

Saharan cities, relationship between urban and desert environment: Case of the ksar (palace) of Ghardaïa in Algeria.

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Abstract:

In the context of an accelerated construction process in the desert areas of the Algerian Sahara, motivated by the discovery of natural and mineral resources as well as by the desire to settle near these deposits, new neighborhoods have emerged on the outskirts of the traditional Saharan ksour, often to the detriment of the surrounding oases. For example, the ksar of the city of Ghardaïa is now surrounded by recent neighborhoods, creating a strong resemblance between the cities of the north and those of the Sahara, due to the adoption of uniform urban planning models and standards that do not take into account the environmental and socio-cultural specificities of each region. These choices were mostly circumstantial and intended to meet the growing demand for housing; these programs were carried out without a forward-looking vision for the future of the ksar, thus producing a heterogeneous and fragmented urban fabric, with management difficulties for technical services and local authorities. Faced with this situation, the question arises: how can we ensure the sustainability of the urban fabric of the ksar so that it can adapt to the environmental and urban conditions that surround it?

Keywords:

Algerian Sahara, Saharan ksour, Ghardaïa, ksar, adaptation.

1-Littérature Review:

The origin of the M'zab Valley dates back to the beginning of the 5th century AD, corresponding to the 11th century AD. Before this period, the region was a holiday resort for nomadic Bedouins, who migrated there in search of subsistence or protection from the harshness of nature. Despite the harshness of nature and its rugged terrain, the local populations were able to settle their thanks to the experience acquired over time; they were able to adapt to the region and found new cities that stood out for their unique character, giving the plain a special flavor and becoming an example of Islamic architecture. During the colonial period, colonialism dominated the region's economy and most areas of cultural and religious life, thus changing lifestyles, the nature of relationships and practices, and reducing the role of religious and educational structures. The ksar (palace) buildings in the M'zab Valley were not scattered in vain, but rather come from a very well-established civilizational order, evident in the fact that it is based on an intellectual foundation, which in turn created social, urban and architectural traditions. Each of these urban entities constitutes a "network city" currently called Ghardaïa which is the center of a valley-oasis, which includes five ksour cities founded between the 11th and 14th centuries, listed since 1982 as a UNESCO World Heritage Site. The city is characterized by its harsh nature. It is a true "desert within the desert". It was named so because it is interspersed with many valleys that have been inhabited

since the most ancient times - the Stone Age - during the eleventh session of the Prehistory Congress held in France in 1954 where the results of the research that was carried out in the Algerian Saharan areas were presented as prehistoric tools and which were collected, numbering 2,959 pieces, thus demonstrating that prehistoric man had settled in the region of Ghardaïa., the results of his field research in the lands of the network in which he described the tools he had collected related to this time, which numbered 2959 pieces, which proves that prehistoric man had settled in this region. Similarly, we find that (Marc, cote.2005) mentioned the reality of urbanization in the Saharan areas. He focused his study on the low-lying desert region of southeastern Algeria and concluded that there is a phenomenon called micro-urbanization, explaining the reality of urbanization in Saharan areas, which is often accelerating. (BISSON.J.2002) also emphasized that natural, environmental and social conditions dictate the uniqueness of these constructions.

According to (Keira Bachar.2021) Since the beginning of the 2000s, new development options have been proposed through urbanization sites located outside the valley, where the various social housing programs designed and built in a hurry are being implemented, in an attempt to meet the high expectations of the population while neglecting to take into account the particular ecological conditions of the region and breaking with the fundamental elements of Saharan urban planning. According to the same author, in recent years, the M'zab valley is undergoing a metamorphosis, it should be noted, without entering into a typomorphological analysis, the extramuros city is in rupture both morphologically, typologically and socially with the old urban fabric.

Research Objectives:

- Understand the architectural and urban framework of the ksar.
- Understand the sustainability elements of the ksar's urban fabric.
- Research the elements that ensure harmony between the ksar and its ecological and urban environment.

Materials and Methods:

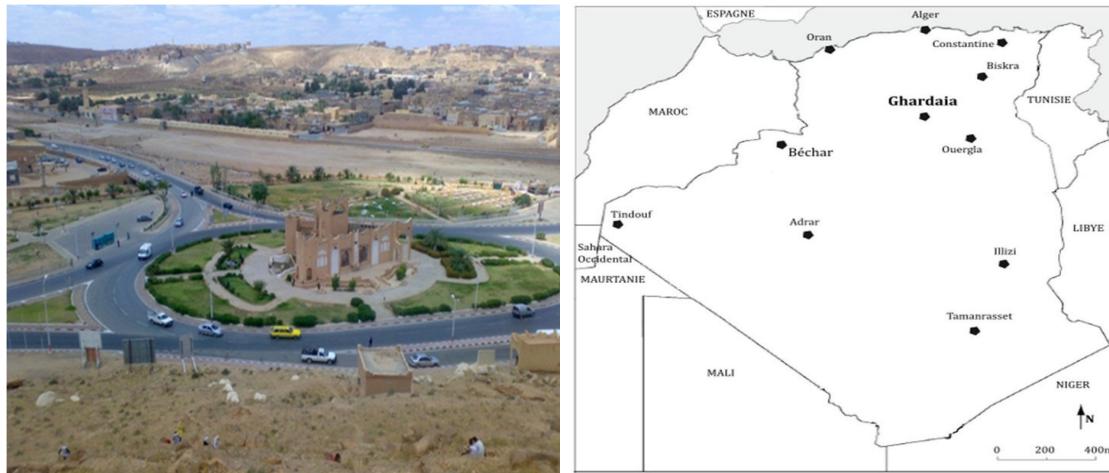
In our research we opted for the historical method which consists of studying and analyzing the past of the study area using available written, visual and material sources, this method is reinforced by the technique of in-situ observation in order to know the current state of the fabric of the ksar.

2-Results:

2-1) Location of the city of Ghardaia:

Ghardaia is located in central Algeria, north of the Sahara, approximately 600 km south of Algiers. It is part of the wilaya (province) of Ghardaia, which is bordered by several other wilayas: Laghouat to the north, Djelfa to the northeast, Ouargla to the east, El Menia to the west, and Adrar to the southwest. The city is a group of five historic towns. It is situated in the M'zab Valley, in the heart of a desert plateau, and is known for its traditional architecture and unique way of life.

Location of the city of Ghardaïa: figure n°01.

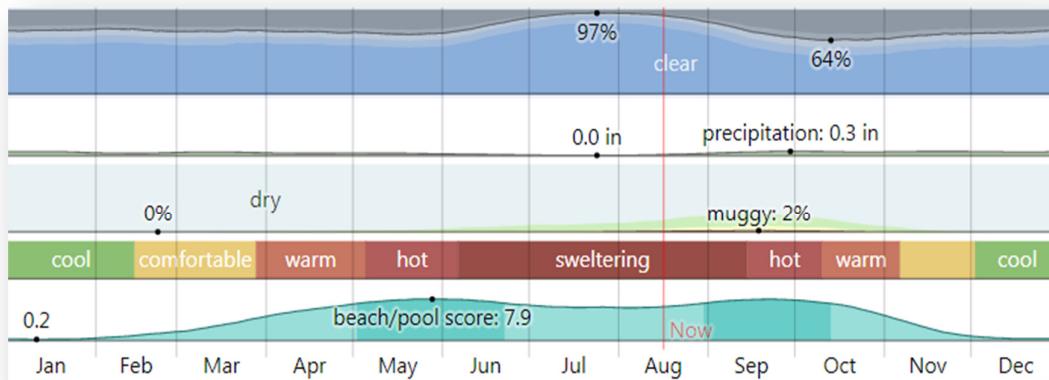


Source: Archive of the municipality of Ghardaïa, 2025.

2-2) Climate study on the city of Ghardaïa:

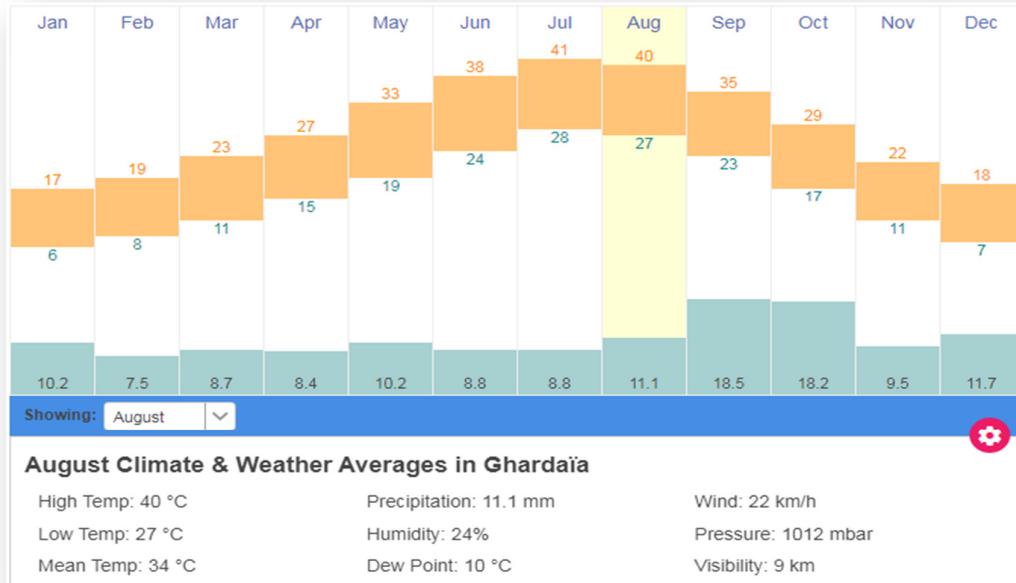
Ghardaïa, has a Sahara desert climate, characterized by hot, dry summers and mild winters. Temperatures can soar during the summer months, often exceeding 40°C (104°F), while winters are relatively mild with average highs around 15°C (59°F). Precipitation is scarce throughout the year, with most rainfall occurring during the winter months. See table no. 01 and 02; cited below.

Climate in Ghardaïa: Table no. 01



Source: <https://fr.weatherspark.com/y/48886/M%C3%A9t%C3%A9o-moyenne-%C3%A0-Gharda%C3%A9-Alg%C3%A9rie-tout-au-long-de-l'ann%C3%A9e>

Annual Weather Averages Near Ghardaïa: Table no. 02



Source: <https://www.timeanddate.com/weather/algeria/ghardaia/climate>

3-DISCUSSION:

3-1) History of the ksar:

Ghardaïa is considered one of the oldest Algerian cities historically, as civilizations have succeeded one another on its territory, from the Stone Age through the Islamic conquests, then the French invasion, until the restoration of national sovereignty. Due to its strategic location, it has been called the gateway to the desert and a link between the north and the south, the east and the west, and has also made it a meeting place of cultures, which has given it importance throughout the stages and historical eras it has crossed.

Since the 1950s, urbanization has spread to the low-lying areas and the surrounding plateaus, gradually joining other ksour, forming a linear conurbation about 8km long, to the detriment of traditional palm groves. Ghardaïa, which became the capital of the wilaya in 1985, has seen its urbanization accelerate, through the creation of housing, facilities and infrastructure. According to (MANSOURI Z., 2018) there are transformations that the ksar is undergoing that are part of the continuity of the ksourian specificities and which are generated by the renewal of traditional modes of appropriation of space. Le *ksar* (palais) de Ghardaïa a été fondé au Ve siècle de l'Hégire, correspondant au XIe siècle de notre ère (1048-1053 après J.-C.).

At the top, and in the middle of Crete, the great mosque of the ksar of Ghardaïa was founded in 1048, around which all other elements of religious and worldly life revolve. It presents an almost perfect concentric geometric configuration marked by streets all rising and climbing to converge at the end of the route towards the Great Mosque. The Ksar is surrounded by several cemeteries, the latter containing funeral mosques.

In the first core of the Ksar, the old and first market square called "Rahba" still exists, which specialized in the sale of pottery products. It is currently very dynamic due to its various uses and street sales in the form of stalls or merchandise stands.

The Ksar has recently benefited from special attention consisting of the development of permanent conservation plans with the aim of enhancing its historical monuments in addition to its restoration. The operation is aimed at preserving the architectural character of the site as well as improving the living environment of its inhabitants. According to (MAZOUZ S. 2005) "It is etymologically a palace. Ksour are fortified complexes that extend from southern Morocco to southern Tunisia and which, originally, were built for defensive purposes. The ksar refers to any Saharan settlement that was built in the past and was more rural in nature, as opposed to the more important structures that are the medinas. It should be noted that the ksour in general, which still strongly mark the landscape of Saharan towns today, were located at the crossroads of the caravan routes that linked the northern bank to the southern bank of the Sahara and constituted relays for commercial exchanges.

Aerial view of the ksar of Ghardaia: figure n°02.



Source : Archive of the APC of Ghardaia, 2025.

3.2) Urban study of the ksar.

3.2.1) The urban fabric of the ksar:

The ksar (palace): It constitutes the heart of the community's life and is considered the place of life. Its distinctive architectural and urban style; presents itself as a whole of a single homogeneous mass, in harmony with the nature of the sloping terrain, Its different parts are connected by a complex network of arterial roads, the whole constitutes a very dense urban fabric and forms a unified and homogeneous mass, connected by a network of arterial roads, interspersed with palm groves, this fabric can also be considered as an integrated unit connected to the external environment; its extension is centered on the west side of the palace, fortified and open from the inside. The mesh of the ksar was designed in accordance with the

rules of the Arab-Muslim city in North Africa in general, and because of its location, which was fortified against raids and protected from flooding in the valley.

The ksar is located on the highest hill, with the mosque at the center, dominating the urban fabric and forming the heart of the palace. This is where meetings are held, where decisions concerning the palace's residents are made. The palace has several entrances and watchtowers, connected to each other along the heights overlooking the oasis, to protect it from invasions and external attacks. A small corridor is located on the ground floor, while the observation room has narrow openings allowing one to observe the surroundings of the palace. The perimeter wall consists of the massive and compact exterior walls of the houses, whose doors open onto the palace. Extensions of walls, independent of the houses, protect the palace. Their thickness decreases as one climbs; they are interspersed with narrow surveillance openings. These narrow, winding, and covered passages also help protect the palace from external intrusions, forming a formidable defensive system.

3.2.2) Extension of the ksar:

The first core was created: By constructing the first building at the top of the peak, which is the mosque that represents the spiritual and moral authority of the palace, then the residences gradually surround it downwards, and after completing the initial space allocated for construction, due to the demographic growth of the palace and the immigration of some families, the urban space expanded downwards, in a circular manner, around the mosque. The old fortification wall became a rampart for the new residences. The limits of the palace were demarcated by the formation of a closed band of walls and residences. The ksar (palace) underwent three major expansions until the 20th century. The first expansion was structured around the original core of the ksar. The second expansion was a central and circular extension in all directions. These developments generate socio-environmental challenges namely: management which has become so complex; emergence of new urban forms; saturation of traditional structures and pressure on water and green spaces constituted by the palm trees of the oasis.

3.2.3) Interventions on the ksar:

According to (BENYOUCEF.B.2010) the new ksour were born following the implementation of a new approach, fully in line with the wishes of the habitats, developed by the prefect of Ghardaïa in 1996. These are integrated ksourian housing programs whose implementation is planned on the mounds outside the perimeter of the palm grove. The local authorities in collaboration with the ksar associations created an ecological project for Ksar Tafilalt in 1990, and which illustrated a modern attempt to respect traditional architecture, while integrating sustainable innovations: insulation; recycling of wastewater; collective greening; structured community life. By aligning with the objectives of urban planning which aims according to (SAIDOUNI.M.2000) to develop urban spaces while ensuring a balance between the well-being of the inhabitants, economic dynamics, social relations and the preservation of the environment.

3.2.4) Compositions of the Ksar:

The entrances are the access points to and from the city and are the points of arrival of the main streets of the palace, from which one can move from the inside to the outside of the palace or vice versa. They do not open at night after the evening prayer except in cases of necessity. In general, we find that the location and number of gates are linked to certain basic conditions, such as their presence at the end of the caravan route leading to the palace, or the oasis road, or the cemetery.

It is noteworthy that on each side is a watchtower, the size of which varies according to its importance and function. It takes the form of a tower with a corridor on the ground floor and a watchtower on the first floor, pierced with narrow openings to monitor the place. These gates also serve as a point of communication between the interior and exterior of the palace. Saharan urban planning in southern Algeria has very specific characteristics, resulting from centuries of adaptation to the arid climate, geographical constraints and traditional ways of life.

These urban entities are structured as follows:

The traditional Saharan city is structured around a ksar, which constitutes the basic unit, often perched on a hilltop to protect itself from floods and incursions, with a compact and organic layout. The alleys are narrow, winding, and irregular, forming a labyrinthine network that reduces sun exposure and protects from the wind. In the center is the main mosque, with a minaret as a watchtower. It opens around a market, a community space par excellence, consisting of a public square where residents interact and mingle. On the outskirts, irrigated dwellings and gardens are organized. The architecture of the ksar is adapted to the climate by using local materials: raw earth reinforced by stones, plaster, and palm wood, providing high thermal inertia. The walls are thick to keep the area cool during the day and warm at night. The massive 60 cm thick walls, fashioned using ancestral construction techniques, where raw earth mixed with straw is patiently shaped, tell the story of generations of artisans and demonstrate their ingenuity in adapting to the constraints of the Saharan climate. The openings are small and minimize the entry of heat and direct light; the terraces are flat, used by residents to sleep during the hot summer nights and to dry agricultural products. (RAVEREAU A., 2003) states that in the crowning of a Mozabite construction, one can see, recognizes, and read that it is perfectly subject to the organic and not to the formal arrangement. Each element, as mentioned above, is located in its appropriate place. This is especially true if, by chance, a part of the terrace is insufficiently protected from view.

Public spaces consist of covered alleys called sabat (sabat) that create shade and lower the ambient temperature. Within this network, another artery contributes to the structure of the ksar, the impasse (dead end), called derb (derb), reserved for residents and ensuring privacy and security. (LEVY.A.2005) emphasizes that these urban forms—streets, alleys, buildings, and open spaces—are shaped by social processes. This type of housing is often located on the edge of a palm grove, which plays an ecological and economic role. According to (SEGHIR A.H., 2018), this harmony between form and function is the key to adapting these houses to the needs and wishes of their residents.

The social and cultural dimensions of housing in the ksar:

- Designed for social cohesion and solidarity.
- The organization of the ksar preserves privacy, especially for women.
- The urban fabric evolves little, but functions can change over time.

The entrances to the ksar of Ghardaia: figure n°03.

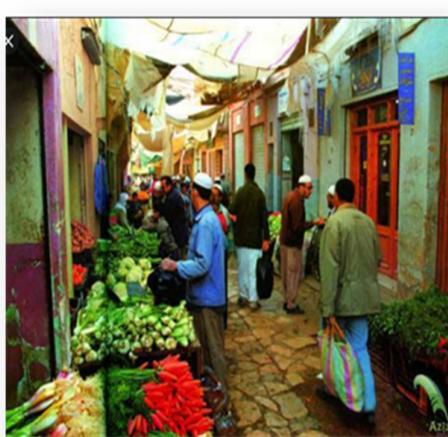


Source: Ghardaia City Hall, 2025.

- Streets, alleys and dead ends:

These public service areas reflect a hierarchy of spaces and a principle of privacy specific to Mozabite culture. They are divided into streets, alleys, and cul-de-sacs, their widths varying between 2.00 and 3.50 meters. Cul-de-sacs are private spaces designed to serve only the residents of the buildings that overlook the cul-de-sac.

Streets and alleys in the ksar of Ghardaia: figure: n°04



Source: Ghardaia City Hall, 2025

-The Ksar Square:

The ksar square, located on the southwestern outskirts, plays a central role in the economic and social life of the city of Ghardaïa. It is frequented by the residents of the ksar; it has an area of approximately 3400 m² and constitutes an important market for the region, a place of meetings, commercial exchanges and memory, having hosted commemorative and occasional festivities. It houses remarkable architectural elements and traditions.

The Ksar Square of the city of Ghardaia : figure : n°05



Source: Institute of Urban Technology Management, Univ-M'sila, 2025

3.2.5) Environmental adaptations of the ksar:

The city is built in a pyramidal shape on a hill, with the Great Mosque at its heart, and its concentric urban planning responding to a social organization based on equality and community life. According to (ADAD. M. Cherif .2021), local architecture and urban planning are in line with local tradition. Throughout its history, the architecture of the M'zab has preserved its identity embodied in its typology, climate, site and social realities. The buildings reflect a mastery of the Saharan climate: narrow streets to preserve shade, insulating materials (stone, lime), absence of solid concrete, mashrabiya filtering the light, while promoting ventilation. An underground water system makes it possible to capture, store and redistribute the scarce water from very deep wells ensuring irrigation, oases and protection against floods. The city presents marked microclimatic variations; urban vegetation, such as palm groves, mitigates heat islands, lowering the local temperature by several degrees.

The use of space varies with the seasons. In winter, to protect themselves from the cold evenings, family life is concentrated on the ground floor, taking advantage of the warmth retained by the thick walls. The thick walls of raw earth, a natural material with remarkable insulating properties, retain the sun's heat stored during the day, creating a warm and comfortable space at the heart of the house. During the summer, when the interiors become overheated, the occupants move to the terrace, which becomes the preferred place for sleeping and socializing at night. However, it is the interior space that is used during the day, providing protection from the intense sunlight. Ghardaïa illustrates a remarkable balance between tradition and adaptation. A Saharan city designed to live in harmony with an arid environment while facing the challenges of modernity. It shows how urban forms, hydraulic strategies, and buildings can interact with the desert.

3.2.6) Legal framework relating to the protection of urban heritage in Algeria:

Although Algeria has a solid legal framework, namely Ordinance No. 67-281 of December 20, 1967 and Law No. 98-04 of June 15, 1998 relating to the protection of cultural heritage, which considerably enriches the legal arsenal dedicated to the protection of urban heritage and constitutes one of the very first texts in terms of heritage protection in Algeria. It regulates excavations, the protection of historical sites and monuments, movable or natural. It sets the criteria, the classification procedure, and the sanctions in the event of damage to the renewed heritage, aimed at protecting traditional urban heritage such as the ksour. This legal framework is supplemented by operational structures; Study workshops and classification systems, restoration projects to extend protection to other ksour. However, challenges remain on the ground: in particular awareness, local governance, respectful rehabilitation, urban planning supervision and the mobilization of all stakeholders in this field.

Conclusion:

In the context and circumstances of the current state of the ksar of Ghardaia and its environment which are experiencing rapid urban development, which affects the urban fabric of the ksar (palace) in particular and the general landscape of the city in general by the lack of insertion and integration of this urban entity in its immediate environment, on the one hand, and on the other hand, the emergence of difficulties in the management control by local authorities, through the inability to introduce modern technical means to control the management of the ksar, such as fire trucks, ambulances and different types of networks. The sustainability of the Saharan ksour in Algeria is a major issue, it is based on a balance between preservation of built heritage, environmental management, social involvement, economic support and legal protection. The fragility of these ksour results from demographic pressure, social transformations and modern construction methods that move away from traditional know-how. Sustainability therefore requires an integrated approach. And which can only be achieved through the following points:

Preserving the ksar's built environment:

The use of local materials in all types of projects (palm, lime, raw earth, and stone) to maintain the building's identity and climate adaptation while ensuring natural thermal regulation.

- Avoiding even partial damage to the ksar's urban fabric
- The creation of a conservation charter that governs all protective and conservation interventions.

From an environmental perspective, it is necessary to:

- Limit uncontrolled urbanization to the detriment of the oasis' agricultural fabric.
- Promote traditional hydraulic systems
- Conserve the ecological system by preserving the palm grove and oases against the encroaching desert.

On the institutional and legislative levels, it is necessary to:

- Strengthen the enforcement of heritage laws, particularly Law 98-04 on the protection of Implement preservation and development plans tailored to each ksar.

On the economic level, it is necessary to:

- Promote the discovery of the ksour, while avoiding any type of folklore.
- Create income-generating activities through crafts and ecotourism.
- Encourage and promote participatory financing and management to address the various types of maintenance and restoration.

On the social and cultural levels, it is necessary to:

- Involve residents in preservation projects to prevent abandonment and exodus to new neighborhoods.
- Maintain community life through social practices that ensure urban cohesion.

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