

Cultural Heritage and Environmental Protection in Algeria: Lessons from the M'zab Valley Region

Mouna Hammou

Geography and Territorial Planning department, University of Sciences and Technology Houari Boumediene, Algiers, (Algeria), hmouna@usthb.dz.

Abstract: The M'zab Valley in southern Algeria, classified as a UNESCO World Heritage Site in 1982, offers a unique example of how cultural heritage can contribute to environmental protection and sustainable living. This study explores both tangible and intangible heritage practices of the Mozabite community, highlighting their relevance for contemporary urban and environmental planning.

On the tangible side, the compact urban design of the ksour (fortified towns) and the passive architecture of their houses illustrate efficient strategies for energy conservation and thermal comfort in arid climates. Narrow streets, thick walls, limited openings, and central courtyards reduce heat gain while allowing natural ventilation. In the oases, the Rainwater Distribution System (RDS) demonstrates an effective use of floodwater, simultaneously irrigating palm groves and recharging aquifers without mechanical intervention.

Intangible heritage is equally significant. Rooted in both Islamic teachings and the scarcity of natural resources, traditional practices emphasize conservation and resource efficiency. These include water reuse for multiple household purposes, the regulation of building heights to protect access to sunlight and wind, and the prohibition of construction in valley streams to safeguard groundwater. Traditional games, waste management habits, and food recycling through domestic animals also reflect sustainable cultural practices. Survey results from 594 inhabitants indicate that 92% of households do not discard food leftovers, with most reusing or redistributing them, thereby reducing organic waste reaching landfills.

The findings show that many Mozabite practices remain relevant today, offering practical solutions to current environmental challenges such as urban sprawl, resource depletion, and waste management. The study concludes that integrating usable cultural heritage into modern planning can both preserve identity and strengthen environmental resilience. The lessons drawn from the M'zab Valley underline the value of heritage as a driver of sustainability, not only in Algeria but also in other regions facing similar challenges.

Keywords: cultural heritage; Mzab Valley; environment protection; urban challenges.

Introduction:

Cultural heritage around the globe can serve as a positive driver of urban development and it can illustrate how traditional knowledge may inform contemporary urban strategies despite the pressures of modernization (Bae et al., 2025). In Ghardaia, for instance, Mzab traditional houses contribute to environmental preservation through their low energy consumption, which is achieved by their compact layout (Bouchair et al., 2013) and by their passive design (Rezig, 2021).

However, these houses have undergone several modifications in recent decades, significantly affecting their ability to provide indoor thermal comfort. Such changes were driven by various factors, including the need for more interior space and adapting the houses for summer use. Nevertheless, 32.4% of households reported making modifications solely to make their homes look modern (MOUNA & DRIAS, 2024), reflecting a lack of awareness both of the importance of

cultural heritage and of the benefits of passive techniques in saving energy and protecting the environment.

The lack of environmental awareness among some of the Mzab population is just one example of a global issue, not limited to Algeria but present all over the world. Moreover, It was found that human–nature connectedness worldwide has declined by more than 60% since 1800 (Richardson, 2025).

This study aims to highlight some aspects of the Mozabites' cultural heritage that can still be applied in many other regions of Algeria or even beyond, with the goal of environmental protection. Emphasising usable cultural heritage can also raise the environmental awareness of the local population and encourage the integration of traditional knowledge into contemporary urban and environmental planning strategies.

1. Research methodology

This study employed a questionnaire survey conducted among local inhabitants to gather data on their practices and attitudes toward waste management, particularly food leftovers. In addition, interviews were carried out with elderly residents to document unwritten habits and practices from earlier times.

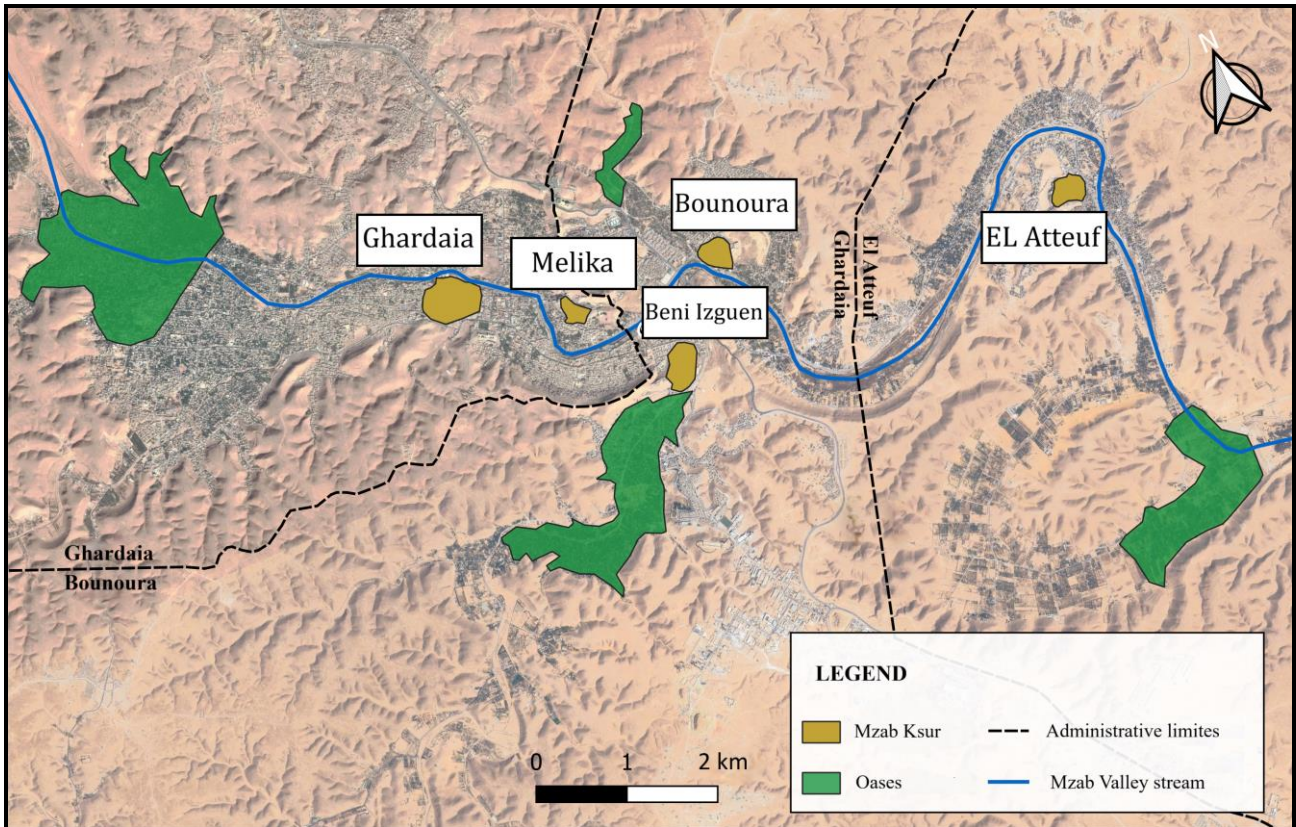
Official data were also collected from the Directorate of Environment of the district of Ghardaïa and the National Waste Agency. These records provided information on the local weight of waste, which was used to complement the survey findings.

2. Study area

In the Algerian desert, about 600 km south of the capital Algiers, lies the Mzab Valley, one of the country's most famous regions. Classified as a UNESCO World Heritage Site in 1982, the valley encompasses five fortified towns, known as ksur (Plural of Ksar), which reflect the unique cultural and architectural heritage of the Mozabite community.

The region of Mzab Valley contains five historical cities, which are: El Atteuf, built in 1012; Bounoura, built in 1046; Ghardaia, built in 1053; Melika, built in 1124; and Beni Isguen, built in 1347 (Coÿne, 1879). Administratively, these are divided into three districts: Ghardaia (including the ksar of Ghardaia and the ksar of Melika), Bounoura (including the ksar of Bounoura and the ksar of Beni Isguen), and El Atteuf (including the ksar of El Atteuf). Each of these Ksar has its own oasis, except for Melike that it was urbanised, as presented in Fig.1. The oases served as the main source of food for the inhabitants and where they planted palm trees and dug most of the region's wells.

The Mzab Valley region is hot and arid, with scarce precipitation averaging only 75 mm per year. For this reason, the Mozabites dug more than a thousand wells in the valley to obtain water from the Complex Terminal (CT) aquifer, both before and after the exploitation of the Continental Intercalary (CI) aquifer in the late 1930s.

Fig.1. The Ksur of Mzab Valley region

Source: drawn by the author

3. Tangible heritage

3.1 In urban areas

The urban layout of the Mzab Ksur and the architecture of their houses has inspired many researches focusing on their energy efficiency and harmonious adaptation to their natural environment. The streets, for instance, are narrow to provide shade for pedestrians, while the houses are compact, which reduces energy use, since detached buildings require up to five times more energy than clustered ones with only their roofs exposed. (Bouchair et al., 2013). In addition, the passive design of the houses contributes in less using of energy in lighting and ventilating, since the traditional houses in Ksur have less openings to the outside to reduce heat transfer, with an opening topped the courtyard to release the heat during the day and allow the cooler air to enter at night. The thick walls made with stone and lime also play a crucial role in preventing the heat transfer through them, however, in summer days, these techniques play a contradictory role as they keep the internal heat, for that reason, most of families go to the oases where they built summer houses, which are generally wider and shaded by palm trees (Bouchair & Dupagne, 2003). That is why the traditional houses of the Ksur provide thermal comfort more than the modern houses that are built outside the Ksur walls, because of their difference in design and in building materials. The table1 shows how traditional houses can provide thermal comfort passively.

The traditional design of the Ksur offers valuable lessons for shaping future sustainable practices. Modern urban planning can adopt compact layouts and shaded streets to reduce heat islands and improve pedestrian comfort. Buildings today could integrate passive cooling strategies, such as limited external openings, inner courtyards with controlled ventilation, and thick insulating materials adapted to local climates. Green infrastructure, like planting trees around neighborhoods, can replicate the cooling role of oases and reduce reliance on energy-intensive air conditioning. By drawing on these traditional solutions, modern housing and city design can move toward greater energy efficiency, reduced carbon emissions, and improved resilience to climate change.

Table1. Thermal comparison of traditional and modern houses

	Min °C	Max °C	Diurnal °C	Diff. outdoor/indoor
Living room				
Traditional house	30.4	30.6	0.2	22
Modern house	30.1	32.3	2.2	10.8
Kitchen				
Traditional house	30.4	30.6	0.2	22
Modern house	34.9	37.2	2.3	16
Wast-eddar (courtyard)				
Traditional house	33.7	34.4	0.7	22
Modern house	37.2	38.9	1.1	16
Outdoor	35	54.6	20	

Source: (Mohd Ariffin et al., 2018)

3.2 In the oases

Besides the passive design of traditional houses, the Rainwater Distribution System (RDS) in the oases provides another example of benefiting from nature. Local inhabitants use floodwater, through the RDS, to irrigate their palm groves and recharge the groundwater aquifer (CT). The RDS does not rely on mechanical equipment to water gardens located at higher elevations; instead, floodwater is captured upstream and guided by gravity with the help of small walls, creating canals that direct it from the valley stream to the oasis.

The traditional RDS highlights the value of designing water management strategies that work with natural flows rather than against them. Modern approaches could draw from this by prioritizing low-energy irrigation methods, decentralized water distribution networks, and techniques that enhance groundwater recharge. Such practices would not only make agriculture more resilient but also ensure fairer and more sustainable use of shared water resources.

4. Intangible heritage

It is important to note that the intangible heritage of the Mozabites emerged from two main factors: a strong faith in God's instructions in the Qur'an and Hadith, which forbid wastefulness and the destruction of natural resources, and the harsh climate combined with water scarcity. Together, these factors contributed to the development and persistence of many practices, many of which still exist today. Some of these practices are presented as follows:

4.1 Traditional games

There are various traditional games that children still play today, inherited from their ancestors. Some are played worldwide, while others are unique to the Mzab region. These games are generally simple outdoor activities, often involving toys handmade by the children themselves. Some are played mainly by boys, others by girls, while some are enjoyed by both. Certain toys are used across different games, such as knucklebones, locally known as *Tishaabine*, which serve as the basis for several variations. Some games are seasonal and depend on the availability of materials, such as *Tahjourt*, a variation of skittles played in autumn, from late September until the onset of cold weather, when palm trees are pruned and dates are harvested, since the cut fronds are essential for the game (Goichon, 1927, p. 60).

Traditional games can have significant impacts on children's development on one hand, and on the other hand, they can save considerable amounts of electricity compared to video games.

4.2 Natural resources conservation and exploitation

The water extracted from wells located near or inside the Ksur is salty and undrinkable. For this reason, it was traditionally used only for purification and for washing vegetables and dishes. The

same water was reused in sequence: first for washing vegetables, then for dishes, and finally given to domestic animals such as donkeys or goats, which were commonly kept in households in the past (Benyoucef, 2010, p. 121). The reused water posed no threat to the animals, as it did not contain chemical products like those found today. Similarly, the scarce rainwater that fell on terraces was collected through water spouts for reuse.

On the other hand, many unwritten regulations, known as *Ourf*, were followed by everyone and remain applicable today. In the construction field, for instance, a person building a new house was not allowed to make it taller than that of a neighbour, so as not to block sunlight and wind.

When floodwater flows through the valley, it carries soil with it, and the dams (a part of the RDS) serve to trap this soil, which is then extracted and used for agricultural purposes and for making mud blocks. These mud blocks, combined with locally produced lime, were traditionally used in the construction of buildings in the oases.

These traditional approaches to water use, construction, and soil management highlight the importance of resource efficiency and community-based regulation. Modern practices could adapt these principles by promoting greywater recycling systems, eco-friendly construction materials derived from local resources, and participatory planning rules that ensure equitable access to natural elements such as sunlight and wind. Such strategies can support sustainable urban development while reducing dependence on energy-intensive or imported materials.

4.3 Protecting the oases from urban sprawl

Several studies, such as (Côte, 2002), (Bouchair, 2004), and (Bensalah et al., 2018), have examined the current impacts of urban sprawl on the oases, which have threatened, and continue to threaten, their cultural heritage, particularly the RDS components. At the same time, a number of regulations were established to protect the oases and agricultural lands from cement and concrete construction, including, for instance, the restriction to only small, essential buildings within the oases while prohibiting larger structures, except for towers and dams. In addition, in cases where the removal of a tree or date palm was unavoidable, such as when it was sick or dead, the owner was required to replace it with another tree or date palm, ensuring that no alternative structure or use could substitute for the lost tree.

On the other hand, to ensure greater protection of both the oases and urban areas, it was prohibited to build, farm, or carry out any activity in the valley stream, which was set at forty cubits from each bank, making a total of eighty cubits. Furthermore, the restriction on establishing an oasis upstream of the Ghardaia oasis aimed to safeguard groundwater resources. This regulation remained in effect for more than two centuries, until 1868, when a waiver allowed a group of semi-nomadic Arabs from the Djebel Amour, the Mdabih, to establish a date palm grove (Josse, 1970, p. 53).

Traditional rules limiting construction and requiring tree replacement highlight early ecological awareness. Such practices can guide modern land-use and conservation policies, helping to balance urban growth with environmental protection and ensuring the sustainable use of natural resources.

4.4 Waste management

Before the Industrial Revolution, although most household waste was biodegradable and did not harm the environment, families made use of almost every part of it, and very little was discarded. Waste was first separated to recover items that could be reused. What remained was often used as cooking fuel, since wood was scarce in the arid climate. Finally, only dust and sand from house sweeping were left, which were typically disposed of in toilets to dry. Dry toilets were the only type available in the region due to water scarcity and the absence of alternative technologies. Moreover, dry toilets were an important source of fertilizer for the M'zab oases and could still be considered an efficient solution against pollution (Bekaddour et al., 2021).

Food leftovers, on the other hand, were always given to domestic animals, with families benefiting in return from their milk and eggs. Many households in the M'zab Valley still keep at least one animal. However, these animals have also become a source of noise and, at times, a

disturbance to neighbours. For this reason, some families have decided either to relocate them to the oases or to stop keeping them altogether.

To assess the current practices of M'zab inhabitants regarding food leftovers, we surveyed 594 individuals from all the M'zab ksour. Respondents were asked whether they still keep domestic animals, such as goats, chickens, or sheep, to which they provide food leftovers including bread, vegetable peels, or spoiled food. The results show that only 27% of the inhabitants currently keep domestic animals for this purpose. However, 65% of the remainder reported giving their food leftovers to neighbours or relatives who own domestic animals. In other words, 92% of ksour inhabitants do not discard their food leftovers as waste. This finding is significant given that 54% of the waste reaching landfills in Algeria consists of organic matter.

The results also explain why the rate of waste per inhabitant in the Mzab region is lower than the national average, as shown in the following table.

Table2. Average waste generation in the Mzab Valley region (2017)

District	Population number	Waste Quantity (tonnes)	Annual waste per capita (kg)	Daily waste per capita (kg)
Ghardaia	130516	27718.58	212	0.58
Bounoura	43000	6717.52	156	0.43
El Atteuf	19188	2561.84	133	0.36
National average				0.80

Source: National Waste Agency

The Mozabites' waste practices show how resource efficiency can be achieved through reuse, recycling, and sharing. Applying similar habits today (such as promoting composting, dry sanitation, and community food-sharing) could significantly reduce organic waste and ease pressure on landfills.

Conclusion

This study has shown how the Mozabite community developed a rich set of tangible and intangible heritage practices that ensured survival in a harsh desert environment while protecting natural resources.

On the tangible side, the compact urban form of the ksour, passive architectural design, and the Rainwater Distribution System (RDS) in the oases illustrate how built heritage served both environmental and social needs. These features reduced energy use, improved thermal comfort, and optimised scarce water resources.

On the intangible side, local traditions and regulations, rooted in both religious values and environmental necessity, guided daily practices. These included careful reuse of water, waste reduction, community rules to protect sunlight and wind, restrictions on urban expansion, and cultural practices such as games that shaped social cohesion while limiting reliance on modern, energy-intensive alternatives.

From these findings, several sustainable lessons can be drawn:

- Compact housing and passive design can inspire low-energy architectural strategies.
- Traditional water management systems offer models for sustainable irrigation without mechanical energy.
- Reuse and recycling practices, especially regarding organic waste, can reduce landfill loads and support local food production.

These lessons demonstrate that cultural heritage is not only about preserving the past but also about providing innovative and practical strategies for sustainable urban and environmental planning today.

This study recommends greater integration of Mozabite traditional practices into urban and environmental planning, while also encouraging wider surveys in other regions to validate the

findings. Future research could explore comparative perspectives with other arid areas worldwide. However, the results are limited by the reliance on self-reported practices and historical sources, which may not fully capture the complexity of past traditions.

Bibliography List

1. Bae, S., Dahiya, B., & Kittipongvises, S. (2025). Cultural Heritage, Indigenous Knowledge and Sustainable Urbanisation in South Korea: Case of Jejudo Island during 1946~1970. *Space and Culture, India*, 13(1), 73–103. <https://doi.org/10.20896/mhmsyn13>
2. Bekaddour, S., Ait-Mouheb, N., & Hartani, T. (2021). Re-emergence of dry toilets and fecal nutrient reuse in M'zab cities. *Journal of Water, Sanitation and Hygiene for Development*, 11(6), 983–993. <https://doi.org/10.2166/washdev.2021.115>
3. Bensalah, I., Yousfi, B., Menaâ, N., & Bougattoucha, Z. (2018). Urbanisation de la vallée du M'zab et mitage de la palmeraie de Ghardaïa (Algérie): Un patrimoine oasien menacé. *Belgeo*, 2, 0–16. <https://doi.org/10.4000/belgeo.24469>
4. Benyoucef, B. (2010). Le M'Zab parcours millénaire. *Alpha, Alger*.
5. Bouchair, A. (2004). Decline of urban ecosystem of Mzab valley. *Building and Environment*, 39(6), 719–732. <https://doi.org/10.1016/j.buildenv.2003.12.001>
6. Bouchair, A., & Dupagne, A. (2003). Building traditions of Mzab facing the challenges of re-shaping of its built form and society. *Building and Environment*, 38, 1345–1364.
7. Bouchair, A., Tebbouche, H., Hammouni, A., Lehtihet, M. C., & Blibli, M. (2013). Compact cities as a response to the challenging local environmental constraints in hot arid lands of Algeria. *Energy Procedia*, 42, 493–502. <https://doi.org/10.1016/j.egypro.2013.11.050>
8. Côte, M. (2002). Une ville remplit sa vallée: Ghardaïa (Note). *Méditerranée*, 99(3), 107–110. <https://doi.org/10.3406/medit.2002.3270>
9. Coÿne, A. A. (1879). *Le Mzab*. Adolphe Jourdan.
10. Goichon, A.-M. (1927). *La vie féminine au Mzab: Étude de sociologie musulmane*. (Vol. 1). Paul Guenther.
11. Josse, R. (1970). Croissance urbaine au Sahara: Ghardaïa. *Cahiers d'outre-mer*, 23(89), 46–72. <https://doi.org/10.3406/caoum.1970.2536>
12. Mohd Ariffin, N. A., Behaz, A., & Denan, Z. (2018). Thermal Comfort Studies on Houses in Hot Arid Climates. *IOP Conference Series: Materials Science and Engineering*, 401(1). <https://doi.org/10.1088/1757-899X/401/1/012028>
13. MOUNA, H., & DRIAS, A. (2024). A socio-environmental analysis of contemporary modifications to Algerian Mzab traditional houses. *African Geographical Review*. <https://doi.org/10.1080/19376812.2024.2318747>
14. Rezig, N. H. (2021). Traditional dwelling Of Mzab Valley in Alheria: The point of adaptation to the envirement. *Сучасні Проблеми Архітектури Та Містобудування*, 61, 159–169.
15. Richardson, M. (2025). Modelling Nature Connectedness Within Environmental Systems: Human-Nature Relationships from 1800 to 2020 and Beyond. *Earth*, 6(3), 82.