residents. The collection was gradually arranged around his small earthen house, strategically located on a terrace overlooking the natural landscape of Dachra El-Hamra, as illustrated by the 1956 Guide Vert Michelin map (Figure 1). As the number of artifacts increased, the site had to be expanded several times, eventually overflowing beyond its initial boundaries and into the adjacent alley. This valuable collection highlights the historical presence of the Romans in El-Kantara and nearby sites along the Oued El-Hai (Figure 5). Marrou [43] documented the Vulpillières collection in an article "*La Collection Gaston de Vulpillières à El Kantara*," published in the journal "*Mélanges d'archéologie et d'histoire*." He pointed out that most of the pieces in the Vulpillières collection provide information about the origins of the inhabitants, their religious practices and their economic and social life. The collection illustrates the various religious beliefs that existed in the region. While the Semitic people of El-Kantara remained faithful to their religion, devoting themselves to Malakhbel (West Semitic sun god worshiped primarily in the ancient Syrian city of Palmyra), there were also traditional Roman gods, such as Jupiter, Mercury, Neptune, and Hercules. African religious practices were also clearly present in El-Kantara, notably the funerary sacrifice of a ram dedicated to Saturn (Figure 5) [43].



Figure 5. a) Old views of the Lapidaire Museum in Dachra El-Hamra, El-Kantara in the 1980s [46]; b) sculptures representing female heads; c) bas-reliefs commemorating the funeral sacrifice of the ram [43].

The original location of the Lapidaire Museum's objects remains largely unknown, limiting the ability to interpret their archaeological context or confirm their provenance. Vulpillières emphasises in his field notes how he obtained them; only a few stone artifacts were found in-situ, as no systematic excavation had ever been carried out in El-Kantara. Most of the pieces were recovered incidentally during everyday activities or building work in and around El-Kantara and Vulpillières often had to recuperate stones that had either already been reused by the locals to build houses (such as stone blocks or column bases) and fences, or had been reused as household utensils. Indeed, Vulpillières' collection includes several millstones, indicating that cereals were a major food source for the inhabitants. In addition, the presence of oil presses also indicates that the region was interested in olive cultivation and olive oil production.

During the French colonisation of Algeria, El-Kantara attracted considerable attention from travellers, painters, and photographers who were captivated by its remarkable landscapes and unique character. This oasis, often referred to as the "Gateway to the Sahara," became a focal point of artistic and literary expression, symbolising the blend of natural beauty and cultural richness in Algeria. In his 1893 travelogue 'Biskra and the Oases and Desert of the Zibans', Sir A. E. Pease [47], second baronet, who made expeditions over a period of twenty years to many parts of Africa, offered a vivid colonial-era portrayal of El-Kantara. He illustrated how European travellers exoticised local rituals and environments, projecting a romanticised view of colonial Algeria. Pease described the reuse (or existence) of ancient materials in villages: blocks, columns, and capitals from the Roman period and identified these remains as the ruins of the ancient site of Calceus Herculis, the former Roman name for the El-Kantara region. In addition, Pease referred to a syncretic religious ritual, common in rural areas of the Maghreb, combining popular Islam and local traditions and described a scene of the ritual led by marabouts (Sufi religious guides or spiritual leaders), accompanied by drums, which aimed to bring rain, and illustrates the importance of popular religious practices and beliefs in community life at that time, particularly in a semi-arid environment where rain was vital but rare.

During the early 20th century, the bridge was designated as a historic monument in 1900, followed by the gorges in 1923, under French colonial preservation policies.

## **6.2. Built environment of Dachra El-Hamra**

Historically, local traditions report that Dachra El-Hamra historically had three gates. Its houses are built close together and are criss-crossed by narrow winding streets. Earth and palm wood are the basic building materials, demonstrating an adaptation to local environmental conditions (Figure 6).

The built environment of El-Kantara and its initial core, Dachra El-Hamra, as in the Ziban region, a semi-arid zone in North-eastern Algeria known for its palm groves and adobe architecture, showcases a remarkably cohesive architectural style deeply influenced by the region's cultural and environmental context [7, 33]. Houses in this area share a nearly identical spatial organisation, highlighting a common approach to functionality and aesthetics. Each house has a spacious vestibule, known as the *sguifa* (or *skifa*), which serves as a transitional space between the public and private realms. This space is customarily used to receive guests, emphasising the region's tradition, notably the desire to preserve privacy. Surrounding an open-air courtyard are several family rooms, forming a compact yet functional

living arrangement. The spatial layout ensures intra-family privacy while maintaining internal communal interaction through the shared courtyard (Figure 7). The courtyard is divided into two areas: an open-air area and a covered area locally known as 'n'cif', a toponymy that refers to the Arabic language 'nisf' meaning half [10]. The traditional houses of Dachra El-Hamra are generally introverted around interior courtyards, and the exterior facades have few and small openings. In certain cases, these facades are dominated by a triangular pattern of design, in the form of ventilation openings or decoration at the top of the walls.

In addition to private houses, the urban centre of Dachra El-Hamra included public buildings, such as mosques, mausoleums, Quranic schools, craftsmen workshops, public baths, and shops.



Figure 6. Current views of Dachra El-Hamra, El-Kantara: a) Façades and passageways; b) traditional building materials.

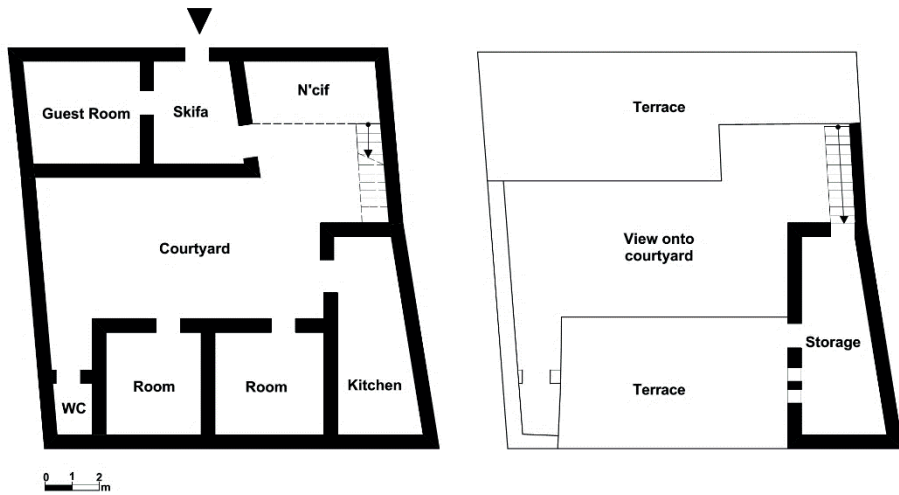


Figure 7. A typical traditional house plan in Dachra El-Hamra, El-Kantara. The plans have been redrawn and adopted by authors after referencing [10].

## 7. Intervention in Dachra El-Hamra

### 7.1. State of conservation and emergency measures in Dachra El-Hamra

Before 2001, i.e. before the implementation of the FSDRS programme in Dachra El-Hamra, the site was in a state of widespread and advanced deterioration, affecting almost all of its built fabric and architectural environment. A substantial number of dwellings were abandoned, while those still inhabited present living conditions that fall significantly below contemporary standards of safety and comfort. Despite this general degradation, the intervention strategy prioritised urgent actions focused on preserving the site's most emblematic monuments and rehabilitating key public spaces, in conjunction with the upgrading of essential infrastructure networks. These measures aimed not only to prevent further structural decay but also to restore adequate living conditions and safeguard the well-being of the resident community.

The initial phase of intervention centred on the restoration of the mausoleums of Dar Cheikh, Cheikh El Hachani, and Ahmed Ben Brahim, identified as being in a critical condition due to material erosion and prolonged neglect. Their conservation was imperative to prevent irreversible structural loss and to protect their symbolic and spiritual significance embedded in the collective memory of the inhabitants. In parallel, the renovation of major gathering spaces – the Rahba and the Batha – sought to revive their traditional role as focal points of social interaction and exchange, while reinforcing their structural stability and enhancing their visual coherence within the historical context.

A subsequent phase extended the restoration works to include the renovation of passageways, skifas, and urban façades. These interventions were designed to strengthen pedestrian connectivity, improve spatial legibility, and re-establish the



unity of the urban fabric. The restoration of boundary walls further contributed to consolidating the physical enclosure of the village and enhancing its overall security.

Simultaneously, the development of the Lapidaire Museum – previously affected by neglect, vandalism and prolonged exposure to outdoor conditions – introduced an important educational and cultural dimension to the project. By providing a secure environment for the conservation and exhibition of archaeological fragments, this initiative enhanced local heritage interpretation and valorised the memory of place.

Finally, the rehabilitation of essential infrastructure networks, including water supply, electricity, and public lighting, constituted a crucial component in reactivating the Dachra as a living environment integrated with contemporary urban needs.

## **7.2. Presentation of urban and architectural interventions**

This section presents and assesses the outcomes of major urban and architectural interventions implemented in Dachra El-Hamra in the framework of the FSDRS (*Le fonds spécial de développement des régions du Sud*) programme. Based on field visits, documentation, and interviews described in the methodology section, this section details the specific interventions carried out for each building, public space, and utility infrastructure. The analysis distinguishes the scale and nature of these interventions – whether limited to structural repairs, wall consolidation, or complete reconstruction – thereby providing a nuanced understanding of the programme's impact.

The FSDRS is an Algerian public mechanism dedicated to supporting and financing projects in the Saharan and southern regions, particularly in the areas of agriculture, irrigation, electrification, and rural development. Dachra El-Hamra has benefited from this mechanism and enabled the restoration of public spaces and buildings, such as squares, passageways, and mausoleums, all of which play a central role in local cultural and social identity. Table 3 illustrates the content of the programme.

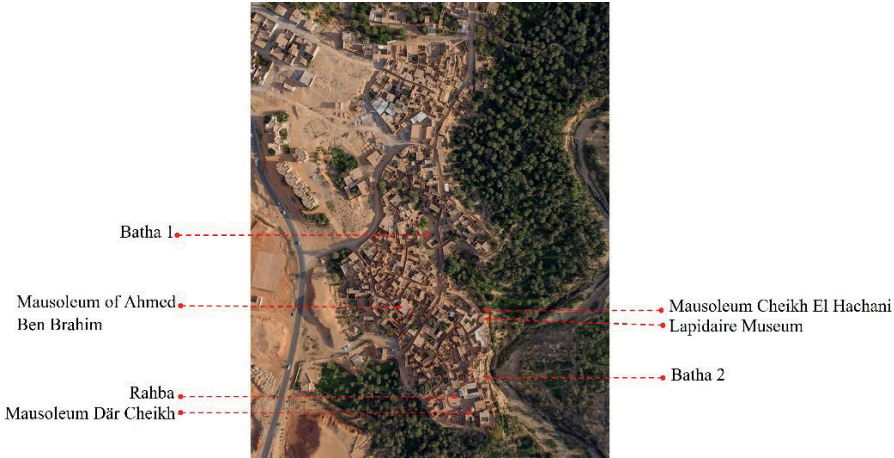
### **7.2.1. Restoration of mausoleums**

A key focus of the project was the renovation of significant religious and cultural monuments, particularly the mausoleums of locally significant religious figures, such as Dar Cheikh, Cheikh El Hachani, and Ahmed Ben Brahim. These mausoleums hold deep cultural and spiritual significance for the local population, serving as important centres of communal memory.

The Dar Cheikh Mausoleum, located in the central village square, underwent extensive reconstruction, including the walls, ceiling, and pillars, using traditional, locally sourced materials to preserve its architectural heritage value. Similarly, the Cheikh El Hachani Mausoleum, a venue for annual festivals, underwent reconstruction, which included reinforcing the stone foundations, rebuilding the adobe walls, and replacing the palm-wood ceiling. The interior walls were limewashed in white, with green pigment applied to specific architectural elements like doorframes and cornices following common religious colour schemes in the region. In contrast, the Ahmed Ben Brahim Mausoleum, which was in relatively better condition, required only targeted repairs, such as reinforcing pillars, restoring walls, and reconstructing the ceiling, while retaining its historical character (Figure 8).



Table 3. Urban and architectural interventions in Dachra El-Hamra

| Urban and architectural interventions                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FSDRS (Fonds spécial de développement des régions du Sud).                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Project management                                                                   | Wilaya de Biskra represented by DUC (Direction d'Urbanisme et de Construction).                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Period of work                                                                       | 2001-2012                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Undertaken actions                                                                   | <ul style="list-style-type: none"><li>• Restoration of the Mausoleum of Dar Cheikh</li><li>• Restoration of the Mausoleum of Cheikh El Hachani</li><li>• Restoration of the Mausoleum of Ahmed Ben Brahim</li><li>• Renovation of public gathering spaces (Rahba and Batha)</li><li>• Renovation of the passageways, including Skifa and urban facades</li><li>• Development of the Lapidaire Museum</li><li>• Renovation of the boundary walls</li><li>• Water and electricity networks and public lighting</li></ul> |
| Location of the projects within Dachra El-Hamra                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

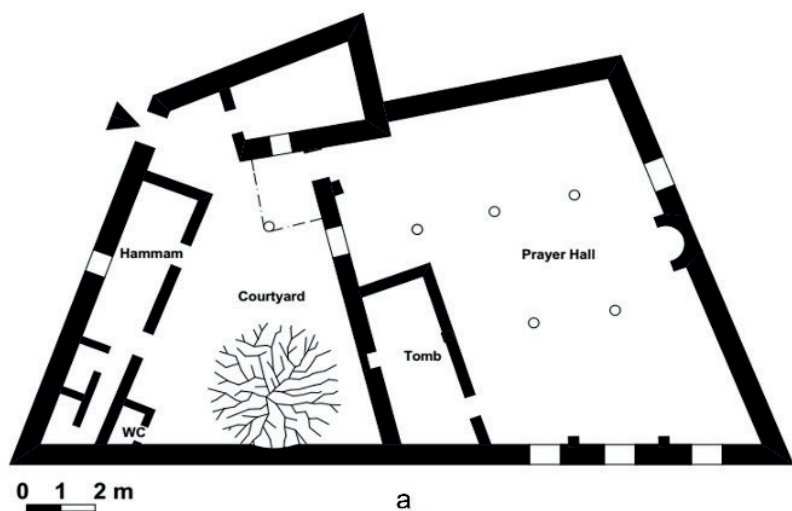


Figure 8. Ahmed ben Brahim Mausoleum: a) Plan of the mausoleum; b) the mausoleum before renovation; c) the mausoleum during renovation; d) the mausoleum after renovation.

### 7.2.2. Renovation of public gathering spaces, passages, skifa, and urban façades

Beyond the mausoleums, the project also focused on renovating and adapting public spaces, such as public gathering spaces (locally named Rahba 1, Rahba 2, and Batha), passageways, skifas, and urban façades. The intervention intended to maintain the historical identity of Dachra El-Hamra while making it more accessible and functional for modern use. This included developing the three public gathering spaces, which were historically places for social gathering, trade, and public interaction (Figure 9). Many aspects of the renovation of these public gathering spaces included paving areas for accessibility, reconstructing some projecting terraces based on earlier forms to optimise visual connections with the surrounding oasis landscape, and introducing simple seating elements to encourage social use of public spaces.



Figure 9. Public gathering spaces before and after renovation: a) Batha 2; b) Batha 2; c) Rahba.

Covered passages, known as 'skifas', are integral to traditional Algerian urban fabrics, serving as key connectors between streets and alleys within these settlements. In Dachra El-Hamra, many of these passages were significantly deteriorated, with some sections badly damaged or completely demolished. Recognising their cultural and functional importance, the intervention project aimed to restore the skifas to their original form. The renovation involved reconstructing walls and palm tree beams to ensure structural integrity while preserving their architectural authenticity. Additionally, the project included the refurbishment of facades, restoring the original appearance and detailing of façades in accordance with the local building tradition and material palette.

### 7.2.3. The development of the open-air Lapidaire Museum

A particularly notable addition to the intervention project was the development of the Lapidaire Museum, which serves as a repository for El-Kantara's rich collection of archaeological remains. It contains a collection of stelae, statues, stone inscriptions, architectural fragments, funerary sarcophagi, and pottery. This museum plays a crucial role in preserving and displaying the material heritage of El-Kantara, offering visitors and local inhabitants insight into the multi-layered history of El-Kantara, particularly its Roman era.

Historically, the Lapidaire Museum was an open-air space, as depicted in old post-cards (Figure 5). The intervention project aimed to create a sheltered area to protect it from climatic conditions and human threats, such as theft and vandalism. The museum was initially built using reinforced concrete, but it was rebuilt using compatible building materials to ensure its integrity within the heritage landscape of Dachra. It was inaugurated on November 15, 2022, by the Minister of Culture and the Arts, as shown by a marble plaque at the museum entrance.

The architectural design of the Lapidaire Museum is adapted to site constraints and topography, and is organised around three main spatial units: the reception area, a covered exhibition hall, and an open-air terrace (Figures 10, 11, 12). The arrangement of enclosed and open spaces facilitates a gradual transition between sheltered exhibition area and the surrounding landscape, reflecting the openness of traditional Saharan settlements. Thus, the museum's design blends traditional and modern construction techniques. The structure combines an IPN steel frame with traditional mudbrick infill,

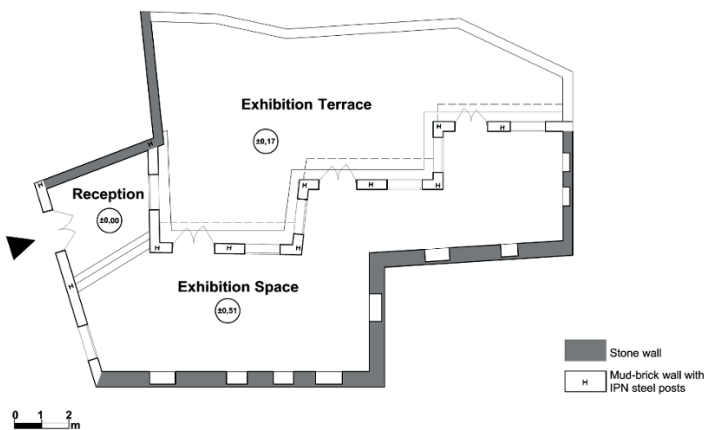


Figure 10. Plan of the Lapidaire Museum.



providing structural robustness while preserving the material authenticity and high thermal inertia characteristic of local vernacular architecture. Additionally, Dachra's stone walls, built with locally sourced materials, create a sense of visual continuity with the surrounding geological landscape.



Figure 11. Current views of the exhibition terrace at the Lapidaire Museum.



Figure 12. Current interior views of the exhibition space at the Lapidaire Museum.

A distinctive feature of the museum's stone walls is the presence of many recessed niches with semicircular arches. These niches serve both functional and decorative purposes, offering display areas for artifacts while recalling the traditional architectural character of Dachra El-Hamra. The roof was constructed using a wooden framework of beams and planks. This construction method intentionally references traditional palm-wood roofing techniques, reinforcing the continuity with local architectural practices.

Overall, the museum exemplifies a context-sensitive approach to heritage architecture, balancing modern conservation needs with traditional construction systems.

#### 7.2.4. Renovation of the boundary walls

The boundary wall, running along the southern edge of Dachra El-Hamra, serves as a protective barrier, offering a panoramic view of the Oued El Hai and the surround-



ing palm groves. This architectural feature has played a crucial role in shaping the village's interaction with its natural environment. Its position and materiality reflect both defensive considerations and an awareness of the surrounding landscape's visual and symbolic value.

Over time, the wall was completely demolished due to environmental factors and neglect. The walls were rebuilt with stone materials similar to the original, ensuring visual continuity with the surrounding hills and consistency with traditional construction practices (Figure 13).



Figure 13. Views of the boundary walls: a) before renovation; b) after renovation.

#### 7.2.5. Water and electricity networks and exterior lighting

According to municipal records, before the interventions, only 20% of Dachra El-Hamra was connected to a drainage system, which discharged directly into the Oued El Hai. This inadequate infrastructure caused significant environmental degradation, including pollution of the riverbed and surrounding vegetation from untreated and often corrosive wastewater. Addressing this issue required technical solutions that were both reliable and cost-effective. The municipality implemented a comprehensive drainage network, extending coverage to the entire village, but unfortunately, two sections of this system still discharge into the Oued El Hai, creating a major environmental issue. Additionally, these infrastructure improvements formed part of a broader strategy to introduce basic modern services into a traditional earthen settlement. Following the drainage upgrade, the municipality connected the village to a formal water supply network and an overhead electrical grid. Prior to these improvements, residents depended

on nearby wells for water and used traditional methods of lighting, conditions that constrained comfort, hygiene, and daily activities. The new installations thus reflected an effort to reconcile contemporary living requirements with the preservation of the village's vernacular architectural character (Figure 14).



Figure 14. Infrastructure renovation: a) Before renovation; b) after renovation.

## 8. Assessment of the intervention projects

In order to evaluate the intervention projects in Dachra El-Hamra we used seven criteria based on the standards and recommendations established by international organisations dedicated to the conservation and protection of cultural heritage worldwide, particularly those with a specialised focus on earthen architecture, including ICOMOS, UNESCO, CRATerre, and related institutional frameworks (Table 4). These criteria were grouped around seven main themes:

- Criterion 1: Authenticity and integrity of the restored structure, respecting traditional materials and techniques.
- Criterion 2: Compatibility of interventions, particularly added materials, with the original elements.
- Criterion 3: Reversibility of the actions undertaken, ensuring the possibility of returning to the previous state without permanent alteration.
- Criterion 4: Legibility of interventions, allowing a clear distinction to be made between the original parts and contemporary additions;
- Criterion 5: Addressing specific vulnerabilities and threats.
- Criterion 6: Community participation and transmission of know-how, promoting local craftsmen and vernacular practices.
- Criterion 7: Respect for the principles of sustainable development, including rational resource management and a low ecological footprint.

Based on the interviews and in-situ investigations concluded in Table 4, the intervention projects reveal a predominantly traditional conservation approach with significant gaps in contemporary heritage practice. All the projects demonstrate adherence to authenticity (C1) and compatibility (C2) criteria, which ensure the use of traditional materials and employment of conventional construction techniques that were historically used in these buildings, while ensuring that the new interventions harmonise with the original elements. However, this pattern reveals critical deficiencies across all projects: reversibility (C3) is not considered in any intervention, implying irreversible modifications that could limit future conservation options, the criterion of addressing specific

vulnerabilities and threats (C5) is not considered, reflecting a missed opportunity to respond to the material and environmental sensitivities of earthen architecture.

The interventions in Dachra El-Hamra revealed a clear shortcoming in terms of community participation (C6) and the transmission of traditional know-how. Although international standards stress the importance of involving local communities, promoting local artisans, and preserving vernacular practices, these intervention projects were planned without meaningful consultation with the residents. As a result, they failed to reflect cultural practices and traditional building techniques. This lack of community engagement not only limited the promotion of local craftsmanship but also weakened the project's cultural authenticity and long-term sustainability. Effective heritage interventions should ensure genuine community participation, support the work of local artisans, and maintain vernacular practices to safeguard both the tangible and intangible heritage values of the site. Community participation can also help reduce costs by engaging participants and volunteers in project activities.

*Table 4. Evaluation of the intervention project within the scope of the FSDRS.*

| Intervention projects                                                                                                                                                                                                                                                                                                                                                                                                                                 | Criteria of evaluation |    |    |    |                                                                                                                                                                                                                                                                                                                                                      |    |    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|----|----|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                       | C1                     | C2 | C3 | C4 | C5                                                                                                                                                                                                                                                                                                                                                   | C6 | C7 |
| IP1                                                                                                                                                                                                                                                                                                                                                                                                                                                   | X                      | X  |    |    |                                                                                                                                                                                                                                                                                                                                                      |    |    |
| IP2                                                                                                                                                                                                                                                                                                                                                                                                                                                   | X                      | X  |    |    |                                                                                                                                                                                                                                                                                                                                                      |    |    |
| IP3                                                                                                                                                                                                                                                                                                                                                                                                                                                   | X                      | X  |    |    |                                                                                                                                                                                                                                                                                                                                                      |    |    |
| IP4                                                                                                                                                                                                                                                                                                                                                                                                                                                   | X                      | X  |    |    |                                                                                                                                                                                                                                                                                                                                                      |    |    |
| IP5                                                                                                                                                                                                                                                                                                                                                                                                                                                   | X                      | X  |    |    |                                                                                                                                                                                                                                                                                                                                                      |    |    |
| IP6                                                                                                                                                                                                                                                                                                                                                                                                                                                   | X                      | X  |    |    |                                                                                                                                                                                                                                                                                                                                                      |    |    |
| IP7                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                        |    |    | X  |                                                                                                                                                                                                                                                                                                                                                      |    |    |
| IP8                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Not applicable         |    |    |    |                                                                                                                                                                                                                                                                                                                                                      |    | X  |
| Coding                                                                                                                                                                                                                                                                                                                                                                                                                                                |                        |    |    |    |                                                                                                                                                                                                                                                                                                                                                      |    |    |
| Coding of the intervention projects                                                                                                                                                                                                                                                                                                                                                                                                                   |                        |    |    |    | Coding of the criteria                                                                                                                                                                                                                                                                                                                               |    |    |
| IP1 - Restoration of the Mausoleum of Dar Cheikh<br>IP2 - Restoration of the Mausoleum of Cheikh El Hachani<br>IP3 - Restoration of the Mausoleum of Ahmed Ben Brahim<br>IP4 - Renovation of public gathering spaces (Rahba and Batha)<br>IP5 - Renovation of the passageways, Skifa, and facades<br>IP7 - Development of the Lapidaire Museum<br>IP6 - Renovation of the enclosure walls<br>IP8 - Water and electricity networks and public lighting |                        |    |    |    | C1 - Authenticity and integrity.<br>C2 - Compatibility of interventions.<br>C3 - Reversibility of the actions undertaken.<br>C4 - Legibility of interventions.<br>C5 - Addressing specific vulnerabilities and threats.<br>C6 - Community participation and transmission of know-how.<br>C7 - Respect for the principles of sustainable development. |    |    |

Although the infrastructure project (IP8), which includes water supply, electricity networks, and public lighting, reflects a desire to introduce modern services, it does not comply with the principles of sustainable conservation (C7). The direct discharge of wastewater into the Oued El Hai poses significant health risks and contributes to environmental pollution. Additionally, the traditional earthen buildings of Dachra El-Hamra are structurally vulnerable due to the inherent fragility of their construction materials and the damaging effects of moisture and climate change. These factors significantly complicate and increase the cost of their rehabilitation. These buildings were not designed for modern living standards, and the integration of contemporary amenities often threatens their authenticity. Compounding this is the loss of traditional construction knowledge, negative social perceptions of earthen architecture as outdated or inferior, and a lack of institutional coordination or clear regulatory frameworks to guide preservation efforts. In many cases, economic constraints and limited state support lead to abandonment or insensitive alterations.

Development of the Lapidaire Museum (IP7) is the only project that focuses on legibility (C4) by appropriately distinguishing new interventions from original fabric. However, the museum was initially built using reinforced concrete (post and beam structure), but this solution was ultimately rejected by concerned authorities due to its incompatibility with the local environment (Figure 15), notably when Dachra was recognised as a safeguarded sector in 2015. The use of materials such as cement or concrete is not only inappropriate in such contexts, as it does not respect the original construction techniques, but it also undermines traditional craftsmanship. Industrial methods tend to erase local craftsmanship, resulting in a significant loss of authenticity for the building.

The decision to demolish and then rebuild the Lapidaire Museum using compatible materials and architecture inspired by the local vernacular language led to a considerable slowdown in the planned intervention projects. Although driven by the desire to respect the site's architectural identity and ensure better integration with the existing fabric, this choice required in-depth preliminary studies, the mobilisation of specific techniques, and validation by heritage authorities. All these steps contributed to the postponement of the initial work schedule, thus delaying the overall implementation of safeguarding actions in Dachra El-Hamra (Figure 16).

This operation of demolition/reconstruction is problematic from a reversibility point of view: once reinforced concrete has been used, its removal without altering the site is complex, even destructive. This shows that initial decisions to intervene can have lasting consequences, underlining the need for in-depth prior reflection on materials, techniques, and restoration principles, particularly in contexts where authenticity and integrity are at stake.



Figure 15. Reinforced concrete structural system of the Lapidaire Museum before its demolition/reconstruction.





Figure 16. Lapidaire Museum during its reconstruction using compatible materials.

## 9. Conclusion

Interventions in cultural heritage raise complex and sensitive issues. Whether restoration, rehabilitation, or enhancement, each action has the potential to alter the authenticity and integrity of heritage properties. The primary objective of the article was to identify and evaluate the intervention projects undertaken in Dachra El-Hamra, El-Kantara, Algeria, before its official designation as a safeguarded sector on May 15, 2013. These interventions were carried out within the *Fonds spécial de développement des régions du Sud* (FSDRS), which is a public fund intended to finance various infrastructure and development projects in the southern regions of the country. The combination of data collection techniques enabled an in-depth evaluation of the quality and circumstances surrounding the implementation of these intervention projects.

In the absence of clear rules or a shared vision, these interventions have led to irreversible damage to the region's mausoleums, the loss of historical and cultural values, and even the erasure of collective memory. The need for rigorous supervision, multidisciplinary expertise, and genuine consultation with local communities, therefore, appears essential to ensure respectful and sustainable heritage conservation practices. Involving residents in these interventions ensures their commitment to the project to safeguard Dachra and strengthens their attachment to this heritage.

Failure to comply with the time allocated to intervention projects inevitably aggravates the gradual deterioration of the building. Earthen architecture, which is by nature more vulnerable, requires constant maintenance and planned interventions to preserve its stability and authenticity.

The compatibility of the materials was clearly demonstrated through the demolition/reconstruction of the Lapidaire Museum, which is a compelling example of the harmonious integration of traditional materials and modern techniques, while respecting the original architectural features of Dachra. The project has thus shown that it is possible to reconcile heritage requirements and current technical constraints, provided that an approach is adopted that respects the materials, local expertise, and the principles of reversibility and legibility of the intervention. This project is now a benchmark in the intervention projects in Dachra El Hamra, based on the physical, chemical, and aesthetic compatibility of materials.

The official designation of Dachra El-Hamra as a safeguarded sector on 15 May, 2013 is an important step towards preserving and promoting this historic urban centre. However, this legal recognition will only have real significance if it is rigorously enforced

and followed up with concrete action. The implementation of the PPMVSS appears essential to translate this protection into real action. This plan will establish a precise and coherent regulatory framework, define the rules for intervention and conservation priorities, and ensure that all projects carried out in Dachra El-Hamra respect its heritage character. By promoting planned and supervised management, the PPMVSS will thus help to prevent inappropriate or destructive interventions, preserve the authenticity of the buildings, and ensure that this cultural heritage is passed on to future generations.

The research conducted on Dachra El-Hamra encountered several constraints that affected both data collection and the timeframe allocated to the study. Access to official documents and technical files related to the FSDRS programme proved limited, due to incomplete archives or restricted availability, while the lack of up-to-date information on the state of the heritage site complicated the assessment of interventions. Field access was at times difficult or partially restricted. Moreover, the varying availability of local and institutional stakeholders did not always allow for all planned interviews to be conducted. The scarcity of prior academic studies on Dachra El-Hamra also required substantial direct documentation and on-site observation. Finally, the diversity (and at times divergence) of the testimonies collected necessitated careful verification and cross-checking to ensure the reliability of the information gathered.

### Acknowledgments

Wahiba Moussi states that part of this research was conducted during the *Programme National Exceptionnel* (PNE) 2019 at the University of Trás-os-Montes and Alto Douro, Portugal. She would like to thank all interviewees for their participation in this research.

### References

- [1] Li, Y., Li, J., Chu, J. (2023) Research on the Revitalization of Huizhou Traditional Villages based on the PAF Model. *Journal of Asian Architecture and Building Engineering*, 22 (6), pp. 3703-3717. doi: 10.1080/13467581.2023.2182637.
- [2] Wang, S., Guo, Q., Yuan, J., Li, H., Fu, B. (2023) Research on the Conservation Methods of Qu Street's Living Heritage from the Perspective of Life Continuity. *Buildings*, 13 (6), pp. 1-25. doi: 10.3390/buildings13061562.
- [3] Jia, A., Yun, X., Zheng, X., Wen, X., Liang, X., Yun, Y. (2024) Towards Sustainable Rural Revitalization: A Multidimensional Evaluation of Rural Vitality in China's Traditional Villages. *Sustainability*, 16 (13). doi: 10.3390/su16135408.
- [4] Mileto, C., López-Manzanares, F. V., Cristini, V., Soriano, L. G. (2021) Earthen Architecture in the Iberian Peninsula: A Portrait of Vulnerability, Sustainability and Conservation. *Built Heritage*, 5 (1), pp. 1-12. doi: 10.1186/s43238-021-00043-9.
- [5] Salimi, N.-D. (2022) Les ksour et les kasbahs au Maroc, contraintes de conservation et perspectives de valorisation durable. *Espace Géographique et Société Marocaine*, 57, pp. 135-154. doi: 10.34874/IMIST.PRSM/EGSM/30560
- [6] Ouaali, S., Anouche, K. (2023) Preventive Conservation – a Means of Sustainability of Cultural Heritage: The Case of the M'Zab Valley. *Architectural Papers of the Faculty of Architecture and Design STU*, 29, pp. 1-14. doi: 10.2478/alfa-2024-0013.
- [7] Zerari, S., Sriti, L., Mansouri, K. (2019) Dégradation du patrimoine ksourien du Sud Algérien. Cas du tissu résidentiel des Ziban (Biskra). *Al-Sabil – Revue*

- d'Histoire, d'Archéologie et d'Architecture Maghrébines*, 7, pp. 1-10. Available at: <https://al-sabil.tn/numero-07/>
- [8] Bachir-Cherif, T., Aiche, M., Sacko, O. (2021) Conservation of Earthen Architecture: Governmental Actions and Owners' Practices to Preserve Ksar Taghit, Algeria. *Conservation Science in Cultural Heritage*, 21, pp. 95-108. doi: 10.48255/1973-9494.JCSCH.21.2021.03.
  - [9] Zerari, S., Cirafici, A., Sriti, L. (2022) Issues in the Expression of Local Identity in the Saharan Regions of Algeria: In Search of References to Vernacular Architecture. *Conservation Science in Cultural Heritage*, 22, pp. 181-206. doi: 10.6092/issn.1973-9494/17314.
  - [10] Hamouda, A., Outtas, S. (2011) Étude topologique et diachronique de l'habitat rural, cas d'El-Kantara, Biskra. *Sciences & Technologies*, 34, pp. 28-37. Available at: <https://asjp.cerist.dz/en/article/58135>.
  - [11] Hamouda, A., Abdou, S. (2017) Approche syntaxique: décodage des habitations traditionnelles oasiennes. Cas d'El Kantara à Biskra. *International Journal of Innovative Technology and Applied Sciences*, 1 (1), pp. 12-17.
  - [12] Hamouda, A., Abdou, S. (2013) Approche d'une analyse syntaxique de l'habitat rural. Cas d'El Kantara. *Courrier du Savoir*, 16, pp. 27-36. Available at: <https://www.univ-biskra.dz/revues/index.php/cds/article/view/383/352>
  - [13] Hamouda, A., Brinis, N. (2017) Potentialités touristiques rurales en zones arides. Cas d'El Kantara, Algérie. *International Journal of Innovative Research in Human Sciences*, 1 (1), pp. 44-52.
  - [14] Ouaret Ladjouze, M., Belakehal, A., Nys, P. (2018) Élaboration d'un modèle d'évaluation pour une caractérisation des valeurs paysagères des sites patrimoniaux exemple du paysage culturel d'El Kantara (Aurès, Biskra ). *Courrier du Savoir*, 26, pp. 521-534. Available at: <https://revues.univ-biskra.dz/index.php/cds/article/view/3975>
  - [15] "ANSS, Safeguarded Sector". Available at: <https://anss.dz/secteurs-sauvegardes/> [accessed: 02/06/2025].
  - [16] Journal Officiel N°44, Loi N° 98-04 Du 20 Safar 1419 correspondant au 15 Juin 1998 relative à la protection du patrimoine culturel, no. 44. p. 16, 1998. Available at: <https://www.joradp.dz/FTP/Jo-Francais/1998/F1998044.pdf>
  - [17] Rapoport, A. (1972) *Pour Une Anthropologie De La Maison*. Paris: Dunod.
  - [18] Oliver, P. (2003) *Dwellings: The Vernacular House Worldwide*. Phaidon Press.
  - [19] Correia, M., Achenza, M., Jerome, P., Yong, S., Stiegler, I., Vasquez, J. A., Rakotomamonjy, B., & Odiaua, I. (2025) ICOMOS-ISCEAH and the Future of Earthen Architectural Heritage Conservation. In L. Rainer, L. F. G. Baca, F. Matero, & L. Meyer (Eds.), *Terra 2022: Proceedings of the 13th World Congress on Earthen Architectural Heritage, Santa Fe, New Mexico, USA, June 7-10, 2022* (pp. 9-15). Getty Publications. doi: <https://doi.org/10.2307/jj.32155379.8>
  - [20] Khalil, I., Üzümcüoğlu, D. (2025) Preserving Heritage Through a Novel Framework for the Adaptive Reuse of Mediterranean Earthen Houses. *Vitruvio*, 10 (1). doi: 10.4995/vitruvio-ijats.2025.23308.
  - [21] Mileto, C., Vegas, F. (2022) Earthen Architectural Heritage in the International Context: Values, Threats, Conservation Principles and Strategies. *Cultural Heritage Management and Sustainable Development*, 12 (2), pp. 192-205. doi: 10.1108/JCHMSD-06-2021-0115.

- [22] Correia, M.R.A.R., Walliman, N.S.R. (2013) Defining Criteria for Intervention in Earthen-Built Heritage Conservation. *International Journal of Architectural Heritage*, 7 (6), pp. 693-714. Available at: <https://www.tandfonline.com/loi/uarc20>
- [23] ICOMOS, Charte de Venise, (1964). Available at: [https://www.icomos.org/charters/venice\\_f.pdf](https://www.icomos.org/charters/venice_f.pdf)
- [24] ICOMOS, Charter for the Conservation of Historic Towns and Urban Areas, (1987). Available at: [http://www.international.icomos.org/charters/towns\\_e.pdf](http://www.international.icomos.org/charters/towns_e.pdf)
- [25] ICOMOS, Charter on the Built Vernacular Heritage, Mexico, (1999). Available at: [https://admin.icomos.org/wp-content/uploads/2023/01/vernacular\\_e.pdf](https://admin.icomos.org/wp-content/uploads/2023/01/vernacular_e.pdf)
- [26] ICOMOS, Principles for the Analysis, Conservation and Structural Restoration of Architectural Heritage, (2003). Available at: [https://www.icomos.org/charters/structures\\_e.pdf](https://www.icomos.org/charters/structures_e.pdf)
- [27] UNESCO, 21C. World Heritage Programme on Earthen Architecture, (2004). Available at: <http://whc.unesco.org/archive/2007/whc07-31com-21Ce.pdf>
- [28] ICOMOS / ISCARSAH, Guidelines for the Analysis, Conservation and Structural Restoration of Architectural Heritage, (2024). Available at: <https://iscarsah.org/wp-content/uploads/2025/04/iscarsah-guidelines.approved-september-2024-1.pdf>
- [29] Ouaret Ladjouze, M. (2019) *Caractérisation des valeurs patrimoniales des paysages culturels traditionnels. Cas de l'Aurès*, PhD diss, University of Mohamed Kheider-Biskra. Available at: <http://thesis.univ-biskra.dz/4424/>
- [30] Michelin. (1956) *Guide Vert*. Clermont-Ferrand: Michelin & Cie.
- [31] Gsell, S. (1901) *Les Monuments Antiques de l'Algérie: Tome Premier*. Paris.
- [32] "El Kantara." Available at: [http://forgalus.free.fr/LE\\_COIN\\_DE\\_GEORGES\\_VIEVILLE/ALGERIE/ALGERIE-VUE\\_AERIENNES/slides/El\\_Kantara.html](http://forgalus.free.fr/LE_COIN_DE_GEORGES_VIEVILLE/ALGERIE/ALGERIE-VUE_AERIENNES/slides/El_Kantara.html), [accessed: 05/ 07/2025].
- [33] Ben Charif, H., Belakehal, A., Zerari, S. (2023) Earthen Architecture in Southern Algeria: An Assessment of Social Values and the Impact of Industrial Building Practices. *Open Archaeology*, 9 (1), pp. 1–21. doi: 10.1515/opar-2022-0324.
- [34] Zerari, S., Pace, V., Sriti, L. (2023) Towards an Understanding of the Local Interpretations of the Arab Mosque Model in the Saharan Regions. Re-exploration of the Ziban in South-Eastern Algeria. *ArchHistoR*, 19, pp. 96–129. doi: 10.14633/AHR384.
- [35] "Lestizis". Available at: <https://www.lestizis.fr/Algerie-1900/Villes-Villages-1900/E-K/El-Kantara/slides/El-Kantara-VillageRouge-PorteDesert.jpg>, [accessed: 01/08/2025].
- [36] "Delcampe". Available at: [https://www.delcampe.net/static/img\\_large/auction/000/419/863/404\\_001.jpg?v=0](https://www.delcampe.net/static/img_large/auction/000/419/863/404_001.jpg?v=0), [accessed: 05/ 07/2025].
- [37] "Delcampe". Available at: [https://www.delcampe.net/static/img\\_large/auction/000/503/079/653\\_001.jpg?v=91](https://www.delcampe.net/static/img_large/auction/000/503/079/653_001.jpg?v=91), [accessed: 05/ 07/2025].
- [38] "El Kantara, Village Blanc". Available at: [https://alger.roi.fr/Alger/el\\_kantara/pages/2\\_d\\_el\\_kantara\\_village\\_blanc\\_15.htm](https://alger.roi.fr/Alger/el_kantara/pages/2_d_el_kantara_village_blanc_15.htm), [accessed: 05/ 07/2025].
- [39] Chelli, N. (2007) *El-kantara, Les Gorges*, Biskra: EAGB Biskra
- [40] Monmarché, M., Ed. (1923) *Les Guides Bleus Illustrés Constantine, Biskra, El Kantara, Timgad, Touggourt*. Paris: Librairie Hachette.



- [41] Kebbour, O. (2017) "مجلة الدراسات", (القنطرة), هركيلوس بكاليوس (السوريتين بكاليوس هركيلوس), 13 (1), pp. 6-13.
- [42] Kebbour, O. (2016) أطروحة دكتوراه جامعة الجزائر 2, *المجتمع القديم بمنطقة القنطرة*.
- [43] Marrou, H.-I. (1933) La collection Gaston de Vulpillières à El-Kantara. *Mélanges d'Archéologie et d'Histoire*, 50, pp. 42–86. doi: 10.3406/mefr.1933.7232.
- [44] "Carte postale – El Kantara". Available at: <https://www.geneanet.org/cartes-postales/view/7804309#0>, [accessed: 05/ 07/2025].
- [45] "Ebayimg". Available at: <https://i.ebayimg.com/images/g/JCUAAOSwmGpi2cf4/s-l1600.webp>, [accessed: 05/ 07/2025].
- [46] "القنطرة تاريخ و حضارة", المتحف الروماني قديماً أيام الثمانينات. Available at: <https://www.facebook.com/elkantarahistoire/posts/2589796637789743/>, [accessed: 15/ 10/2025].
- [47] (Sir) Pease, A. E. (1893) *Biskra and the Oases and Desert of the Zibans: With Information for Travellers*, 1st ed. London: Edward Stanford.

### Biographical notes

**Wahiba Moussi** is an architect. She has a master's degree in "Urban planning" from the University of Biskra, Algeria. Currently, Moussi is doing her PhD in "Architecture" at the University of Biskra. Her major research interests include the revitalisation of urban centres, history of cities, traditional construction materials, and conservation of cultural heritage.

**Sami Zerari** is an architect specialising in the field of cultural heritage. He received his Bachelor's degree in Urbanism and Architecture, and his Master's degree in Urban and Architectural Heritage in the Sahara from the University of Biskra, Algeria. In 2021, Zerari received his Ph.D. degree in architecture with honours from the same university. In 2021, he was admitted to Ph.D. research course – 37th cycle with administration headquarters at the University of Campania "Luigi Vanvitelli", Aversa, Italy, in Architecture, Industrial Design, and Cultural Heritage. His major research and teaching interests include the history of architecture, conservation of cultural heritage, historical building analysis, cultural studies, etc.

**Khaled Selatnia** is an architect. He has a master's degree in "Architecture and housing in arid and semi-arid regions" from the University of Biskra, Algeria. In 2015, Selatnia received his Ph.D. degree in "Architecture" from the same university. Currently, he is teaching methodology of research and project studio at the University of Constantine 3, Algeria. His major research interests include urban planning, urban geography, and the application of QGIS in spatial analysis.

**Mostefa Medouki** is an architect. He has a master's degree in "Architecture and housing in arid and semi-arid regions" from the University of Biskra, Algeria. In 2022, Medouki received his Ph.D. degree in "Architecture" from the same university. Throughout his academic career, he has been responsible for many administrative tasks. Since 2024, he has been heading the department of architecture. His major research interests focus on historic urban centres, urban morphology, and the use of QGIS in spatial analysis.

## Summary

This article focuses exclusively on Dachra El-Hamra, the historic core of El Kantara, Algeria, officially designated as a safeguarded sector on May 15, 2013. It aims to identify and evaluate the urban and architectural interventions implemented through the Algerian governmental programme FSDRS (Fonds spécial de développement des régions du Sud) aimed at preserving the public spaces and cultural landmarks of Dachra El-Hamra. The methodology employed follows a comprehensive investigative approach, combining on-site visits, in-depth archival research, and semi-structured interviews with officials and key actors involved in the conservation process. To assess the quality and effectiveness of the interventions, seven evaluation criteria were developed based on international standards and recommendations for the conservation of cultural heritage – particularly vernacular and earthen architecture. Findings revealed that, although the project addressed the urgent restoration of severely degraded public spaces and landmarks, it failed to comply with key international conservation principles; these shortcomings were caused by the lack of knowledge of vernacular techniques, a lack of serious diagnosis, the choice of incompatible materials, and a lack of involvement of the local populations. Stricter oversight only began after the site was designated as a safeguarded sector under Algerian Law 98-04, which established a more rigorous legal framework for heritage protection. This shift is evident in cases such as the demolition and subsequent reconstruction of the Lapidaire Museum with compatible materials. The forthcoming implementation of the PPSMVSS (Permanent Plan for the Safeguarding and Enhancement of the Safeguarded Sector) is expected to establish clearer regulations and a more robust framework for future interventions in Dachra El-Hamra.

## Riassunto

Questo articolo si concentra esclusivamente su Dachra El-Hamra, il centro storico di El Kantara, in Algeria, ufficialmente designato il 15 maggio 2013 come settore protetto. Il suo obiettivo è identificare e valutare gli interventi urbani e architettonici realizzati attraverso il programma governativo algerino FSDRS (Fonds spécial de développement des régions du Sud) volto a preservare gli spazi pubblici e i monumenti culturali di Dachra El-Hamra. La metodologia utilizzata segue un approccio investigativo completo, che combina visite in loco, ricerche approfondite negli archivi e interviste semi-strutturate con funzionari e attori chiave coinvolti nel processo di conservazione. Per valutare la qualità e l'efficacia degli interventi, sono stati sviluppati sette criteri di valutazione basati su standard internazionali e raccomandazioni per la conservazione del patrimonio culturale, in particolare dell'architettura vernacolare e in terra cruda. I risultati rivelano che, sebbene il progetto abbia affrontato il restauro urgente di spazi pubblici e monumenti gravemente degradati, non è riuscito a rispettare i principi internazionali fondamentali di conservazione. Queste carenze sono causate dalla mancanza di conoscenza delle tecniche vernacolari, dalla mancanza di una diagnosi seria, dalla scelta di materiali incompatibili e dalla mancanza di coinvolgimento delle popolazioni locali. La supervisione più rigorosa iniziò solo dopo che il sito fu designato come settore salvaguardato ai sensi della Legge algerina 98-04, che introdusse un quadro giuridico più severo per la tutela del patrimonio. Questo cambiamento è evidente in casi come la demolizione e la successiva ricostruzione del Museo Lapidario con materiali compatibili. La prossima attuazione del PPSMVSS (Piano permanente per la salvaguardia e la valorizzazione del settore protetto) dovrebbe stabilire norme più chiare e un quadro più solido per i futuri interventi a Dachra El-Hamra.