

Diagnostic Study of Troglodytic Landscapes in the Zone of the Ancient Matmata in the South-East of Tunisia

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Abstract—This study has been interested in the diagnostics of the landscape of the city of the ancient matmata which comes from the governorate of gabes situated southeast of tunisia. Objectives: the purpose of this research is to understand the part of integration which the population of this area adopted on the function of the relief and the natural data omnipresent, supporting this appearance of the local landscape, as well as identify ancestral techniques used by the inhabitants for the conservation of the landscape of arid zones while taking profit. A study by multi-scale analysis and analysis of the different data provided by the ministry of equipment, the national institute of heritage and the medina safeguard association, accompanied by a socio-economic survey land and the direct contact of local actors, has permitted to characterize these fragile and specific landscapes. Analysis of the various topographic cards with matmata land use cards allowed us to know the history of this area and reconstitute the manner that our ancestors have adopted to produce their hollow fireplaces at the level of this landscape riche en relief. We note from the investigation that the traditional practices of protection of the arid relief by the production of troglodytic habitats underground are respectful of nature, increasing the remarkable ecological and sustainable territorial development. The human habitat of the matmata area is typical thanks to a rich and diversified local know-how, which emerges a natural landscape with a very important value. This value can be envisaged by the decision-makers to install projects south of tunisia and make our heritage benefits.

Keywords— integration party, local landscape, conservation, traditional practices, troglodyte habitats, know-how.

I. INTRODUCTION

The Tunisian South is gradually emerging from its isolation. Gabes is already a large modern industrial center. Its influence will only increase in the course of days on the region of which it is the metropolis (...) Tomorrow, the Tunisian South will inevitably have another face. So it is urgent to take snapshots of a world that will soon be no longer the same? (Abdesmad ZAIED: The world of the ksours of the Tunisian South.). In the midst of an arid and ungrateful nature, which incites to insecurity, the troglodyte works adorn their majestic masses with the peaks and ridges of the Tunisian South. Their number is imposing: 150 of which 70 are listed at the end of the book. They intrigue and sharpen curiosity, and modern man today comes to rest in their ghorfas for a moment in the age of the caves. (M.TALBI-H.DJAIT-

F.Dachraoui-M.A.M'RABET: History of Tunisia: The Middle Ages.

These dwellings are built at the base in order to cope with the heavy heat waves in the Matmata region several times a year. This particular arrangement of the habitat makes it possible to penetrate the light in the underground rooms while maintaining coolness in the warmest summer. (Ibn KHALDOUN: Kitab al ibar) At the level of this study we will explain the logic adopted by the ancestral population of southern Tunisia to integrate their architectural works according to each typology of reliefs and natural data of the occupied environment while ensuring the conservation of the local landscape of the arid zones. The study area focuses on the south of Gabes, the country of Ourghamma, more precisely the town of Matmata which constitutes an essentially mountainous region.

This area was chosen because of the existence of the greatest concentration of Troglodyte Habitats, under different typologies, which clearly shows the interaction between Man and nature.

II. MATERIAL AND METHODS

1. Presentation of the study area

Situated to the southeast of Chott el-Jérid, in the foothills of Jebel Dahar, the ancient Matmata mountains

dominate the vast plain of the Djeffara and form a cuesta (515 meters) uncovered in the limestone and upper Cretaceous marls and Through various wadis.

The village is about forty kilometers south-west of Gabes. Surrounded by mountainside, 600 meters above sea level, this village has 2,116 inhabitants in 2004. It is renowned for its remarkable cave dwellings which make it one of the high places of Tunisian tourism. (Abdesmad ZAIED: The world of the ksours of the Tunisian South.)

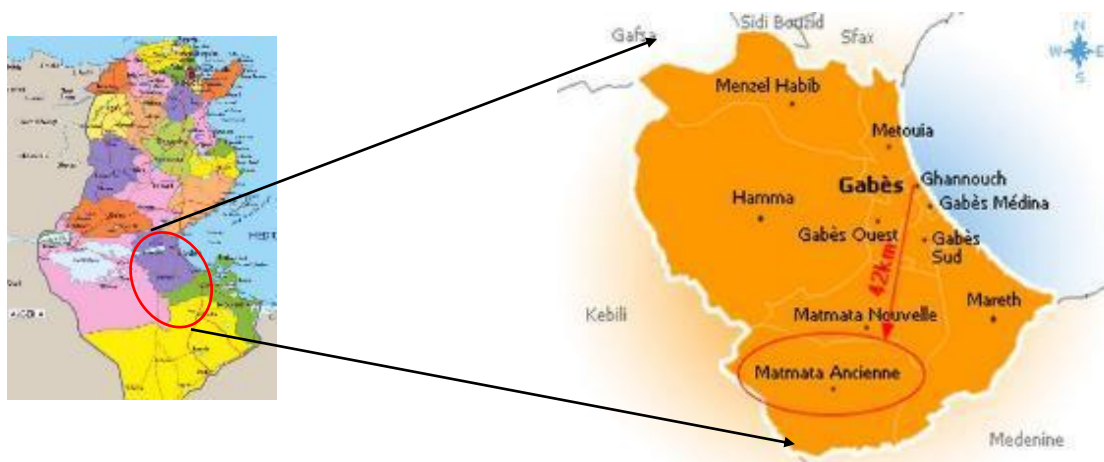


Fig.1: Location map of the town of ancient Matmata in Gabes

2. Methods

This research project aims to provide an update on the situation of troglodyte works in the town of Matmata and to study the opportunity for sustainable development in the region, based on the improvement of the natural landscape. The originality of the methodological approach used in this research is the application of complementary methodological tools to approach the decision support and the management of the exploitation of the troglodyte heritage with a view to conserving and enhancing the landscape that shelters them.

2.1. Spatial analysis

To optimally and efficiently intervene in the old urban fabric of the town of Matmata, we have opted for a methodological approach that includes two phases:

First phase: Analysis of statistical data

The collection of general data on troglodyte habitats to place it in the overall context through a reading of the statistical data required by the Ministry of Equipment and the National Heritage Institute. - Review of data extracted from GIS: Analysis of the land use database Map of the Matmata area and the topographic map of Matmata to differentiate the different reliefs and characterize the

typology of troglodyte integration according to the relief.

Phase 2: Analysis of field data

Since independence, a cultural openness to the world has changed the references that guided all human realization. Several practices, ideologies, habits have been modified or even squarely changed. Towards a new development approach, with a modernist horizon and a revolutionary image of the country, all kinds of realization with traditional roots have gradually lost their social position on the road to development. (Abdesmad ZAIED: The world of the ksours of the Tunisian South.) Among these works, the Troglodyte architecture of the arid zones was perceived as primitive and outdated, to be surpassed insofar as the Troglodytic spirit could not be part of the modernist aspect sought. So we started to build new cities in the south, on plains closer to the big cities. One can cite the case of Matmata (Southeast Tunisia), which is located in a mountainous area, so we went down to the plain to found the town of La new Matmata, close to the city of Gabes. Many other examples can be enumerated, where the term "New" is added to the old denomination to found new cities with more modernist images, eg New Zraoua, New Guermesssa, etc. The old rustic towns are now conglomerations with low concentrations of populations.

(Abdesmad ZAIED: The world of the ksours of the Tunisian South.)

In order to characterize the exploitation rates of the various troglodyte works, we develop operational parameters based on several surveys: habitat area, habitat occupation, type of activity, state of conservation ... these investigations have affected a sample Representative of 50 habitats in two areas of Matmata: Untouched and undisturbed cave area and area where troglodytes have been restored and converted. The usual statistical analyzes identified the operating systems in the study area.

2.2. Landscape reading of arid zones using the Neuray citation method

In order to determine the value of the landscape by the Neuray scoring method, a visit to the Matmata was necessary. Three observation sites were selected. The geographical coordinates N and E taken by the GPS for each observation point are converted into metric coordinates by a "GeoCalc" application (Saadaoui et al., 2014). The citation method only provides landscape values; It is based on an analysis of points of view taken at crucial places. It provides both an overall landscape value and a separate assessment of the various essential elements. The method takes into account the principle of reciprocity (if I see that I am seen) (Toussaint, 2009). In

each view, more data is determined: • The length, orientation and width of the view • The vertical dimension of the view • Valuation factors • The value of the base of the view. The base value of the view is calculated using the following formula: $V = L \times R \times S$. The base value of the view represents a current view of the landscape from a point of view.

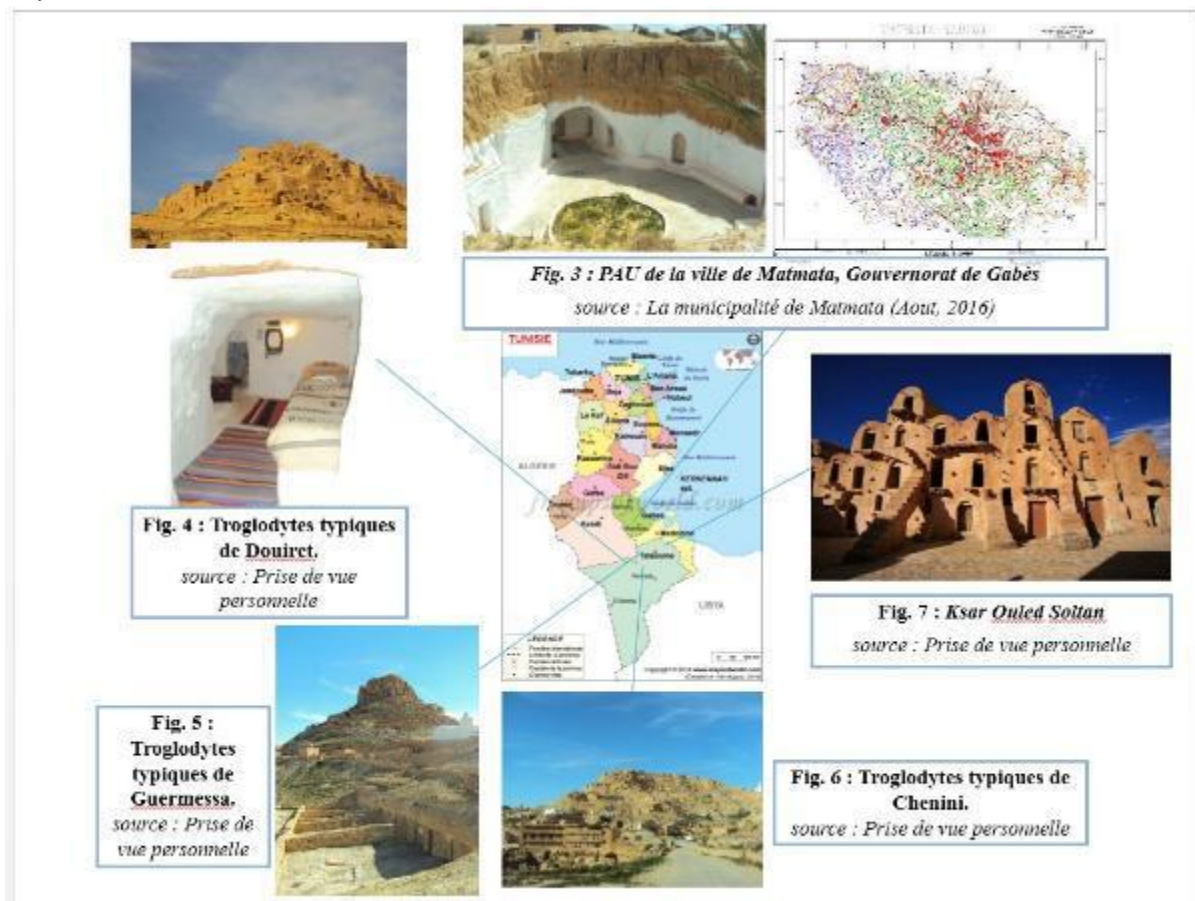
L: Width of the view

A: The vertical dimension of the view

S: valuation factor = $1 + T / 10$

Table 1. Characteristics of viewpoint

Caracteristics	Locations of chosen sites	The southern Tunisia	
		Station 1	Station 2
The view direction		200° North	200° North
Length of view (he)		2.4	7.6
Visual angle of vertical dimensions (°)			
α		-10	-7
β		20	-14
Δ		30	20



III. RESULTS

MATMATA KADIMA

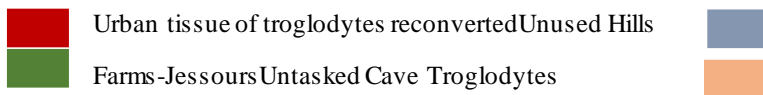
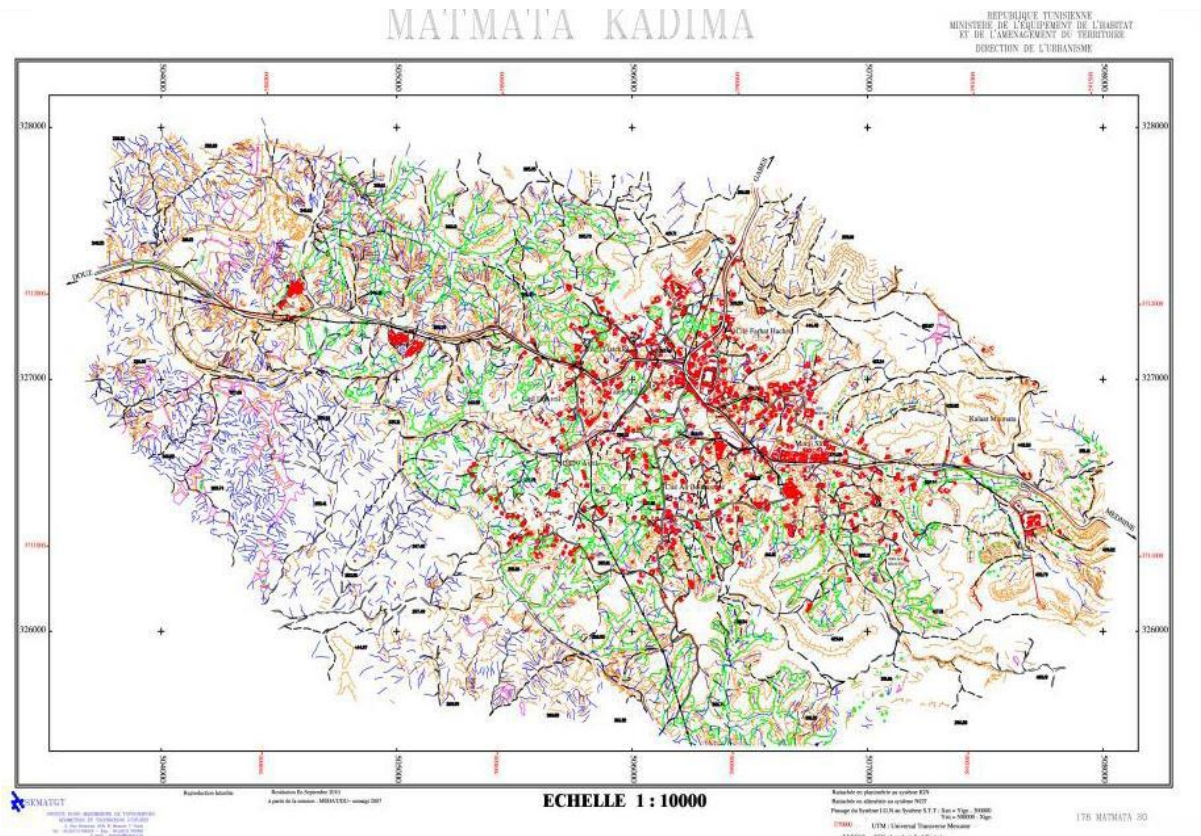


Fig.2: Land use map of ancient Matmata

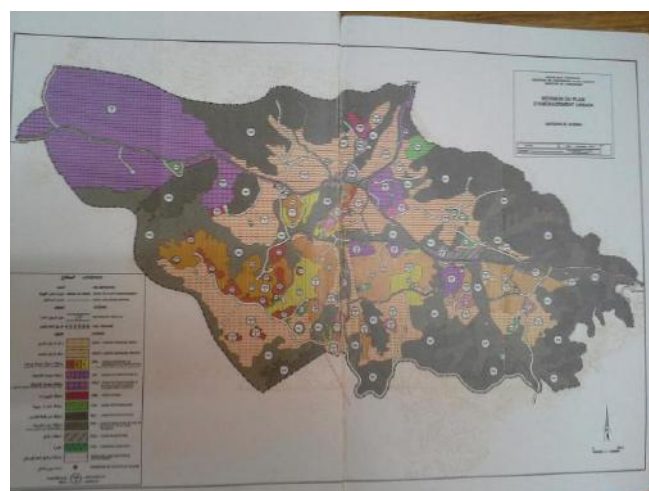
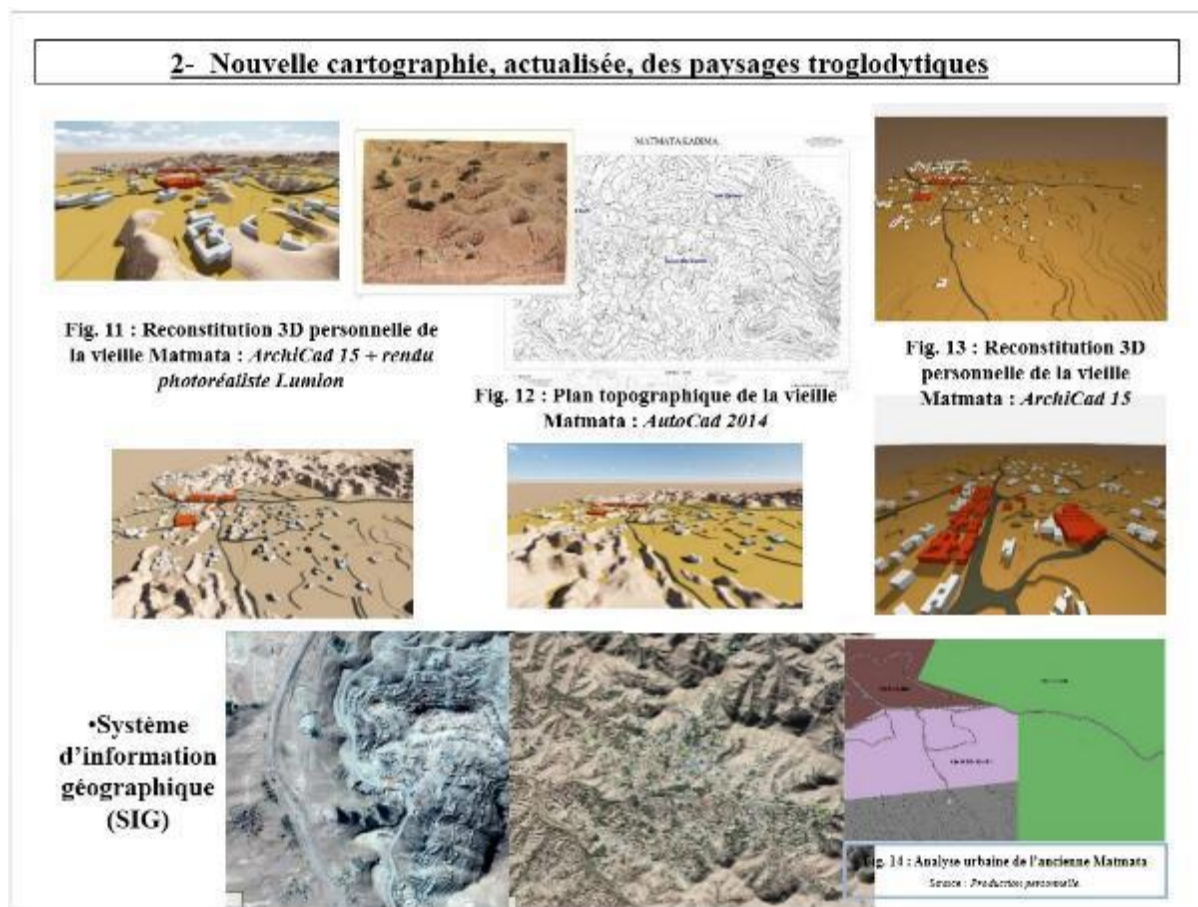


Fig.3 : PAU of the town of the ancient Matmata



It is important to clarify the following distinction: As long as it remains virgin, it is called nature. Following human intervention, the name changed to "landscape". (André TOUSSAINT: Reading of the Landscape)

The nature of the occupied environment which is characterized by its constraints and its potential, translated according to the culture and manners of the occupants, as well as the tools available to them, constitutes a generator of architectural modes and adequate and optimal landscape management.

There are three general typologies of sites in which our ancestors designed their habitats: (Mongi BOURGUOU: Atlas of landscapes of Tunisia.)- Defensive sites, perched on hills, spurs and pitons hardly accessible -Mounting eminences more easily accessible-Plains We notice that each type of relief adapts a modality of architectural response that is well adapted and well adapted given accessibility, orientation, techniques of realization, etc.

-The fight against desertification and the reduction of silting

According to its morphology, location, proportions and frequency of localization, underground Troglodytes are an active factor in the stabilization of karstic soils (karst is a geomorphological structure resulting from the water

erosion of all soluble rocks , Mainly of carbonate rocks, mainly limestones).

These soils are desert, arid, lacking dense vegetation cover to protect them from wind and stormwater runoff.

- Optimal integration with the landscape

Our ancestors have made a choice of occupying the landscape, which is distinguished and subtle, prompting us to study it more closely to reveal the corresponding reading code.

It is a question of perceiving the site not as a support on which one is indebted for the implantation of a chosen standard housing model, but rather as being a kind of raw material on a large scale, carving and shaping Organic and flexible.

This mode of habitat greatly enhances the potential of the occupied site by being grounded in the mass and constituting with the natural relief only a single entity balanced and in synergy. It is a question of inhabiting the landscape, it is not about implanting an architecture in a natural landscape but rather we talk about architectural landscape (Marinella ARENA: Ksour), since, in this case, architecture and landscape are the subject of a similar picture.

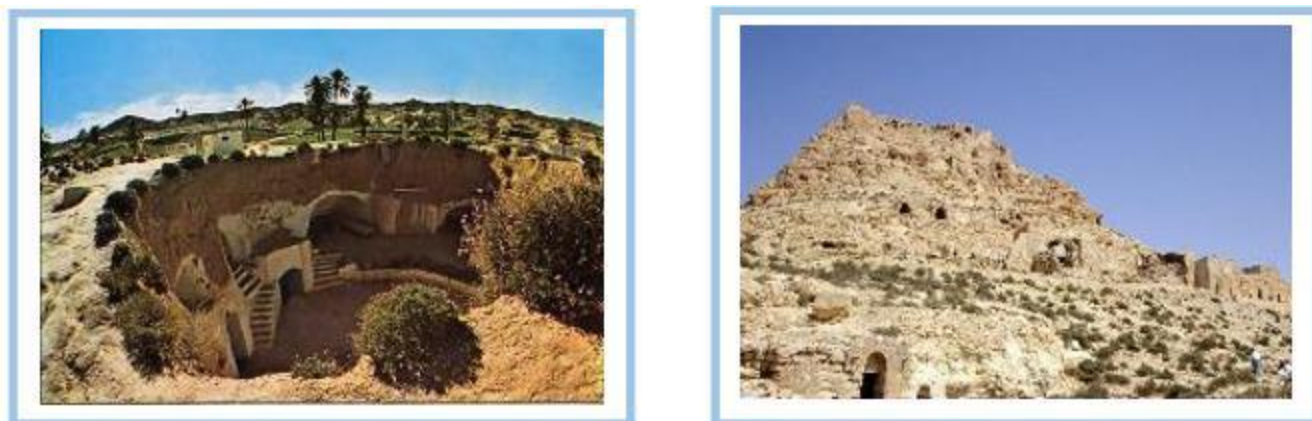


Fig.4: Different landscape integration of the troglodytes of the ancient Matmata.

-Natural regulator of climatic environments: isomorphism of houses

The earth and the mountains naturally balance the internal climate with the external climate by regulating the temperature, dissipating it when the heat is superior to its exterior to create freshness or, on the contrary, by the release of the Energy stored in the form of heat, when it is colder than inside (Habitat-Bulles.com).

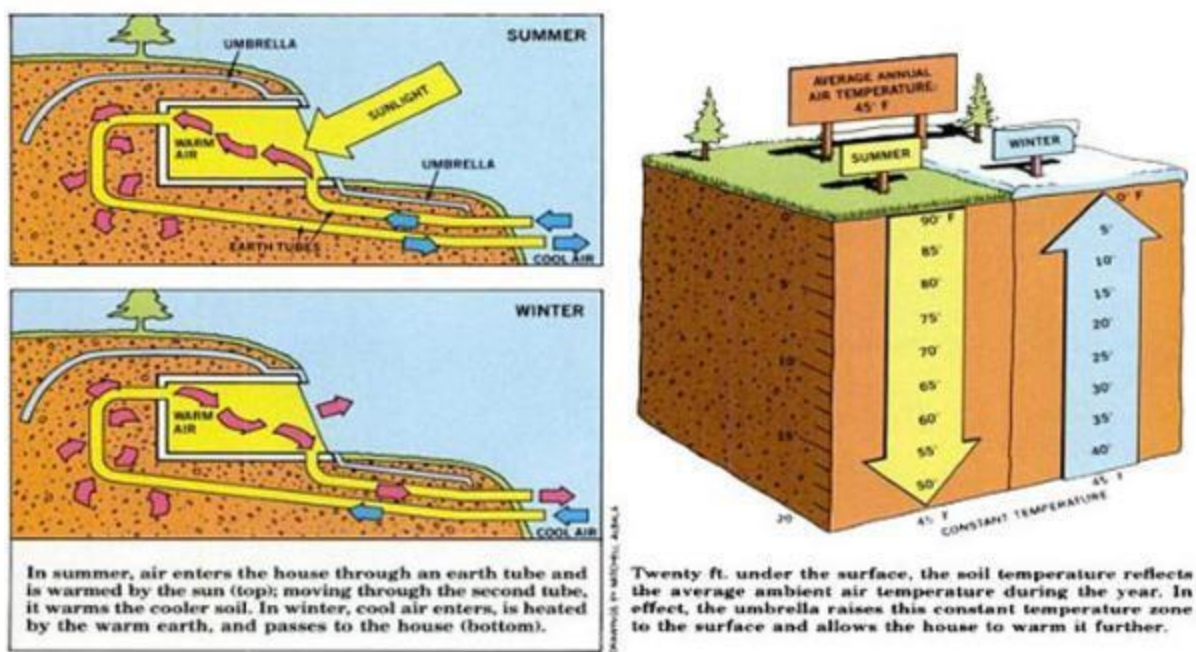
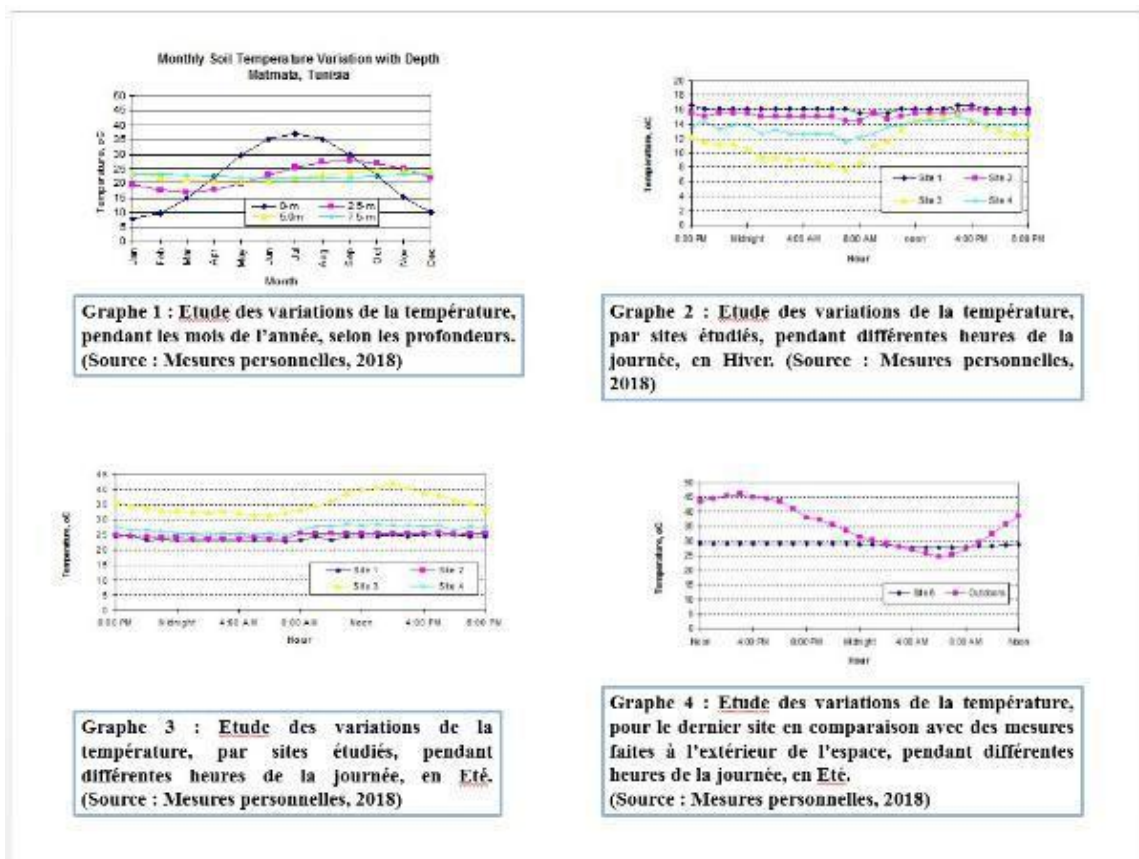


Fig.5: Phenomenon of isomorphism. (personal measurement)



Considering the criterion of natural regulation of climatic atmospheres, the energy needs to heat up or provide freshness become minimal and not imposing view that this Architectural mode is not energy-intensive. (Habitat-Bulles.com).

-Ecological architecture, sustainable

In addition to the two previous criteria for natural regulation of climatic environments leading to energy saving, there is another basic criterion of ecological architecture, which is defined by the economy of building materials (Habitat-Bulles. Com), since our building is a

sculpture inside a hill or a mountain, with a whitewash and woodwork based on palm trunks. As a result, there is no need to look for materials elsewhere.

-Special and unmatched atmosphere

As is the case for any sculptural work, the result of uniqueness, authenticity and kinesthesia is assured. (Françoise Monnin: Modern sculpture.)

The irregular walls in continuity being only one global entity with the non-planar roof, constitute the sources of an infinite artistic architectural production.

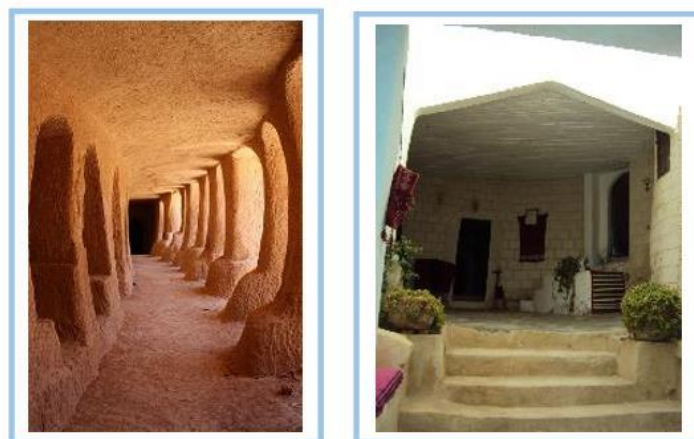


Fig.6: Particularly distinguished internal environments.

-Structural research constraint minimized

This prowess is explained as follows: At the moment when it is no longer a question of creating supports and completing the realization by creating a roof along its supports, taking into account the dimensions of the various components of this variable system Multiple,

every designer finds happiness to create and render real and existent any atmosphere to which he has thought, far from the technical constraint, one is only concerned with surpassing his imagination by manipulating the mass of matter.

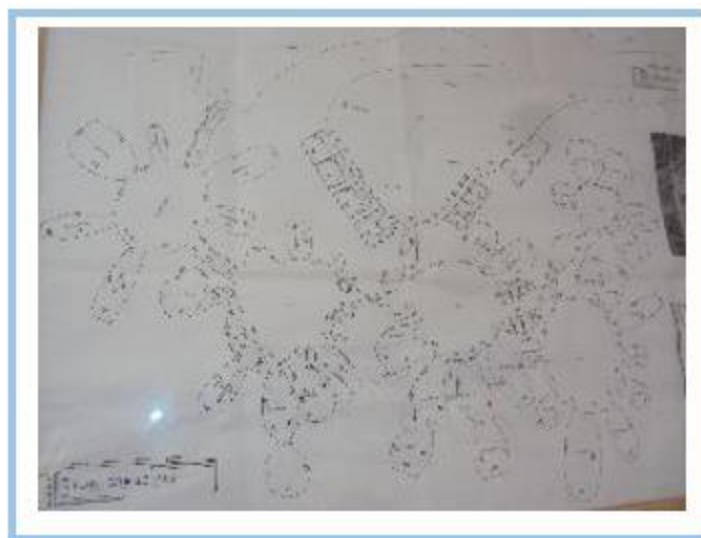
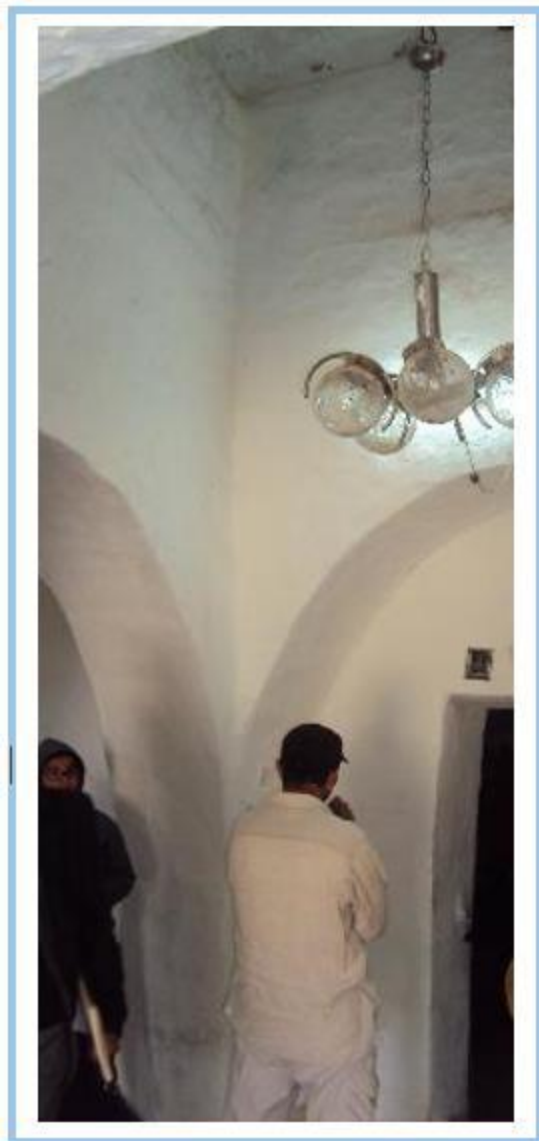


Fig.7 : Free spaces with imposing heights.

An Architectural model is a multi-component system, which is one of several possible responses to a set of needs and uses.

These needs are predefined according to the practices (traditions and customs), the standard of living and the environment that will host the project (geography, bioclimate, accessibility, availability of materials, availability of equipment, etc.).

The troglodyte architecture constantly reminds us that this form of appropriation of space constitutes an inseparable part of the landscape which is omnipresent, thus inciting

us to bring out all the rules of landscape, which gave rise to this modality of To understand the space and to integrate in the site, so as to have created an authentic work of occupation of the territory. It is about Habit the landscape: Creation of architectural landscape or landscape architecture par excellence.

As a result, the architectural work Troglodyte emphasizes the reconciliation between inhabited environment and human being as occupant of this environment, valuing it. Landscape value of different areas of the ancient town of Matmata.

We intend to make explicit the modification of the use of troglodyte habitats and its impact on the landscape and urban image. For this reason, at the level of the old Matmata, the differentiation between the abandoned troglodyte areas and the areas where the inhabitants intervened to modify the troglodytes was detected and introduced a new architecture in the vicinity, and we then discussed the comparison .

We estimated the landscape value of the two points of view chosen from the sites visited in Matmata (Figure 8). The selected viewpoints are characterized by more or less harsh reliefs, a low presence of rainfed agricultural practices (olive trees) and a large presence of troglodyte habitats, especially underground, that harmonize the different components of the natural landscape having undergone different rates Human intervention.



Fig.8 : Identification of the landscape area with selected views in ancient Matmata

Table 2. Valorizaion factors

Valorisation factors	View 1	View 2
Présence de nouvelles constructions	5	-
Presence of the rocks	5	5
Size and quality of the open space in front of the viewer	4	7
Presence successive planes	6	6
Framing and polarization of view	5	6
Quality of the ridgeline	4	5
Accentuation of natural landforms	5	7
Visual quality of communication routes	5	6
Integrity	7	7
Total (T)	46	49
$S = 1 + T/10$	5.6	5.9

After calculating the V-value of each observation site, we found that the high value of these views exceeded 60. (Table 3)

Table 3. Values of views (V).

	L-Length of view : $1/2 \times 10 \times \log_{10} 1$	R : Vertical dimension of view : $1 + \sin \alpha + \sin \beta + \sin \delta + d/100$	S Valorisation factors	$V = L * R * S$
Site 1	4.377	2.468	5.6	60.49
Site 2	10.14	1.428	5.9	85.43

IV. DISCUSSION

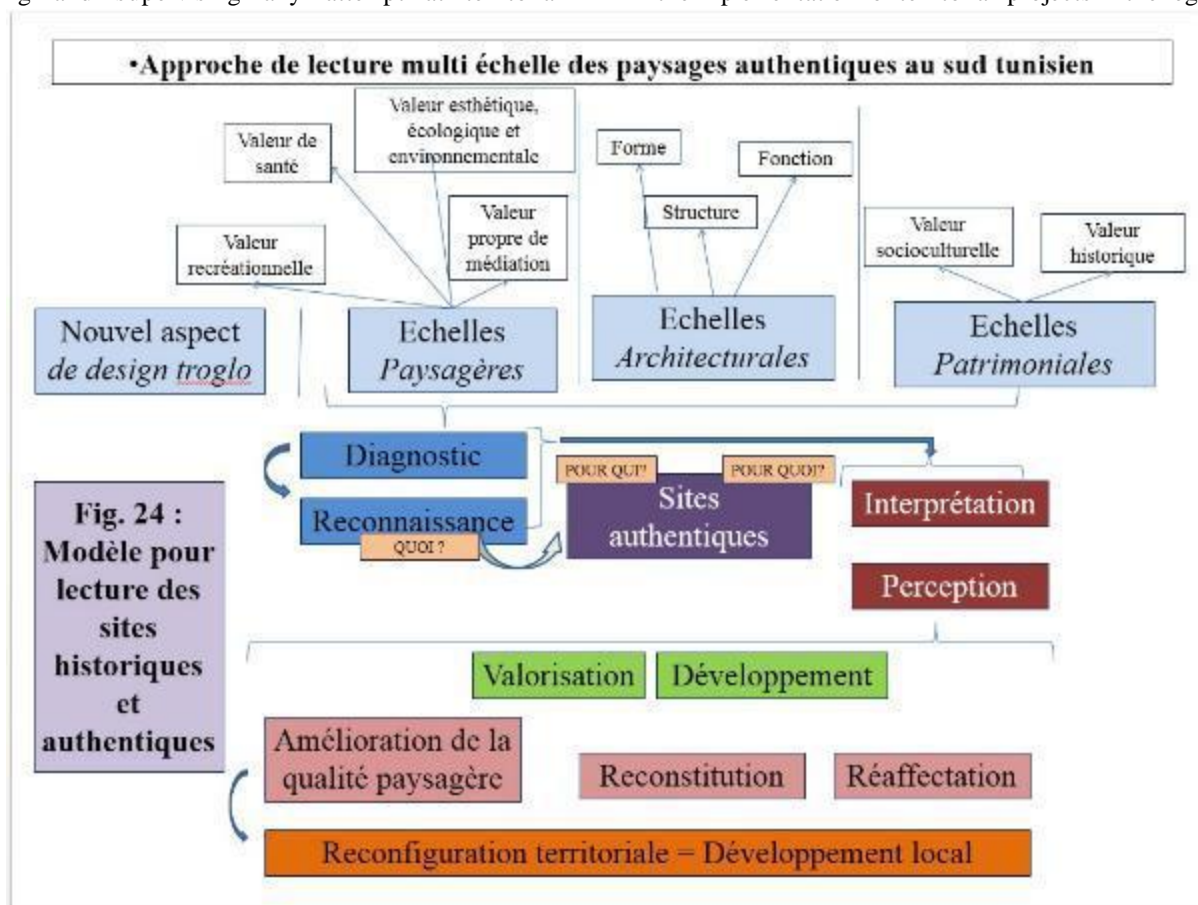
We have tried to characterize the troglodyte landscapes of the region of the old Matmata. We analyzed landscape integration systems from habitats to the study area using a reading map and data analysis and survey.

The results of the first part of this study showed that the rustic troglodyte works of the old Matmata have reached

the limit of not being able to meet the new needs of the population. This change in morals prompted some inhabitants to seek an adaptation of their rustic troglodyte habitats to their modernized daily. Most of the other troglodyte structures have been abandoned to ruin. In this way, we have touched the genesis of a new urban image that constitutes, more exactly, the mutation of the old

traditional rustic urban image. This change threatens to have serious consequences for the landscapes of the city of the old Matmata, insofar as one is forced to integrate all the activities associated with the new modern way of life, namely environmental pollution, vehicular congestion, Noise, earthworks. All its activities constitute real aggressors of the fragile and particular landscapes of the area of the old Matmata. All these findings prompt the regularization of the unbalanced and anarchic exploitation of the troglodyte heritage in the old Matmata, as well as directing and supervising any attempt at territorial

development towards a rational use and in harmony with the landscape ensemble, such as the producers Ancestral rustic troglodyte works have enhanced this landscape. The evaluation of these landscapes by the Neuray citation method has shown us a landscape value that exceeds 70, the site of study is characterized by a high landscape value caused by the presence of anthropogenic action in favor of the " Ecosystem and the preservation of the natural landscape of the mountains. These results can be taken into account by policy makers and shareholders in the implementation of territorial projects in the region.



V. CONCLUSION

This study remains a means of determining the typology and the different forms of troglodytic architecture. It was also an opportunity to showcase the potential of this way of housing the landscape. On the other hand, these authentic and typical works have been presented as areas favorable to the development of cultural and ecological tourism. This architectural landscape, constituting a true natural force of a patrimonial character, requires a modeling and a popularization having a tourist aspect. Troglodytic landscapes and their environments (agricultural, historical, urban) are a legacy that transcribes a know-how that highlights the fact that the Troglodytic habitat mode constitutes not only an

architectural, landscape and cultural heritage, but Essentially a force of nature.

The natural space, urban and agricultural, has undergone mutations throughout history. The preservation of this authentic and unique architectural mode of heritage must determine, on the one hand, a certain singularity which expresses, in a way, the richness of a historical landscape. On the other hand, the emergence of an intelligibility of adaptation and management of well-defined data that give priority today to a better living environment and gives its regions their natural, original and artistic character.

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