

Littoralization and Urbanization

Djerba Scale, Tunisia





Analysis of Threats and Enabling Factors for Sustainable Tourism at Pilot Scale

Littoralization and Urbanization Djerba scale, Tunisia



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OVERVIEW

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REVIEW

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List of abbreviations

OCAA: The Office of Civil Aviation and Airports

RTC: Regional Transport Company of Medenine and Gabes

GHG: Greenhouse Gases

NDC: Nationally Determined Contribution

LPG: Liquefied petroleum gas

UTICA: The Tunisian Union of Industry, Commerce and Handicrafts

PNU: Programme des Nations Unies

NIS: National Institute of Statistics

Abstract

The limited resources of small Island space and the increased density of people and activities based on the development of resources of coastal ecosystems are major obstacles to the sustainable development of Djerba. The analysis of the characteristic situation of Djerba's natural and human environment is that we are perfectly balanced with the environment and tourism exclusively from the traditional consistent development system resulting from the use of experience and ancient techniques. Such restrictions justify a new strategy for the development of new sustainable tourism that integrates with the blue economy sector. A systematic vision may have made it possible to highlight the various elements of each system in dynamic interactions, organized around goals, here sustainable tourism and blue growth.

Additionally, Djerba as an Island, its international airport contributes to the development of large-scale beach tourism. Sustainable islands can only be considered by promoting alternatives to individual transportation with motors, coordinating various forms of movement in intermodal systems, and promoting the use of public transport and soft movement. Improving road network connectivity and internal accessibility is essential to reduce the need for transportation and avoid the use of private vehicles.

I. Introduction

The tourism industry has experienced a boom in the last few decades in both developed and developing countries, establishing itself as a key driver of global economic growth. The tourism industry exhibits a multiplier effect on the host country's economy by not only generating revenue in its domain but also creating new employment, increasing production, and boosting labor earnings through inter-industry linkages like transport, entertainment, hospitality, *etc.*

Degrees of impact vary according to the number of tourists, the resilience of the ecosystem to the pressure wrought by tourism, time, the changing fashions in tourism, and the transformational nature of tourism itself.

Transportation links the various destinations and ferries people, goods, and services. Tourism is all about travel; and the role of transportation in its operation is vital. It is largely due to the improvement of transportation that tourism has expanded. The advent of flight has shrunk the world, and the motor vehicle has made travel to anywhere possible. This reality coupled with changing work patterns and innovative marketing has driven international mass tourism through the years.

As well as transport, urban tourism has undergone a dramatic renewal since the 1980s. This revival has helped the city to regenerate its economy (after the industrial economic crisis of the 1970s and 1980s) and increase its growth and attractiveness of the city. The relationship between the city and tourism will then present a new but complex reality. This fact questions urban tourism in terms of its concept and contribution to urbanization. On the Mediterranean coast the island of Djerba, which is a pilot area, is an interesting case study for the issue of coastal urbanization and transport in relation to tourism development.

This report, as part of the Co-Evolve4BG project, aims to investigate the type of relationship that exists between these variables and the development of coastal tourism in the Mediterranean.

II. Tourism in Djerba Island

II.1. Introduction

The island has been considered as an idyllic tourist destination for centuries and has long occupied the place of tourists. Mainly, offering a genuine cultural and natural experience in a unique session that is far from the usual source of tourists on the island. Their general relative isolation gives rise to the notion of the island's perimeter, not only geographically but also politically and economically, according to which the administrative and economic centers get most of the economic benefits in return for the generation of the investment fund.

The small size and distance of islands from other areas account directly or indirectly for their distinctiveness. Such distinctiveness finds its expression in richness or poverty, in biodiversity and natural resources, in the range of economic activities and opportunities, in social and cultural patterns and traditions, in heritage associated with buildings, monuments and architecture, in land-use patterns and the scale of infrastructure and urban development, *etc.*

In this context, located in southeastern Tunisia, Djerba is one of the largest islands in North Africa and is Tunisia's main tourist destination. Djerba continued to experience the growth of the tourism industry by offering a variety of tourism activities in addition to increasing tourists and locals. Therefore, Djerba is an interesting case study for urbanization and coastal transport related to tourism development.

II.2. Study area

II.2.1. Island history

Djerba Island was once known by many names. Homere mentioned it from the 8th century BC, in his Odyssey during the visit of Ulysses to the island by designating it by the island of Lotophages eating lotus. During the 5th century BC, it bore the name of the island Phla. But from the 4th century BC, appeared the name of Meninx at the same time of the capital and name of the island. This name remained until the appearance of the name Girba mentioned on an inscription, found during the excavations of Fort Ghazi Mustapha, which dates to the 3rd century AD. Girba became Djerbah, then Djerba and it kept this name until today.

Since the 7th century BC, the island experienced a commercial boom and was a transit point between the sub-Saharan countries and the Mediterranean, under the aegis of Carthage. But, with the arrival of the Romans on the island around 46 BC., the economic life had further evolved, given the interest that the new conquerors gave to agriculture and essentially to the olive tree and the exploitation of its oil. Many of the rites and customs related to its practices have been inherited since that time and we keep some of their traces to the present day. At that time, the causeway connecting the island with the mainland was built and a dense implantation of olive trees was carried out. It was

during the first three centuries of the Christian era that the island experienced its greatest economic boom.

The 5th century AC experienced the Vandal invasion in the year 455 AD which touched Djerba like the rest of the country. Then the Byzantines invaded the island in the year 534 AD until the arrival of the Muslim Arabs.

Djerba was conquered by the Arabs in the year 667 AD under the reign of Mouawia Ibn Abi Sofiane by Ruwayfaa Ibn Thabeet Al Ansari. Thus, most of the island was converted to Islam and particularly to a puritan doctrine called Ibadism, which is one of the spiritual doctrines of Islam. She professes a sober religion and a strict return to the sources of Islam. Its name comes from one of its founders, Abd Allah Ben Ibad Al Murri Al Tamimi. Historically, it is linked to Kharidjism although politically and ideologically it was different.

The island experienced during the 11th and 12th century AD. J.C. successive Christian expeditions. Then the difficult days continued since Djerba was, during the 16th century AD. J.C, the theater of certain episodes of the conflict within the Mediterranean opposing Ottomans and Spaniards.

The famous Turkish corsair Khairuddin Barbarous, with his brother, took Djerba as a base for their maneuver in the Maghreb, on the orders of the Hafsid sovereign. As a result, the Spaniards launched an expedition against Djerba in the year 1520 and it was recovered in 1524 by the Ottomans, under the command of their governor in Tripoli, Darghouth Bacha.

The conflicts between the Ottomans and the Spaniards were only stopped on the island's soil after the decisive battle of 1560, during which Darghouth Bacha achieved victory thanks to the help of the Djerbians to close a dramatic episode in history of Djerba where it was pillaged and massacred.

After the victory of the Turks in 1560, local power was transferred from the Smoumni family, which reigned for more than three centuries, to a new family, the Ben Jloud, allies of the Turks, and this lasted from 1560 until 1759. The Ben Ayyèd family succeeded him during the Husseinite era. The political system had passed from the system of the Mechyakha, the status of the pious and learned man who arbitrates between the inhabitants, to the Gâyed, governor of the island charged by the Bey with collecting taxes.

The island, which remained until 1605 attached to the Turkish governor of Tripoli, became part of the Tunisian province. Thus, it was subject, like the whole country, respectively to the Mouradite and Husseinite dynasties until the establishment of the French protectorate in 1881.

During the period of the French protectorate, the Djerbians had largely contributed to the Tunisian national movement. After independence, the island became one of the most important tourist centers.

II.2.2. Djerba position

Djerba Island is in southern Tunisia (33°48'N; 10°51'E), in the Gulf of Gabes and in the Mediterranean Sea (Fig.1). Djerba belongs to the province of Medenine and It is about 500 km by road from the capital Tunis. The administrative capital of the island is a small town called Houmt-Souk. Djerba is served by two banks, The Ajim Canal side on the west side (about 2 km wide) and the Roman Bridge on the east side (El kantara width about 6 km). The presence of Djerba-Zarzis International Airport and road infrastructure helps to form an important tourism center and promote economic growth in the region. Additionally, the peninsula-shaped extension, Ras R'mal, is one of the main tourist attractions on the island.

The total area of Djerba Island is 514 km² and the total coastline is estimated to be 150 kilometers. The island is divided into 03 municipalities (Houmt Souk, Midoun, Ajim).

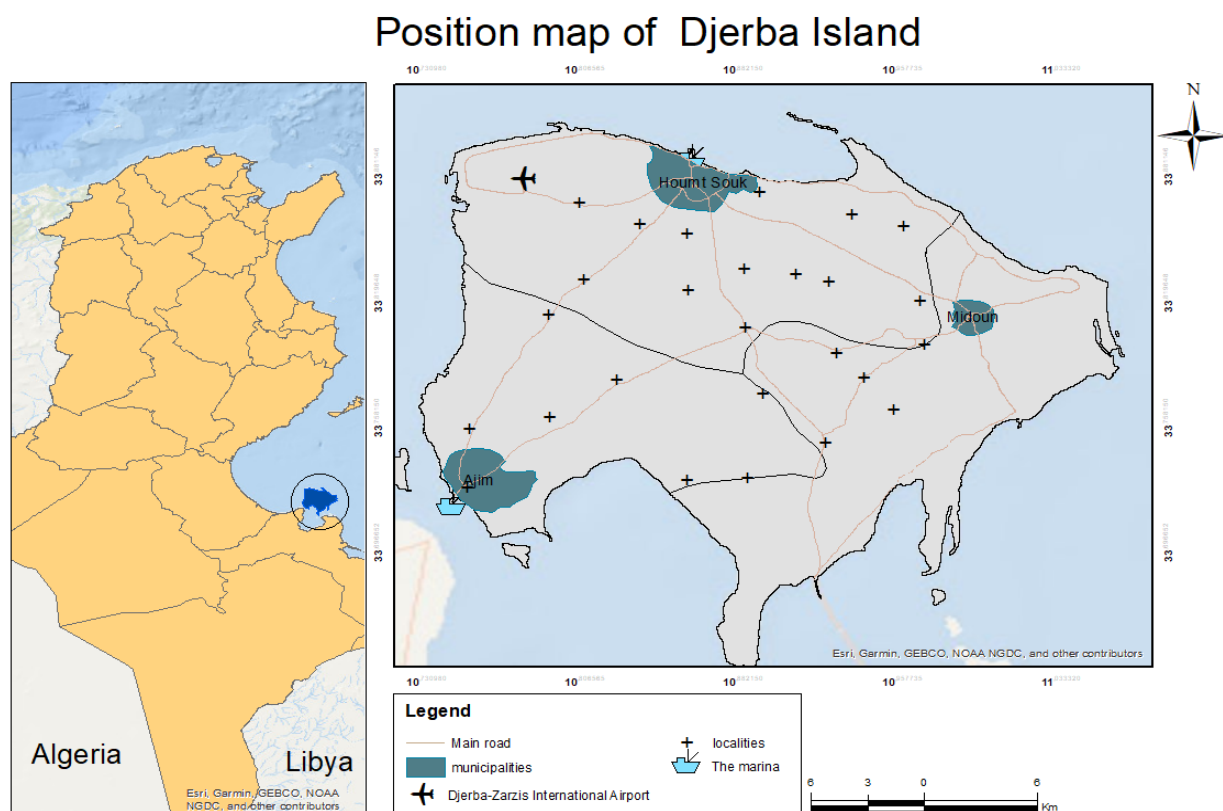


Figure 1. Djerba Island

The average height of Djerba is about 20 meters and the highest point is about 53 meters and is located at DhahretGuallala. There are no rivers on Djerba, there are few shallow wells with high salinity, and there is a shortage of water.

In 2014, Djerba Island was dispersed with 163726 inhabitants in three delegations.

- Houmet Souk delegate which represents the “capital” of the island with 75,904 inhabitants.
- Midoun delegate with 63,528 inhabitants.
- Ajim delegate with 24,294 residents.

Since 1980, Djerba’s main economic activity has been tourism. The agricultural sector at that time was mainly growing olive trees, dates, fruit trees and barley. 64% of total agricultural production income comes from Palm and Olive trees. In Djerba, industrial activities are not well developed, except for traditional leather tanning factories and craft manufacturing.

This activity plays an important role in the island’s economic and social life and is an important source of income for the islanders.

Tourism activities that have developed in Tunisia since independence are expected to increase rapidly in the future. Indeed, the natural beauty of the place, the rich past of the country, the hospitality, and the courtesy of the Tunisian people do not have many benefits that bring special developments to this activity.

II.2.3. The diversity of heritage Djerba Island

The great advantage of its tourism potential is that the natural and cultural environment overlaps in a mosaic, providing a very attractive, complete, and rich discovery product.

II.2.3.1. Natural diversity

The coastline: The coast is characterized by a low percentage of coast, mostly sandy beaches, mainly between Ras R’mel and Borg El Kastil. Djerba has about twenty kilometers of sandy beaches, located especially at the eastern end of the island, which pushed Gustave Flaubert to call it “the island of Golden Sands”. The most beautiful are in the north-east (Sidi Hacchani, Sidi Mahrez and Sidi Bakkour), in the east (between Sidi Garrous and Aghir), in the south (near Guallala) and in the west (Sidi Jmour). The island is adjacent to the hospitality side of 40 km. They have irregular plans, especially on the south side of the Ajim, Ras Terbella et de Borg El Kastil, peninsulas, built on tentacles, indicating the closest point to the continent. In fact, the Ajim Strait is only 2 km wide, while the El Kantara Strait is 6 km wide. Also, it is interrupted by a road that follows the route of the ancient Roman roads that connect Djerba to the mainland.

In addition to the beauty and vastness of its beaches, the strategic location of Djerba is worth mentioning. Due to its proximity to the south of Tunisia, tourists can enjoy the sea, desert, and sun at the same time.

The climate of the island: the island’s climate is sensitive to the effects of these two factors. In addition, the island’s nature of characterizes the Djarbian climate that “literature was blessed with the fifth season”, with mild temperatures due to the influence of the sea, averaging 12 degrees in January and 27 degrees in August.

The hot season lasts for 3.3 months from June 17th to September 26th, with an average daily maximum temperature of over 30 °C. The hottest month of the year in Djerba is August, with an average maximum temperature of 33 °C and a minimum temperature of 25 °C. The cool season lasts for 3.5 months from November 30th to March 13th, with an average daily maximum temperature of less than 20 °C. January is the coldest month of the year in Djerba, with an average minimum temperature of 10 degrees Celsius and a maximum temperature of 16 degrees Celsius.

Consequently, Djerba has a Mediterranean climate, with dry and hot summers, warm and relatively humid winters, and a tendency to be semi-dry.

The rainfall is low and most of the precipitation is concentrated between September and December. The rainy days do not exceed 4 days a year, knowing that this figure hides significant disparities because it may very well only rain 4 days in the year.

The humidity of maritime origin contributes through the dew effect to dampen the thermal gradients and makes it possible to obtain a very precious atmosphere of freshness during the summer season.

The rainy period of the year lasts for 6.3 months, from September 20 to March 30, with a rainfall of at least 0.5 inches over a sliding period of 31 days. The wettest month in Djerba is December, with an average rainfall of 24 millimeters.

The rainless period of the year lasts for 5.7 months, from March 30 to September 20. The driest month in Djerba is July, with an average rainfall of 0 millimeters.

These natural diversities play a predominant role in the success of Djerba's tourist image and Djerbian benefit from these assets through a wide range of activities offered to them.

II.2.3.2. Cultural diversity

Very conservative, the Djerbians have kept their customs, their traditions, and their architectural techniques which in some cases date back to antiquity. Djerba draws its originality from its insularity, the consequences of which affect not only all the data of the natural environment, but also the history of the island and the Djerbian personality. Indeed, Djerba benefits from an ethnic mix and a historical evolution which gives the island a unique cultural and heritage richness (Table 1).

From its past, Djerba still has an architectural composition charged with social meanings. Indeed, a particular habitat, organized and dispersed, characterizes the landscape of Djerba. This landscape is the result of the slow and methodical organization of human space and reflects a way of life and significant social relations.

The dispersion of the habitat has a historical reason. Indeed, the Djerbians had to undergo repeated attacks from the sea. They therefore moved away from the coast and dispersed into the countryside (Table 2).

In addition, their essentially agrarian type of activity a continual presence and a repetition of the habitat around the water points.

Moreover, the Djarbian has a rather individualistic character. The mosques constitute a structuring element of the traditional rural space. Thus, the whole of the island is covered with religious buildings, which reveals an island space deeply marked by the sacred and a population deeply attached to its territory.

The buildings there are traditionally isolated and sparse except for three habitat groups: Houmt-Souk (which developed thanks to the souk, whose emergence is explained by the defensive and port character of the site). Hara kebira (big one) and Hara Sghira (small one), both inhabited by the Jewish minority, the latter engaged in trade and craft activities, which are generally located in the cities.

On this dispersion of the habitat is superimposed an organization of the hierarchical space in nested levels, which begins at the level of Menzel and leads to the whole of the island. The Menzel constitutes the basic cell of the spatial organization of the island. It represents the residential and functional space in which the family lives and organizes itself. It is made up of one or more “Houch” and elements of economic life: orchards, fields, but also weaving workshops, attics, wells, and the cistern, essential to family life.

Menzel integrates its population with its agricultural environment. Surrounded by a “Tabia”, which is organized as a defensive site. The “Tabia” protects the soil, crops and from the wind. It also has a separating function like the walls in a medina.

This type of dwelling and particular to the island, traditional “Houch” comes in the form of a rectangular building with a dazzling swing whose striking element is the square elevation, at each corner of the house giving rise to 4 small towers, with a former purpose of fortifications. The framework of community life, the “Houma” and “the mosque” different from the traditional habitat. Families live according to their origin, in isolation in a particular Houma.

The various civilizations and cultures that have crossed the history of Djerba (Arabs, Berber, Jews, *etc.*) and formed a diverse and international population. The people of Djerba come from different countries across the three continents of Africa, Asia, and Europe. Cocktails of this culture are only rich in value. There is little racism because everyone has learned to live in peace with their neighbors.

Table 1. Origin of the Djarbian population

Population	Origin
Arab population	Middle Arab and Arabian Peninsula
Jewish population of Hara Sghira	Palestine and Mesopotamia
Jewish population of Hara Kebira	Spain, Turkey, Libya, Syria
Black population	Sudan and Niger
Berber population	North Africa

Table 2. Population distribution by municipality Djerba

Year Municipality	2004	2014	2020
Houmt Souk	64919	75904	83470
Midoun	50459	63528	72291
Ajim	24166	24294	24865

Overall, Djerba's environment is an urban structure. The elements of nature themselves are constructed and structured by humans. Whether they are "tabias" or plantation arrangements, they are an integral part of the architectural composition and are full of social significance. Thus, when coming to Djerba, tourists can discover the unique architectural heritage and cultural and civilized features of Djerba, an island space born of a long historical development.

II.2.3.3. Djerbian Economy (Productive System)

Djerba has enjoyed famous prosperity over the centuries of its history. Despite the harshness of the area and its drought, the inhabitants were able to adapt their environment to exploit and meet their needs (Agriculture, fishing, crafts, *etc.*). The diversity of the island's economic activities is noteworthy.

1. Agriculture

Agriculture is built on the use of local and regional eco-systems, whilst its main objects of labor represent 'living nature'.

Basically, agriculture is a rudimentary and underdeveloped activity, which can be explained by poor soil quality. However, Mahbubani (a village located 19 km from Houmt Souk and 4 km from Midoun, one of the island's most beautiful gardens), Mai and Midoun due to the weakness of the irrigation system under the control of the brackish waters, at low altitudes on the island. Thus, Djerba is characterized above all by an ungrateful nature, marked by insufficient water resources. The island has no hydrographic network, and its water tables are quite insufficient to meet the needs.

The focus is on agriculture, and therefore mainly on dry crops: the cereals occupy 3000 hectares or 6% of the surface of the island, while the palm groves cover 12,063 hectares 23%. In 1974 there were 1 million palm trees (according to the Development Planning Bureau). Border arboriculture is dominated by olive trees at 90% and managed extensively. It occupies a little over 20,000 hectares, or 38% of the territory for 500,000 olive trees. In addition, agriculture employed 3,916 people, or 27% of the total working population, according to the Department of Development and Planning, 15% of whom are from outside the island. It is necessary to add to these numbers many weavers who convert for a few months of the year into laborers and fishermen.

2. Fishing

The coastline and the position of the island have always favored fishing and its related activities.

It was therefore natural that since antiquity the Djerbian was tempted by fishing more pleasant as it proved to be a source of profit, and that, from father to son.

Like agriculture, fishing is an important activity in the daily life of the Djerbian. The sea surrounding the island offers an impressive variety of fish, invertebrates, crustaceans, shells, and sponges. The Djerbian derives great benefit from this natural wealth thanks to the methods he has been able to invent and adapt to natural data.

Agriculture is a critical and relatively resilient sector in the face of economic and social tensions. In Tunisia, the agriculture and fisheries sector remain economically and socio-politically important as it contributes to national goals related to food security, income generation, employment, regional balance, and natural resource management. In 2017, the agricultural and fishery sector contributed 10% of GDP, with an average annual growth rate of 2.8% during 2011-2017, much higher than the national GDP.

3. Craft

- Pottery:

Pottery is an old traditional activity in Guallala in the clay lands of the southern part of the island. Djerbian potters have encountered difficulties in adapting to a profession that no longer attracts young people, who consider it too difficult and unprofitable.

- Weaving

Weaving, which was the pride of Djerba and which for a long time allowed it to be the hub of wool from southern Tunisia, and which is also in decline. This regression is explained by competition from industrial products, the loss of foreign markets such as Libya and the scarcity of labor attracted by the emerging tourism or emigration. The weaving of woolen blankets and spinning are the main weaving activities. The two were no longer successful. For instance, Djerbian coverage, a very old activity in Djerba, has increasingly lost its workforce. The work being hard and poorly paid; it is not very attractive for young people.

II.2.3.4. Tourism in Djerba Island

In Tunisia, tourism was not a state policy priority until the first half of the 1960s.

Tourism played a secondary role in the political program. The success of tourism in 1964 prompted the government to change its strategy and place more emphasis on this sector. In 1965, a tourism plan was formulated. The state is increasingly disengaging from direct investment in tourism and encouraging private and foreign investors to invest in the sector. Decree No. 66-339 of September 2, 1966, provides investors with important tourist facilities. At the time, this sector was a step backward compared to

the tight state control over other sectors of the economy. The main areas of tourism investment are Hammamet, Nabeul, Sousse, Monastir and Djerba-Zarzis.

Tourism in Djerba began in 1954, when Club Med founder Gilbert Trigano purchased a piece of land on which to build a village of palm houses. The tourist area of Djerba stretches over 20 kilometers from Aghir in the south to Houmt Souk in the north.

The number of hotels in Djerba is 89 (30 in Houmt Souk and 59 in Midoun); they are categorized from one to five stars. Hotel capacity increased from 8,300 beds in 1975 to 39,000 beds in 2002 and 42,748 beds in 2012. The number of tourists visiting Djerba in 2012 was 9 069 132; the number of overnight stays was 6,392,117. Tourism on the island of Djerba is very important to the Tunisian economy, mainly because of employment opportunities and foreign exchange inflows.

Top Attractions in Djerba Island

An island tour will tell tourists where they are interested.

To start with, visit the 7km-long Roman road that connects the island and the mainland, the village of Guallala and its museums with the popular pottery tradition, and the Griba synagogue. And it is highly recommended to visit its magnificent architecture, Houmt Souk city center and its charming handicrafts.

As a true cultural crossroads with mosques and fortresses, Djerba is an ideal starting point for exploring the desert and Sahara of Tunisia. Moreover, the dream island Djerba invites tourists to the magical world by attending the various tourist attractions such as the thematic evenings offered at the Djerba explore park. The evenings are pleasant for individuals, groups and families with the majestic decor and the warm welcome in the form of a show. They will have the choice between an evening of Arab-Andalusian and Malouf music, an evening of Tunisian music, an evening of discovery of Eastern art, an evening under Berber tents to the rhythm of dance and folk music, an evening of oriental style and the Medina evening with show and traditional souk atmosphere (Fig.2). In addition, in Djerba, you can spend half a day or a day off the coast on a vibrant sightseeing vacation or a friendly pirate boat excursion, enjoying the refreshing sea air and relaxing with popular entertainment. The marina of Houmt Souk will be the starting point for the ideal boat trip animated by the members of the crew until the arrival at the peninsula of the Pink Flamingos.

The atmosphere on board and a typical lunch are comfortable for a group of friends and family to satisfy young and old. A refreshing swim during this mini cruise to the Pink Flamingo Island and the possibility of a fisherman's net fishing demonstration.

Top Attractions in Djerba Island

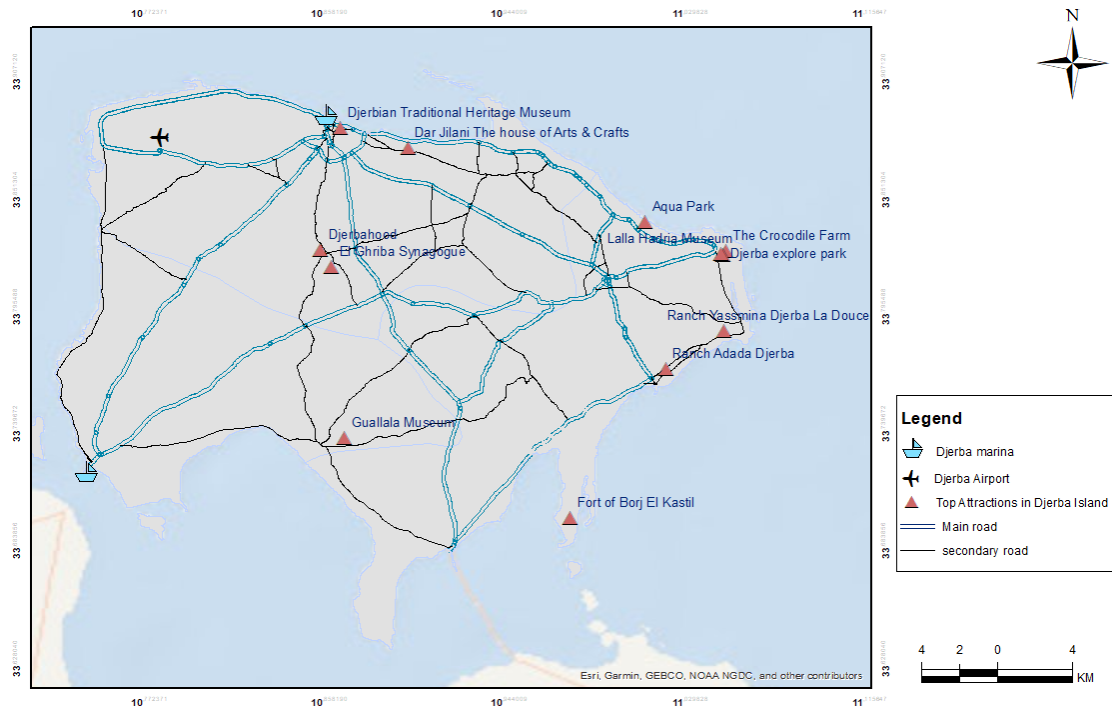


Figure 2. Top Attractions in Djerba Island

III. Transports and accessibility - Djerba Scale

III.1. Introduction

Djerba is an island. Its international airport has contributed to the growth of mass cruises. Alternatively, domestic tourists reach the island by ferry or the Roman road. About moving to the island, tourists use taxis. On the other hand, locals use private buses and cars.

Regarding the internal transportation system on the island, the transportation system causes certain annoyances to the urban environment: noise, pollution, danger, energy loss, not to mention the problems of communication approach and park. A sustainable island can only be formed by promoting alternatives to individual motorized transport, by coordinating different modes of movement in multimodal systems, and by promoting encourage the use of public transport and soft transportation. In this sense, a cycling scheme, currently being drawn up, is an opportunity to seize, but also an overhaul of the public transport organization. To limit transport demand and avoid the use of private cars, it is essential to improve the connectivity and internal accessibility of the road network. Routes that avoid East-West can avoid the need to travel between urban centers.

Djerba, being an island territory, has access restrictions. Means of transport certainly contribute to the development of tourism activities. Air transport has played an important role in the development of international mass tourism. Thus, infrastructure and all land transport (except for train that is not included in our study area) allow tourists to visit the island of Djerba.

III.2. Main issues of transport and accessibility

The accessibility by means of transport in Djerba Island is an important factor for the development of tourism.

III.2.1. Accessible transport infrastructure

The island is very close to the mainland via two outposts: one west of Jorf on the mainland at Ajim, and east of Zarziss on the mainland at El Kantara. Djerba increasingly sees itself as a peninsula rather than an island. However, the main tourist flows arrive in Djerba by plane.

- Roman Road: From the south of the island through El Kantara to the Zarziss peninsula, connecting Djerba and the mainland. It is 7.5km long and has existed since the Punic era, but it was converted into a real connecting road during the Roman era. Since 1973, the drinking water pipe has been expanded by about 10 m to reach Djerba (PNU / PAM, 2011).

- The ferry between Jorf and Ajim: For travellers coming from the north, this is the fastest route. The crossing, about 2.5 km long, takes 15 minutes. There is a ferry every 15 minutes, 24 hours a day.
- The airport: In Tunisia, airports have been set up in all tourist areas or near the accommodation to which holidaymakers are transferred; the airport-hotel transfer should never exceed 60 minutes. The place in the plane constitutes a key element in the tourist package; each tourist needs a bed, and each bed needs a plane seat; the development of air transport has been the main factor which has participated in the development of the destinations.
- The international airport of Djerba-Zarziss is located 9 kilometers west of Houmet Souk, near the town of Mellita. During the Second World War, the airport served as a strategic base for the Allies. From 1960 onwards, the airport underwent a series of works and since 1970; it has become one of the main international airports in the country. The development of mass tourism has obviously been at the basis of this evolution.

The South-East region is served by the airport of Djerba-Zarziss, the international airport of Sfax Thyna, and the airport of Gabes Matamata. On the other hand, the airport of Djerba remains the most touristic and the most active. It covers an area of 295 hectares. It is backed by a (73,000 m²) terminal building that can accommodate 4,500,000 passengers per year. The airport's activity is essentially linked to the transport of tourists visiting the island. OCAA is the body responsible for managing the airport. The OCAA is a public law company which operates in the civil aviation and commercial fields.

The airport has a capacity of 4,000,000 passengers per year; its activity is essentially linked to the routing of tourists visiting Djerba and its region. It is served by 20 airlines, including 3 national ones: Tunisair, Tunisair-express and Nouvelair.

III.2.2. Island accessibility challenges

III.2.2.1. Land transport and accessibility of the island

Land transport provides transportation for tourists and employees to and from Djerba. Regional companies provide trips to Gabes, Sfax and Gafsa, with most trips to Gabes being made by the Regional Transport Company of Medenine and Gabes (RTC) (Table 3).

Table 3. Lines of the Irrigation Services for the transport of people (DGAT/APAL/ UNDP: 2019).

Place	Society	Destination		
		Gabes	Sfax	Gabes
Djerba bus station	SRT Medenine	3	1	1
	SRT Gabes	4	--	--
	SRT Sfax	--	1	--
	SRT Gafsa	--	--	1

The national road transport bus companies (SNTRI and STC) operate trips from the Djerba bus station to Tunis and Bizerte via Sfax and Sousse (Table 4).

Table 4. Lines of regular passenger transport services (National Companies) (DGAT/APAL/UNDP: 2019.)

Place	Society	Destination			
		Tunis	Sfax	Sousse	Bizerte
Djerba bus station	SNTRI	4	1	1	2
	STC	2	-	-	-

Public transport links Djerba with the major Tunisian cities: Tunis, Sousse, Sfax and Gabes contribute to the development of national tourism on the island.

III.2.2.2. Road network in the interior of the island

The road network has 742.2 km of roads, of which only 59% are paved. Moreover, this island territory is endowed with few national roads, but it is relatively well endowed with regional roads in comparison with other regions. National roads account for only 3% of the total existing road infrastructure on the island. Most of the road infrastructure consists of agricultural tracks, followed by numbered roads, local roads and regional roads.

In terms of paved roads, especially of the local and regional type, the commune of Midoun is the best off as it has the advantage of being a tourist commune. With 68.51 km of local roads, it is the best connected and integrated with the rest of the island territory. Its tourist road, which connects the hotel units located on the coast, is the most important infrastructure on the scale of its territory. To this end, the local roads are concentrated in the east of the island, particularly around the tourist area and along the entire coastal area of the east, north and south of the island (Table 5). The network of local roads is not developed to the same degree in the western part and particularly in the municipality of Ajim.

Table 5. The road network in 2019

Delegation	Total		Agricultural tracks		Local. R		Regional. R		National. R		Numbered roads	
	N.B	B	N.B	B	N.B	B	N.B	B	N.B	B	N.B	B
Houmet Souk	104.94	186.91	104.94	107.54	0.00	50.75	0.00	28.62	0.00	0.00	0.00	79.37
Midoun	78.90	183.91	78.90	78.40	0.00	68.51	0.00	37.00	0.00	0.00	0.00	105.51
Ajim	78.40	115.75	78.40	70.25	0.00	32.00	0.00	13.50	0.00	0.00	0.00	45.50
Djerba Island	262.40	486.57	262.2	256.19	0.00	151.26	0.00	79.12	0.00	0.00	0.00	230.38
Medenine Governorate Total	2,922.68	2,563.61	2,179.90	1,293.89	703.01	549.22	49.30	549.37	0.00	171.06	752.31	1,269.75

Minister of Economy, Finance, and Investment Support / Office of Southern Development, 2019

B: Bitumen

N.B: No Bitumen

The regional roads are formed by the RR117, RR209, RR116, and RR16E which ensure, firstly, the connection between the main urban centers of the communes of Midoun, Houmt Souk, and Ajim, and secondly, the connection between the island and the continent. On the other hand, the road link between Djerba and the mainland is provided only by the RR117, which starts at Houmt Souk, crosses the center of the island, and leads to Zarzis from the south-east (see the road network map in Fig.3).

Djerba road map

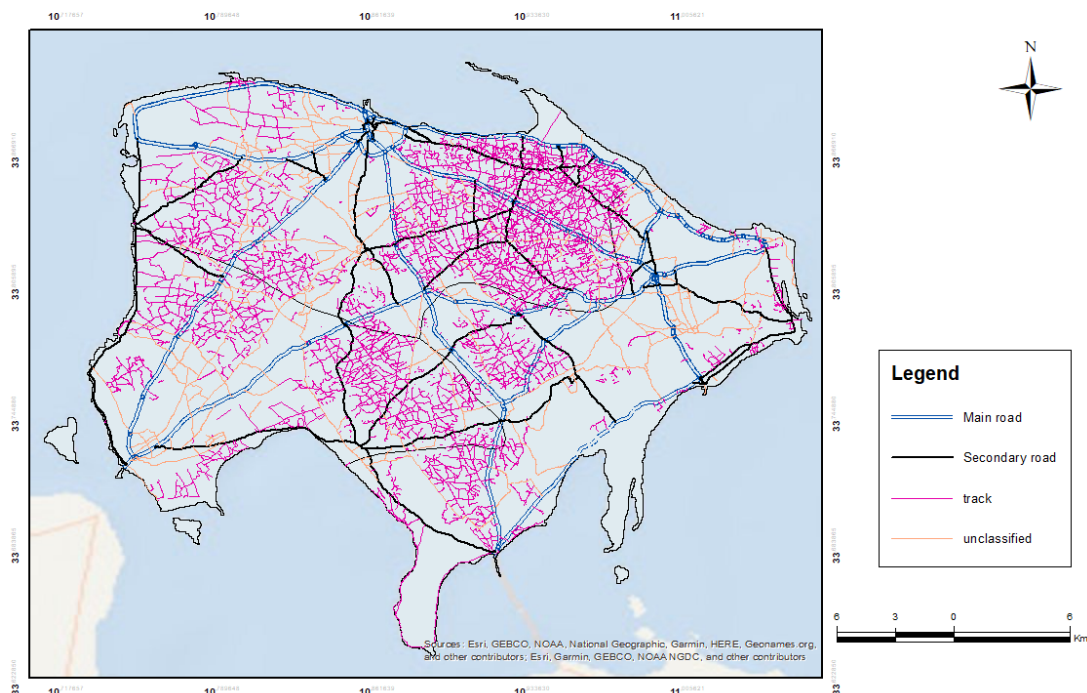


Figure 3. Roads Map

The analysis of the existing road network shows that the connectivity and accessibility within the island needs to be improved. Indeed, the residential areas located within the large road networks are poorly served by local roads. The organization of the road network is unbalanced, which results in a network of undeveloped tracks where houses are built, and access is difficult and painful. As a result, access to public transport also remains inefficient, due to the remoteness of the access points to the public transport network because of the spatial organization of the built environment and the layout of the road network. Finally, the impact of land transport on air quality remains low and unevenly distributed like road infrastructure.

III.2.2.3. Public transport network

The total number of bus stations is about 168, of which more than 90% are located on classified roads. Similarly, most of these stops are located on local and unclassified roads; this means that most of the traffic on unclassified roads is driven by individual vehicles and that the demand for public transport is located not on the main transport arteries, but rather in the internal parts of the road network (Fig.4). In addition, there are populated, but unserved areas within the major road network. Similarly, for the road network, the public bus transport network is concentrated in the North, Center, and East of the island, given the concentration of economic, tourist and commercial activities and that the two main urban centers of the island: Houmet souk and Midoun are located respectively in the North and East. The map of the transport network consists mainly of

two radiations around two nuclei: Houmt Souk and secondarily Midoun. The projected transport lines attempt to improve the integration of the southern part of the island, which remains poorly connected.

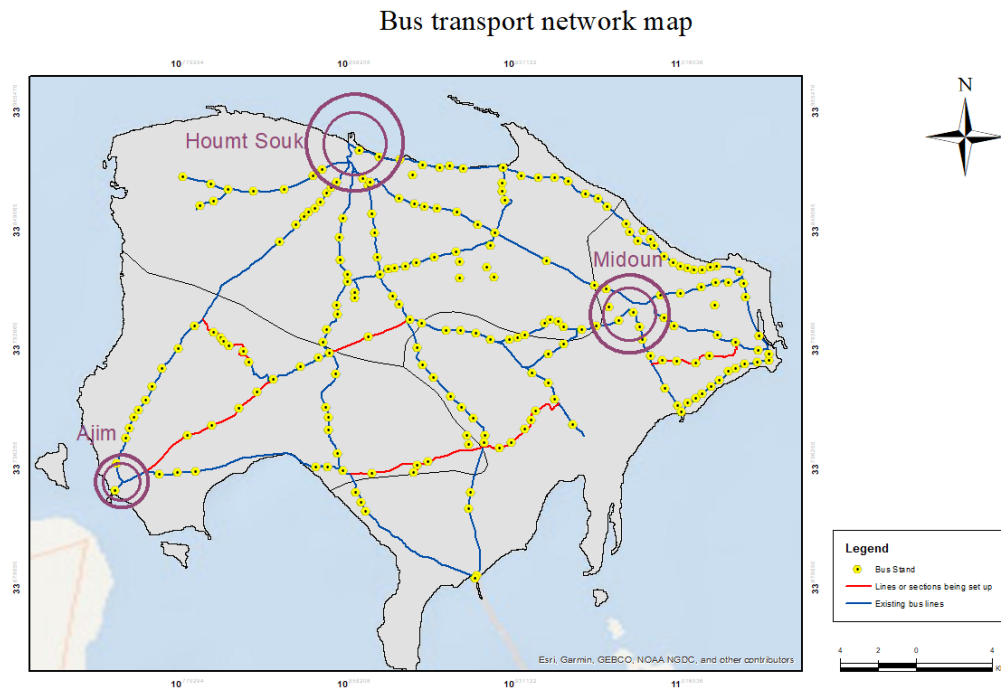


Figure 4. Bus transport network Map

The data provided on the public bus network, which is the most used public transport network, lacks some data that would allow the identification of opportunities for service improvement. In addition, the existing data do not provide information on travel time.

III.2.3. The transport effect on tourism

III.2.3.1. Air transport

The share of Djerba Zarziss airport does not exceed 16.50 % of the total national air traffic. The flights in Djerba airport are of regular or charter type. The latter type concerns flights that are chartered by Tours Operators. Flights are almost equal between the two types. Air traffic is dominated by traffic to and from outside the national territory, linked to international tourist flows (Table 6).

Table 6. Nature of air traffic in Djerba (TONT, 2019)

Air Traffic (planes)	International		National	Total
	Regular	Not regular		
Djerba	6,437	6,481	2,340	15,258
Total national	64,609	18,950	8,888	92,447

In terms of passengers, the share of Djerba-Zarziss airport exceeds 2 million in 2019, which represents nearly 17.26% of the national total. Thus, passengers transported by non-scheduled flights (charter) represent nearly 51% of passengers (Table 7). On the other hand, passengers on domestic flights represent only about 8% of the total passengers.

Table 7. Air transport passengers in Djerba

Passenger	International		National	Total
	Regular	Not regular		
Djerba	824,969	1,028,913	160,707	2,014,589
Total national	8,040,297	3,238,307	393,241	11,671,845

TONT, 2019

The passengers of the stopovers counted only 27429, the majority of which are from regular flights 69% of which are from Tunis-Carthage airport (Table 8).

Table 8. Air transport stopover passengers in Djerba (TONT, 2019)

Stop-over passengers	International		National	Total
	Regular	Not regular		
Djerba	18,957	7,852	620	27,429
Total national	47,344	22,797	22,112	92,253

The airport of Djerba-Zarziss remains a predominantly tourist airport. It is the main transport facility for opening to the international environment and developing mass tourism.

III.2.3.2. Public transport related to tourism development and road traffic

In terms of public transport of people, the highest number of buses is in Houmet Souk with 70% of the total number. This is because the number of this is due to the fact that the number of passengers (per ticket, subscribers, pupils and students) is highest in Houmet Souk with a total of 6364000 trips, which accounts for 66% of the total number of trips on the island of Djerba (Table 9). These buses, which belong to the regional transport company in Medenine, mainly transport employees and rarely tourists. The latter mainly use private taxis when travelling around the island of Djerba.

Table 9.Transport of people

	Regular passenger transports SRT Medenine			No regular passenger transports		
Agency	Houmet Souk	Midoun	Total	Taxis	Rental	
Number of passengers per ticket	2,125,000	783,000	2,908,000	859 vehicles	Intra-governorate	Intra-governorate
Number of subscribed passengers	591,000	140,000	731,000		37 vehicles	39 vehicles
Number of pupils and students	3,648,000	2,291,000	5,939,000			
Number of buses	41	17	58			

TONT, 2019

The weakness of public transport and the tourist aspect of Djerba make the private car the primary means of transport on the island. In addition, there is truck traffic for the transport of all types of goods. The road traffic map below illustrates the average daily flow of motorized traffic. The analysis studies the road traffic on the main regional and local roads, revealing that most of the traffic is generated by the arrivals from Jerba-Zarzis international airport to the tourist area. Zarzis international airport to the tourist area via Mellita and Houmt Souk (more than 14,000 vehicles/day). The coastal dual carriageway facilitates the flows, despite the bottleneck on the unfinished Houmt Souk bypass.

In second position comes the continental traffic coming, rather, from the Roman road and (more than 7,000 vehicles/day), which is exactly half of the traffic between the airport and the tourist area.

The traffic map divides the island into two distinct territories: the traffic remains confined to the whole of the eastern and central part, which includes the main towns and tourist areas. The south-western side remains empty and has a lower flow of traffic, although Ajim is the ferry docking point there.

Faced with the problem of waiting for ferries, which sometimes exceeds 3 hours during the summer season, the Roman road is increasingly used.

III.2.3.3. Maritime transport and the effect on tourism

In Djerba, maritime activity has declined compared to what the island had known until the end of the 19th century. The port of Houmt Souk served the island and a large part of south-eastern Tunisia (Table 10). The island was already connected to other ports in the country and to many foreign ports such as Alexandria and Istanbul. In 1966, imports through the port of Houmt Souk amounted to 40,000 tons and outflows to 2,000 tons.

At present, the existing port infrastructure in Houmt Souk consists of a marina, which is made up of a marina and a port complex, being built next to the fishing port. The role of the marina is limited to tourist activities and sometimes its role is that of a boarding station for yachts and pleasure or sports boats. The fishing harbour is nevertheless the most important on the island (Fig.5).

The marina of Djerba Houmt Souk has a capacity of 100 beds. It is the final piece in a chain of 9 marinas in Tunisia.

Table 10. Marina's capacity in Tunisia (TONT, Tunisian Tourism Barometer, 2019)

Ports	Rings
Tabarka	140
Bizerte	800
Gammarth	466
Bou Said	400
Yasmine Hamma- met	720
Port El Kantaoui	340
Monastir	300
HoumtSouk (Djerba)	100
Total	

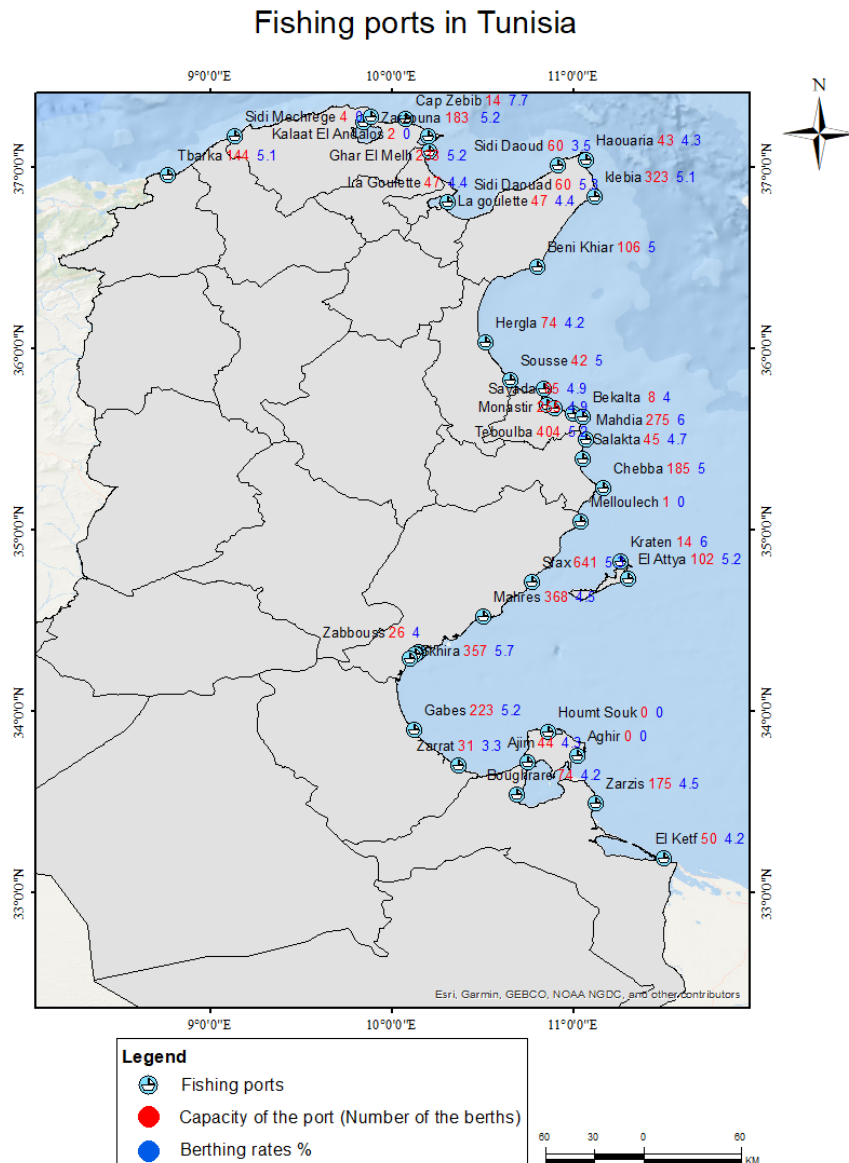


Figure 5. Fishing ports in Tunisia

Regarding expenditure, no one can deny that the activity is a strong generator of foreign currency. In the opinion of the professionals, a 40-meter boat needs two rental cars, a bus for the staff: about 4 to 5 thousand dinars for supplies, 100 thousand liters of diesel, and boat maintenance. In 15 days, the boat can leave 40 thousand dinars in Tunisia, and that's a minimum figure that no hotel can achieve in such a short time. In terms of formalities which complicate the development of yachting in Tunisia, the problem of the acquisition and registration of boats is mentioned. They obey tremendously and above all long formalities. To register or buy a boat, the person

concerned must undergo a police investigation. According to professionals, one can only detect a major problem of communication, raising the awareness of the customs agents, the Ministry of the Interior and the other administrations involved in the activity, but also of training in seafaring professions. For some professionals, the question of procedures in some ports is due to overzealous agents.

It is true that on the side of the State and the administration, there is a certain awareness of the importance of yachting tourism as an activity which generates foreign currency income. Nevertheless, on the one hand there is a desire to develop it, on the other hand there are fears linked to illegal immigration which hamper initiatives.

The problem of communication exists at all levels. It would perhaps be interesting to start by talking to each other, by communicating, explaining, and raising the awareness of the law enforcement agents on the issue of pleasure tourism since the brand image of the destination is at stake. In this sense, the very young Chamber of Nautical Industries, recently created within UTICA, has its work cut out for it, notably to open the debate, to make people understand what pleasure boating tourism is, to be distinguished imperatively from the merchant navy, and to explain the imperatives, the problems, and the constraints. It would also be interesting for the professionals to group together within a Federation so that they can become a real force for proposals.

On the scale of Djerba, a second port is in Ajim to the southwest of Djerba. It has two components: maritime transport via ferries going back and forth between the island and the mainland and fishing (Fig.6).

Most of the maritime transport is currently done by transshipment of vehicles and passengers by ferries between Ajim and Jorf. Most of the traffic is carried out by light vehicles, some heavy vehicles, and two-wheelers. Ferry traffic changes according to the seasons, so during the high tourist season, the maritime transport flows are the most coveted.

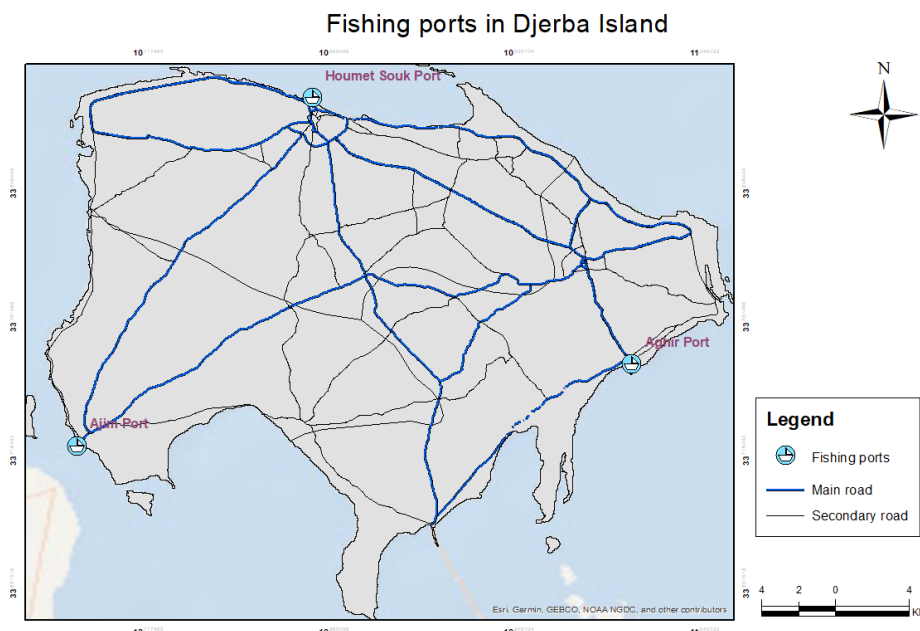


Figure 6. Fishing ports in Djerba Island

III.2.4. Policies and programs to manage transport issues

III.2.4.1. Accessibility and traffic problems

Due to its location on the island, Djerba is necessarily an area that is accessible by sea, even if its insularity has become relative due to its gradual attachment to the mainland, both in natural and human terms. By turning more and more towards the continent,

Djerba and the Djerbians have relatively severed their ancestral ties with the sea and with the maritime relations that linked them to the peoples and economies of the overseas territories.

Access to the island by ferry is both a picturesque aspect of Djerba's charm and a constraint on the flow of traffic for those who choose to approach the island by sea.

The long queues are becoming increasingly restrictive during busy periods (summer period, school holidays, festivals, *etc.*). The increase in the number and modernization of ferries and transshipment facilities has proved insufficient to limit bottlenecks. The prospects for an increase in road traffic from the mainland in the near and distant future point to a long-term saturation of the ferries currently in use.

The existing road on the side of the Roman causeway to the south-east polarizes most of the flows access to the island. Flows on the south-west side managed by the ferry system are lower and represent approximately half. However, the link between Ajim and Jorf is less busy and waiting times can be as long as 3.5 hours at peak times peak period. In addition, the existing ferry system is characterized by recurrent malfunctions and breakdowns, which hamper its performance. A study is underway to build a 2.45 km bridge to link Ajim and Jorf.

The bridge would be an extension of the RR116 to the mainland. The capital will be provided in the form of a loan from the Chinese government of 317 million euros (corresponding to 1074 million dinars in April 2019) with an overall interest rate of 3% and an annual interest rate of 1.75%, for which the Tunisian government would provide.

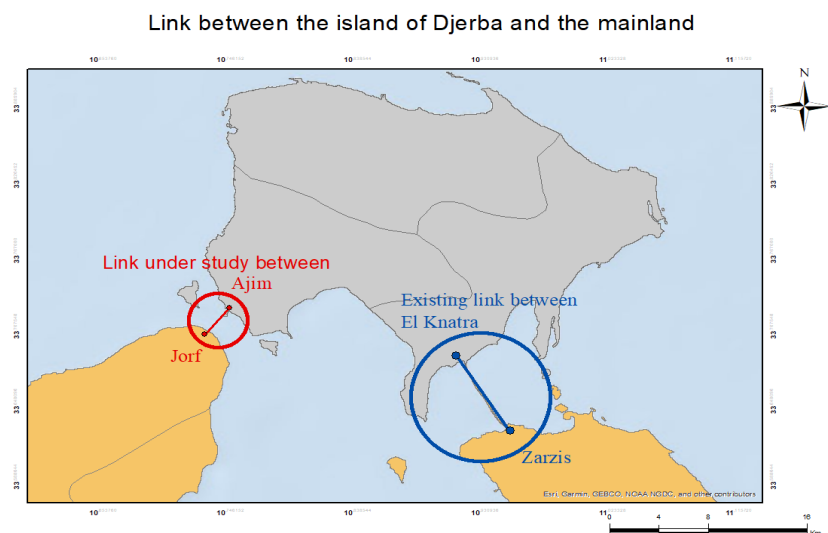


Figure 7. Link between Djerba Island and the mainland

A preliminary feasibility study identified the entire island of Djerba and the connecting area of the bridge between Jorf and Ajim as the affected area. It is important to remember that the types of travel are categorized as follows in this survey: 42% are for work, 34% are for personal business, and 23% are for leisure.

Therefore, the main objectives of the project are:

- To improve the accessibility and attractiveness of the island of Djerba and further promote the tourism.
- Promote economic activities and trade between the island and the mainland.
- Improving the movement of people and vehicles to provide road users with greater safety and efficiency.

The challenges associated with the construction of a bridge would be:

- Impacts on landscape features.
- Impacts on the natural environment of the lagoon.
- Urban insertion of the bridge's intersection points with the island and the mainland.
- The use of demolitions of existing buildings and land expropriations on behalf of the State.

A second alternative to the bridge construction project would be the strengthening of the existing ferry system, currently managed and operated by the division of the pre-feasibility study has been completed. The pre-feasibility study identified 3 ferry berths. In this scenario, an increase in the number of containers and an expansion of the vehicle boarding areas can be envisaged with a view to increasing the current level of service, namely: boarding frequency and payload in the containers.

The possibilities are:

- Harmonious integration into the natural and urban landscape of the impact area
- Reduction of travel time

The challenges are:

- Service inefficiencies due to reduced capacity of existing infrastructure
- Service slowness
- No trucks are allowed.
- Ecological impact due to discharge of pollutants and carbon dioxide emissions

III.2.4.2. Impact of transport on the environment

In consonance with a study on Tourism and Environmental Health in Changing Climates, Tunisia does not have a system to monitor urban particulate matter (PM) pollution, making it difficult to assess the impact of specific activities. In this case, in the tourism sector of Djerba. The fact that Djerba uses natural gas as its source of power reduces the effects of air pollution. Therefore, it was more important to look at transport-related emissions. Tourism-related activities within tourist areas, especially air pollution from the use of energy for transportation, are generally under-researched areas. A study in Mallorca that investigated air pollution from tourism found that, in addition to meteorological variables, tourism was also a determinant of the island's PM10 concentration. Specifically, researchers estimated that a 1% increase in tourist numbers could be associated with an increase in PM levels of up to 0.45%.

Particulate matter (PM), also known as particle contamination, is a complex mixture of very small particles and droplets that float in the air. Particulate matter contamination can be divided into two categories. PM10 is a breathable particle generally less than 10 microns in diameter, and PM2.5 is a fine breathable particle generally less than 2.5 microns in diameter. When inhaled, these particles affect the heart and lungs and can cause serious health effects. PM2.5 is a bigger concern because these particles deposit deep into the alveoli, causing inflammation and even being small enough to enter the bloodstream.

The data obtained in Djerba can be used to estimate PM10 emissions from various sources related to tourism activities, although the results cannot be correlated, they provide the best indicators of pollution sources. Since the peak of tourism activity on Djerba occurs in the summer, we estimated total PM emissions from the summer months. The activities included in this analysis were electricity and LPG, taxi use, waste transportation, and transportation related to hotel supply (Fig.8).

According to the Study of Tourism and Environmental Health in Climate Change, transporting tourists by taxi is the number one source of tourism-related PM10 emissions on Djerba Island.

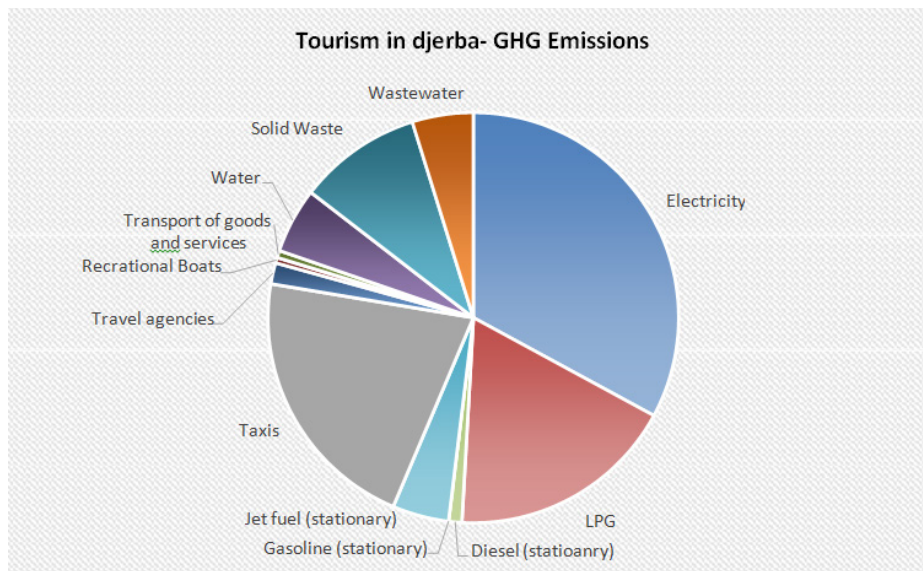


Figure 8. PM10 emissions from Tunisia Djerba

Conforming to this study, the average nightly CO₂ emissions of tourists in Djerba were estimated to be 25 kg CO₂ in 2017. These GHG emissions include all major tourism-related direct emissions generated within the destination, as well as 25 GHG emissions from power generation that meet the electricity needs of the tourism industry. According to the same study, total CO₂ emissions from tourism in Djerba are estimated to be 100330 tons per year. Electricity is the largest contributor, followed by tourism transportation by LPG and taxi within the destination, followed by solid waste, wastewater, desalination, and aircraft emissions. Tourists' CO₂ emissions per night are more than three times the daily CO₂ emissions of Tunisia (equivalent to 7.69 kg CO₂). This means that if tourism on Djerba continues normally, it will not follow the decarbonization path that Tunisia has promised in the NDC (carbon intensity reduced by 41% by 2030; Fig.9).

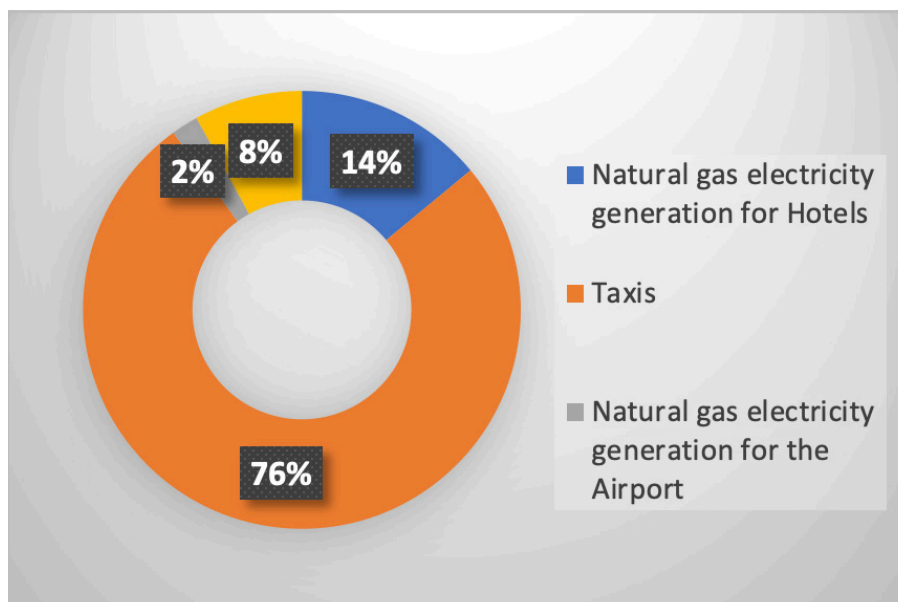


Figure 9. Tourism in Djerba GHG emissions

III.2.5. Blue Economy and Transport in the context of sustainable Coastal/Maritime Tourism development

III.2.5.1. Opening without nuisance

To reduce the constraints of insularity and to revive a glorious past as a seafaring people, the Djerbians are called upon to look more towards the marine horizon and to develop maritime links with nearby and distant overseas civilizations and markets (Mediterranean, European and Asian).

The development of maritime links should also be made, as a priority, with the continent to which Djerba is necessarily attached administratively and economically. Maritime links with the port cities of eastern Tunisia (Tunis, Sfax, Gabès, Zarziss, *etc.*) will make it possible to develop coastal traffic for travelers and for heavy goods that are currently transported by road and contribute to the congestion and pollution of land routes, in addition to the higher cost of land transport.

The improvement of access conditions to the island for visitors from the mainland will have to be done by improving transshipment services through the optimization of rotations and the use of high-capacity car ferries, and by the rational development of the land route along the Gulf of Boughrara.

A marina project could participate in the opening of tourism on the island of Djerba. Moreover, the marina of Houmet Souk has not participated in the development of tourism, as it was already planned. It remains a project closed in on itself, without being a public space open to its urban environment and becoming a place for tourist practices. This is in addition to the environmental problems, particularly linked to the pollution of

the water in the dock. The cohabitation of yachting and fishing activities has not been successful. As a result, the marina has been deserted by yachtsmen. It remains a place for “pirate boats”, which organize trips for tourists.

The marina project requires a major restructuring project to improve its capacity by separating the fishing activity from the yachting activity. Thus, this activity needs technical services to develop the activity of wintering and maintenance of yachts. Thus, leisure services (cafes, restaurants, shops) must be developed to improve its attractiveness and create an atmosphere.

From an urban point of view, the marina of Houmet Souk is well situated in relation to the fort and the promenade, without taking advantage of it. It can become the pedestrian continuity of this promenade. In this way, the fort can become a setting for a larger marina. This integrated project can be a meeting place for tourists and the local population.

Boaters have become very sensitive to environmental quality. Ecolabels are an advertising argument for this. For these reasons, the marina of Houmet Souk must undergo a major updating project and be part of a labelling process.

III.2.5.2. The prospects for the development of transport infrastructure

Intensifying road traffic will inevitably affect the interior of the island. It will raise the question of how to provide the island with the road infrastructure needed to meet these growing transportation needs. Pollution caused by exhaust fumes and noise from trucks and high-speed vehicles is a nuisance that is incompatible with Djerba’s mission and residents’ desire for a comfortable and healthy environment.

As long as the eastern and northern parts of the island are the most densely populated, they suffer more from the effects of land transport on the environment, particularly in terms of CO₂ emissions. The busiest roads with good easements, especially the tourist road, deserve to be widened. We therefore recommend that one-meter-long cycle paths be laid out on both sides of these roads.

To reduce the use of cars on the island, we recommend increasing the number of public buses and improving their network and rotations to adapt to the needs and expectations of the local population and tourists. At the same time, it is interesting to develop electric or hybrid buses to reduce the pollution of the area.

Additionally, to the transport network, it is interesting to invest in other types of networks, especially communication networks. The objective of integration into the globalization networks cannot be achieved without a considerable effort in terms of telecommunications and telematics infrastructures and equipment. Strengthening human interaction, which is the basis for strengthening general relationship life, presupposes the development of the material means necessary to ensure long-distance communication efficiently and at competitive costs. It also requires training of managers to master the advanced technologies required to implement and maintain telecommunications and telematics equipment.

For hotel owners, industry owners, and a variety of Djerbian and non-Djerbian promoters and businesspeople who find fruitful investment opportunities in Djerba, the new communication technology offers the possibility to communicate in real time and cheaply anywhere in the world. Integration with digital networks is essential to the success of your business and saves you money and time without traveling or wasting energy.

IV. Littoralization and Urbanization - Djerba Scale

IV.1. Introduction

The island of Djerba, which is a pilot area, is an interesting case study for the issue of coastal urbanization in relation to tourism development.

Mass seaside tourism, which has been developing since the 1960s, has disrupted the local economic system. As far as traditional economic activities are concerned, they are represented, among others, by underground oil mills, weaving workshops, pottery kilns, lime kilns and caravanserais. These remains bear witness to an ingenious know-how that allowed the “Djerbian” to lead a sustainable economy by judiciously using the local resources available both for building materials and for the artefacts he used to meet his daily needs.

The urban dynamics that have accompanied the development of mass tourism on the island have not been without impact on the sustainable development of the island. The territory has become more environmentally fragile, due to the evolution of the population and the phenomenon of global warming.

IV.2. Characteristics of Urbanization and Littoralization

IV.2.1. Land Occupation and Human Settlements: Impact of Mass Tourism on Djerba Island

The island of Djerba has a singular mode of land occupation and traditional human settlements. It forms a homogeneous whole hosting a civilization with an authentic culture that has managed to preserve its cohesion until the recent past. The traditional way of occupying the space is essentially the result of the surrounding natural factors characterized by aridity. These constraints have given rise to an exceptional mode of human settlement; in areas of varying population densities dictated by the water potential present (Fig.10). Kassah and Bourgou consider the fondouks as the first hotel establishments in Djerba. These establishments were intended to accommodate foreigners passing through for whatever reason they came to Djerba for: traders, civil servants, craftsmen, fishermen, missionaries, and others. These foundouks, whose number was about twenty, were concentrated in the agglomeration of Houmt Souk. They are traditional structures with a patio that served at the same time as an inn for travelers, a shop for goods and a stable for transport animals.

The location of these fondouks in the old urban center, Houmt Souk, reflected its multiple functions as the administrative capital, fishing port and commercial center for the whole island. At least in modern times, urbanization was grafted onto this old core, before the disruption of the socio-economic system through the development of mass tourism.

Djerbian territory before the development of mass tourism

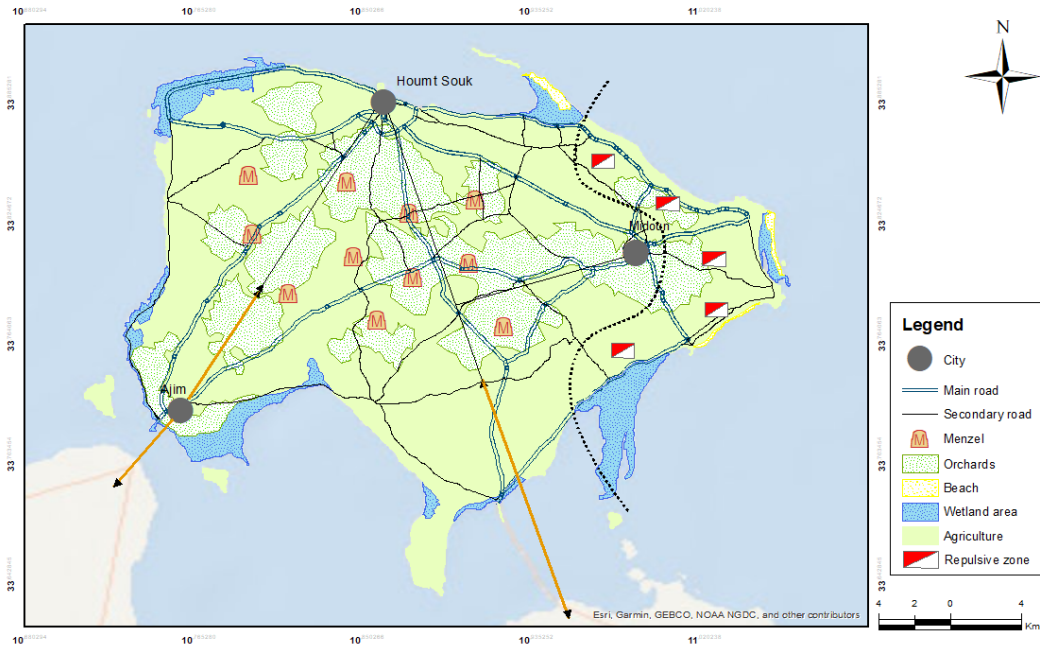


Figure 10. Djerbian territory before the development of mass tourism

The first modern hotel dates to the early 1930s. It had only 25 rooms and was paradoxically called “the grand hotel”.

The entry on the scene of an international tourist actor would give a new dynamic to tourism and it its current character of a seaside tourism oriented towards a large clientele, the “Club Med” which is a holiday village. It was the 4th establishment of this chain, in Djerba in 1954. It has just taken its place in the chain of this club in the Mediterranean basin after those of the Balearic Islands in Spain, Elba Island in Italy, and Corfu in Greece.

Club med in Djerba consisted of tents and rudimentary huts. It represented the beginning of international mass tourism on the island. Since then, tourism in Djerba was born as an extroverted sector turned towards the satisfaction of the needs and expectations of a European needs. The main attractions that fascinated these European elites were the landscapes, the beaches, and the immutable lifestyles. To these resources, we must add a major asset for Djerba, which is its insular character.

At the beginning of the 1960s, the role of the state of independence was primordial in the development and establishment of a modern infrastructure: hotels, roads, drinking water supply, electricity and telephone network, sewage station, in addition to encouraging private investment.

After Club-med, El Jazira was the first tourist promoter to set up a hotel on the eastern coast of the island. El Jazira hotel was built very close to the beach and at the expense of the coastal dune. It is the first attack on the fragile ecosystem of the coastline. The beach quickly deteriorated, and the waves attacked the hotel establishment. Thus, we note that since that time, several hotels have been built on sabkhas.

Since the 1960s, when mass seaside tourism developed, the supply of tourist accommodation has continued to increase at a steady rate. In 1967, the tourist accommodation capacity in the south-east, of which Djerba is a part of, which takes up most of the capacity, was 3,349 beds equivalent to 18% of the accommodation capacity in the whole of Tunisia. Thus, the realizations between 1962 and 1971 exceeded 6,000 beds distributed among 20 hotels. In 1973, the island of Djerba already had about 7,500 beds. Ten years later, the capacity rose to 8,650 beds. Thus, the offer of accommodation has diversified: hotels of different standards, boarding houses, flat hotels, holiday villages, and unclassified hotels (Table 11).

In 2003, the tourist region Djerba-Zarziss-Gabès totaled 49,317 beds, with a 22% share of the national capacity. In 2018, the tourist region had a capacity of 53,263 beds, with a share of 22.4% of the national total (Tunisian Tourism barometer TNTO, 2019).

In 2019, the capacity reached 53,079 beds provided by 144 hotels (representing 22.5% share of national capacity). So, the capacity is slowly evolving, reflecting some supply saturation. This is confirmed by the average occupancy rate of 55.8%. However, we should highlight that the occupancy could reach 97% in August, and on some days, hotels fall into stop sale and/or overbooking situations. For this reason, the accommodation is reinforced during this decade by some guest houses and apart-hotels (Tunisian Tourism barometer TNTO, 2019).

Table 11. Capacity in beds by category in Djerba (Tunisian Tourism barometer (TNTO, 2019))

	Hotels	Appart-Hotels	Guest Houses	Time share	Holidays resorts	Cottage	Others
Djerba	49,675	957	30	0	1,831	10	576

In Djerba, most of these hotels are located on the eastern coast and are under the jurisdiction of the delegation of Midoun. The tourist establishments occupy the entire seafront over a length of about 30 km. Thus, the whole island is influenced by the expansion of the tourist sector which generated 7.41 million TND as direct investments; most of them were related to accommodation's infrastructure. Besides, the international airport of Djerba is an important key player to boost tourism expansion. In 2019, it recorded more than 1 million passengers via 7635 arrivals (Tunisian Tourism barometer TNTO, 2019).

Following the development of mass tourism, the island of Djerba has undergone a profound transformation in the mode of human settlement, leading to major spatial changes, under the effect of several factors, including:

- The setting up of large infrastructures and the intensification of the tourist activity.
- The acceleration of urbanization and the sedentarization of migrant populations.
- The regression of agricultural activity followed by the change of vocation of agricultural land in favor of urbanization.

The impact of these changes on the island territory:

- Urban concentration in and around existing urban areas.
- Urban sprawl of the rural space and urban sprawl along the main roads.
- Strong occupation of the north-eastern sector of the island by tourist activities.

IV.2.2. Tourism development and coastal urbanization

After the installation of several small hotel units in the 1960s, a tourist zone was developed in the early 1970s, accelerating hotel construction to about 10,000 beds in 1988. At that point, the realization of the tourism zone development plan began. As a result, the zone's capacity has grown excessively to 50,000 beds at the expense of vacancies. The dunes have been absorbed and the top of the beach has been privatized by reducing public access to the sea.

Djerba has benefited from accelerated development since independence, on account of its natural and cultural heritage potential. On this island, the tourism sector plays a leading role in directly influencing the island's overall economic and social activities with 38 hotels in the 4-star category, 25 hotels in the 3-star category and 21 other accommodations, the island will be the first tourist destination in the country, with 1,072,976 entries and 6,288,588 entries in 2019. One Ministry of Economy, Finance and Investment Support and Southern Development Authority.

On the eve of the drafting of the tourism development plan (Italconsult, 1975), the hotel area was already in its most interesting part, the beach, used by the area between Aghir and the "Ulysses" hotel. There were 16 hotels with a total of 7,644 floors in an area of 140.95 hectares.

This early development led to various initiatives leading to the installation of facilities and infrastructure built without reference to organized spatial fabrics. The result was «bad coastalization» scattered hotels along the coast, and privatization of the waterfront. A discussion of tourism development strategies is focused on the development and planning of tourism zones to accommodate future hotel units in well-equipped plots. As a result of this examination, a "tourist zone" consisting of many hotels was created.

The significant development of the tourism sector, with the great advantage that it has led to the economic development of the entire island, is certainly dominated by tourism, but, highly diversified. In fact, manufacturing, service, transportation, and commercial employment rates are higher than the regional average and, in some cases, higher than the national average.

The development of tourism and the overall dynamic that it has fostered has had a direct impact on job creation and consequently on the improvement of the population's income. As a result, Djerba has become an attractive territory for migrants.

The organization of the island territory after the development of mass tourism

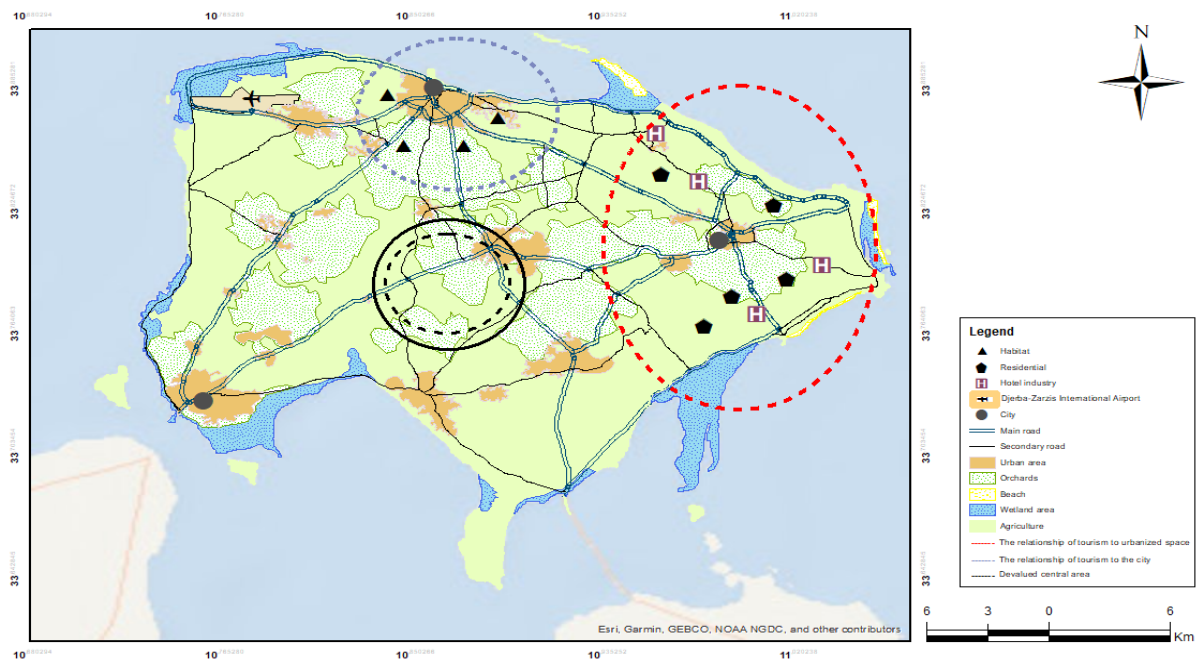


Figure 11. Organization of the Island territory after the development of mass tourism

IV.2.3. Population Growth and Urban Development: Impact on Sustainable Development and Ecosystem

Economic development achieved primarily through tourism makes the island attractive to job-seeking migrants from many southern and central provinces. As a result, the island recorded a positive migration balance of 3,700 arrivals between 2009 and 2014(NIS), but all other Medenine Governorate delegations except MedenineSud (Governor's seat) were negative during the same period. Djerba is more crowded with major city center as it is attractive to locals looking for a job and is fascinated by the presence of public facilities, especially educational and medical facilities.

- Houmt Souk; the island's traditional capital, has seen a significant increase in population due to the presence of major institutions (Technical High School, Regional Hospital, *etc.*) and government agencies (Delegation, Municipality, Court, *etc.*).
- Midoun; Close to tourist destinations, Midoun gradually became the center of the second city, as important as Ume Suk, by being promoted to the seats of delegations and local governments in 1985.

- Ajim: Despite being promoted as a delegation and local government, Ajim is not developing at the same rate as the other two centers in 1985, as it has a weak economic base and is largely unaffected by tourism activities.

Additionally, to these three capitals, in other regions such as Guallala, Sedouikech, El May and Mellita, after being promoted to local government, some urban development, installation of equipment and services, certain assets (pottery in Guallala, proximity of the airport in Mellita...).

At the island level, the urban dynamics just mentioned at both the three major city center levels and the rural and rural levels are not without impact on the island's sustainable development. It manifests itself in the tendency of overpopulation in certain sectors of the island. Demographic pressure on Djerba is very pronounced, especially in Midoun and Houmt-Souk. There is a certain stagnation of the population in Ajim. In fact, Djerba's population growth rate is far higher than national (1.03%) or regional (1.04%) between 2004 and 2014. It is 2.33% per year for Midoun and 1.58% for Houmt Souk. This population growth is a result of the well-balanced movement of Djerba, which is mainly explained by the attractiveness of the island due to the employment opportunities offered by the tourism industry. This strong population growth is reflected in certain overpopulations in certain sectors of the island and strong construction pressures, especially in housing.

Although it is diffuse, land pressure is particularly sensitive in the sectors close to the tourist zone. As a result, the land in Midoun and its periphery is under strong pressure for construction.

In addition, regional pressures that have dominated about 2,370 hectares between 2008 and 2018 are sensitive both within and around urban development plans and in remote agricultural areas, with the proliferation of urban structures and the corridors along them. It leads to the formation, main road. In agricultural areas, demand for land is increasing due to low land prices and easy access to networks. This phenomenon, which has led to a massive surge of informal settlements, is fueled by land speculation, administrative laziness, and loopholes in current regulations.

In this regard, the regulatory status of Midoun's municipality, a city plan that has been studied for several years, nourishes land speculation, occupies about 45% of the houses built, and supports an increase in illegal urban expansion that occupies an area 96 hectares. This is an average of 215 homes per year. For this reason, it is necessary to expedite the revision and approval of various urban plans on the island to better manage the development of urban structures.

The development of tourist destinations, which depend on the coastal areas that are sensitive, and the spread of disorderly development within the island affect the island's ecosystem.

IV.3. Impacts of Urbanization and littoralization on ecosystem, tourism, and territory

IV.3.1. High attractiveness and difficulty in governing urbanization

The other side of the coin is related to the island's attractiveness, which, as mentioned above, combines demographic growth with a positive movement balance, resulting in pressure on the island's territory and restrained urbanization. This lack of control over urbanization has led to the emergence of unmanaged residential areas in some places, sometimes even in the immediate vicinity of tourist zones, detrimental to the entire tourism sector, the source of the island's wealth. Unlimited growth and demographic growth in the tourism sector has a negative impact on the environment and is a very prominent sign of dire waste management. There are other drawbacks. For example, landscape protection, widespread use in urban areas, traffic and parking restrictions, wastewater reuse, *etc.* In fact, the increase in the number of households and apartments will affect the sewer network and its treatment. Sewage treatment plants become saturated in the summer, draining raw water into the sea, and directly affecting marine ecosystems.

When it comes to mobility, mobility systems pose significant obstacles to the urban environment, including noise, pollution, danger, and energy loss, not to mention accessibility and parking issues. Many of the sprawl phenomena, concentration of facilities in major centers, and activities in tourist areas are the cause of high mobility, as tourism activities themselves are known to be characterized by high levels of motorization. Sustainable islands can only be considered by promoting alternatives to individual transportation with motors, coordinating various forms of movement in intermodal systems, and promoting the use of public transport and soft movement. In that sense, the cycling plan currently being created is an opportunity to seize, but it is also essential to reform the organization of public transportation.

Starting with overfishing of natural resources and coasts, island governance should change direction, embrace precautionary principles, and move towards sustainability. The subdivided administrative bodies of the three delegations and three municipalities, the lack of coordination between municipalities, and the lack of solidarity increased selfishness and prevented the emergence of a common island vision in favor of a unified government.

IV.3.2. Impact of urbanization on the ecosystem

As a result of the island's urban dynamics, residents have relied on unsustainable construction techniques, materials, and resources. In the field of construction and urban planning, certain sustainability flaws, especially the use of materials with low thermal resistance, and the resulting increased use of energy-intensive air conditioning and heating means can be identified. Numerous windows and inadequate attention to the orientation of the building complicate the situation and achieving a good level of thermal comfort is difficult and costly.

- Urban control and climate change adaptation are targeted for collective cities to promote mobility by increasing housing density, properly managing and planting open spaces, and addressing urban sprawl. These are not facilitated because of lack of planning policies.
- The loss of a culture of water conservation among the citizens, coupled with very low use of treated water, leads to a constant shift from traditional rainwater harvesting techniques (Majel, Fesguia). All of this is increasing the pressure on the island's water resources, leading to the use of very expensive seawater desalination processes to meet the growing demand for water in the population and tourism industry.

The Djerbian ecosystem has undergone major changes, particularly in terms of land use, where the changes are on a large scale. Added to the risks linked to climate change, this trend may lead to irreversible situations in the absence of voluntary or directed collective action to readjust the current mode of land use and resource management with a view to greater efficiency and sustainability.

In his doctoral thesis Dribek clearly showed that the human action linked to the establishment of tourist activity in Djerba, as well as the specific natural data of the islands, are gradually undermining the balance of the natural coastal environment. Due to coastal erosion, the beach of the El Jazira hotel has disappeared. Thus, between the Sirène and Dar Midoun hotels, the beautiful beaches have started to deteriorate. Then, between the club Med Djerba la Fidele, the retreat of the beach is important, and the outcrops are visible.

In the face of these attacks from the sea, initiatives are however taken. These are most often defensive works by accumulating large blocks on the foreshore or creating groins and riprap. Nevertheless, in addition to their unsightly aspects, these works constitute an additional threat by accentuating erosion phenomena.

The border dunes that characterize the Djerbian landscape play a very important role in the natural balance of the island. The destruction of the border dunes is one of the most important causes of beach erosion. This erosion has accelerated due to the densification of the implantation of hotel units in the immediate vicinity of the coast.

As far as the whole island territory is concerned, in addition to the saturation of the tourist area, the interior of the island has suffered the effects of the extension of the urban fabric. The high demand for building materials has led to wild and illegal exploitation of sand and stone. Similarly, these areas have been invaded by uncontrolled dumping.

A perfect knowledge of the specificities of the island ecosystem and the limits of its natural resource potential should favor the search for ingenious solutions that can ensure the sustainable development of the island.

IV.3.3. Saturation of the tourism sector and loss of comparative competitiveness

After the phase of strong economic growth, brought about by the development of the tourist sector, the island of Djerba is currently faced with multiple challenges that all converge on the question of sustainability on both the socio-economic and environmental levels. Therefore, we can say that today the island of Djerba is facing the end of a cycle of its tourism development and that it is at a crossroads. The manifestations of this new difficult situation concern in particular:

- A tourist sectors whose achievements and positive impacts on the whole economic and social fabric are undeniable, but which has been recording for some years a certain saturation in its current model, characterized by fluctuating and weak indicators of filling up at times.
- A loss of comparative competitiveness in an increasingly competitive regional (Mediterranean) environment.
- An increased fragility of the tourist activity linked to political instability and the security threat at national and international level.
- Seaside tourism based on the exploitation of natural resources, particularly the coastline, which is in permanent degradation.

Indeed, the islands are vulnerable ecosystems and consequently any error in the management of their territory or of their resources, which are naturally limited, may be irreversible. In this respect, the “feet in the water” mode of occupation adopted by the development plan for the tourist zone and the concentration of tourist infrastructure on the north-eastern coast of the island, with an exaggerated density of use of the seafront, has led to a degradation of the coastal ecosystem and the destruction of the dune cordon, aggravating the phenomenon of coastal erosion. Faced with this situation of saturation, the sustainability of the tourism sector necessarily implies an adaptation of the development model of this activity to the requirements of the new environmental context.

IV.3.4. Risks of water scarcity and climate change

Natural resources, in particular water resources, are faced with excessive mobilization and consequently overexploitation due to the economic dynamism and demographic growth of the island. As a result, the risk of water shortages, in a context increasingly marked by climate change, constitutes a real challenge for the island, which for decades was supplied with drinking water by a pipeline from the mainland (Koutine aquifers). However, since May 2018, the island has benefited from a seawater desalination unit with a capacity of 50,000 m³/day, extendable to 75,000 m³/day, which has significantly improved the drinking water supply of the whole island. However, the high cost of desalination (2,500 DT/m³) constitutes a major burden for the State. More generally, the management of water resources on the island should respond to numerous challenges:

guaranteeing access to quality drinking water for the population, ensuring the supply of the tourist sector, maintaining the irrigation of a local arboricultural heritage.

Concerning the impact of climate change, the results of the most recent studies have resulted in worrying scenarios corresponding to a rise in sea level of between 30 and 50 cm by 2100, and due to the resulting increase in the risk of erosion and submergence of low-lying areas, it is estimated that 11 % of the island's land is potentially submergible. Also, the expected increase in temperature is likely to have a negative impact on thermal comfort, particularly during the summer period due to the frequency of prolonged heat waves, which would penalize tourist activity and significantly increase energy consumption for air conditioning. Thus, it can be said that the threats linked to climate change are real and obviously imply the urgency of an adaptation strategy for the entire island ecosystem to this climate degradation.

IV.3.5. The effect of urbanization on the territorial system

Djerba's economic development, on the other hand, nevertheless failed to adequately utilize the heritage of a very rich region. It is not well developed and integrated into tourism products. Example: Less attention is paid to Djerba's unique landscapes and land use (Houma, Menzel, Olive Trees, Palm Trees, Path Networks, *etc.*) to secure and enhance tourism activities. Moreover, this traditional type of profession is in perfect agreement with the modern notion of eco-neighborhood, where the urbanization of the old Houma accelerates and is left behind or disappears due to poor control. It's on the verge. The role of municipalities in this context points the way to more sustainable urban development, facilitating economically, socially, and ecologically sustainable living spaces, as well as clarifying the quality of shared spaces and service provision.

The cultural and archaeological heritage has not been integrated into the global dynamics of the tourism sector either. Moreover, this heritage is increasingly endangered by multiple factors such as the insufficiencies noted in terms of documentation, national classification and the absence of a safeguard and development plan. Deficits remain persistent in terms of protection and control against covetousness and anarchic use and other illegal extensions, sometimes irreparably disfiguring historic mosques and thousand-year-old monuments. As a result, despite the efforts made by official bodies National Heritage Institute (NHI) and civil society, much remains to be done to safeguard this precious heritage against degradation.

Intangible heritage is no better off in a context marked by globalization, where the safeguarding of local cultural specificities has become a major challenge in the face of dominant cultural production. Moreover, all these threats seriously complicate the argument in favor of the inscription of Djerba Island on the World Heritage List (UNESCO) and cause additional difficulties.

The traditional economic sectors: agriculture, fishing and handicrafts are all losing ground. This territorial economy is based on the complementarity of local activities and resources, whether they be agricultural, maritime, craft or, above all, commercial. These

different activities, which are an integral part of the traditional Djerbian organization, are in danger, due to a lack of profitability, attractiveness for young people and above all sectoral complementarities. Despite the opportunities and possibilities for innovation, crafts, and agriculture, among others, have hardly made any progress due to the lack of a global development vision adapted to the current development context of the country.

IV.4. Future trends in urbanization and littoralization

IV.4.1. Demographic dynamics

The main demographic characteristics of the population of Djerba Island are the following:

Table 12. Demography of Djerba (DGAT/APAL/PNUD, 2019)

	Houmet Souk	Midoun	Ajim	Governorate of Medenine	Total Tunisia
Total population	75,904	63,528	24,294	479,520	10,982,476
Urbanization rate %	100.00	100.00	100.00	78.7	67.6
Male population rate %	50.57	51.00	47.2	48.8	49.8
Female population rate %	49.43	49.00	52.8	51.2	50.2
Density (ha/km²)	428.80	303.90	189.9	52.3	725
Internal net migration	+1,018	+2,706	-20	1,110	0
Number of households	19,479	19,479	5,832	113,300	2,713,000
Number of housings	27,321	25,342	8,629	164,871	3,289,901
Illiteracy rate	9.53	10.61	15.66	16.60	19.27
Unemployment rate	9.29	9.22	10.00	15.1	14.8
Higher graduate unemployment rate	15.94	18.20	21.76	28.1	20.1

Since the last decades, the resident population in Djerba is growing. The number of inhabitants has continued to grow, from 139,144 thousand in 2004 to 163,726 in 2014. Despite the rapid decline in the national total fertility rate from seven children per woman in the 1960s-1970s to 2 in 2014, Djerba is still experiencing significant population growth. This is the result of a drop in the national mortality rate and an improvement in life expectancy, estimated at 76 years. Thus, the average annual growth rate, which was around 2.03% during the period 1994-2004, increased over the period 2004-2014 to reach an average annual rate of 2.6%.

This is more than double the Tunisian national average of 1.03 in 2014. This population growth is also the result of a migration trend towards Djerba thanks to the employment opportunities offered by the tourist activity.

In the delegations of the study area, the population has evolved although the growth rate has declined considerably, especially in the delegation of Ajim, which recorded a negative growth rate (0.05%).

This finding indicates that the island is attractive as it offers many more employment opportunities than the rest of the country due to the favorable economic conditions. For these delegations, the development of the tourist sector remains a privileged economic sector and still plays a predominant role in the demographic growth of the island through its migratory contribution.

IV.4.2. The prospects for the evolution of the population of Djerba Island

Based on the indicators analyzed above, and assuming the same population growth rates in the period 2004-2014 will be the same in the medium term, the prospects for regional population regional population evolution prospects for 2015-2025 can be established as shown in Table 13.

Table 13. Population development projection by region and delegation between 2015 and 2025

Region	Growth %	Population 10 ³	Growth %	Population 10 ³	Growth %	Population 10 ³
	2011-2015	2015	2016-2020	2020	2020-2025	2025
Tunisia	--	11,147.1	0.96%	11,692.0	0.77%	12148.8
Governorate of Medenine	0.99%	484.2	0.85%	505.2	0.72%	523.5
North Medenine	0.94%	55.3	0.81%	57.6	0.67%	59.5
South Medenine	1.30%	55.4	1.09%	58.4	0.88%	61.1
Beni Khadache	-1.13%	25.3	-0.85%	24.5	-0.57%	823
Ben Garden	1.28%	80.9	1.08%	85.4	0.87%	89.2
Zarzis	0.19%	75.5	0.20%	76.3	0.21%	77.1
Djerba H.Souk	1.37%	76.9	1.15%	81.5	0.93%	85.3
Djerba Midoun	2.14%	64.9	1.77%	70.8	1.39%	75.9
Djerba Ajim	-0.35%	24.2	0.23%	23.9	0.11%	23.8
Sidi Makhoulouf	1.11%	25.5	0.94%	0.94	0.77%	27.8

Source: DGAT/APAL/PNUD, 2019

Projections for the year 2025 indicate a total population in Djerba of approximately 185,000 inhabitants compared to 163,726 in 2014. Households are scattered throughout the island, with a stronger concentration in the areas most favored by the various economic activities. The 2014 census reveals that those residing in the two economic poles of Houmet Souk and Midoun are more numerous than residents of the commune of Ajim.

Table 14. Evolution of the number of households and dwellings between 2004 and 2014 (DGAT/APAL/PNUD, 2019)

Communes	Nbr of households 2004	Nbr of housings 2004	Nbr households 2014	Nbr of housings 2014
Houmet Souk	14,767	--	19,479	27,321
Midoun	11,361	--	19,479	25,342
Ajim	5,274	--	5,832	8,629
Total	31,402	--	44,790	61,292

Urban Population Growth in Djerba Island 2015-2019

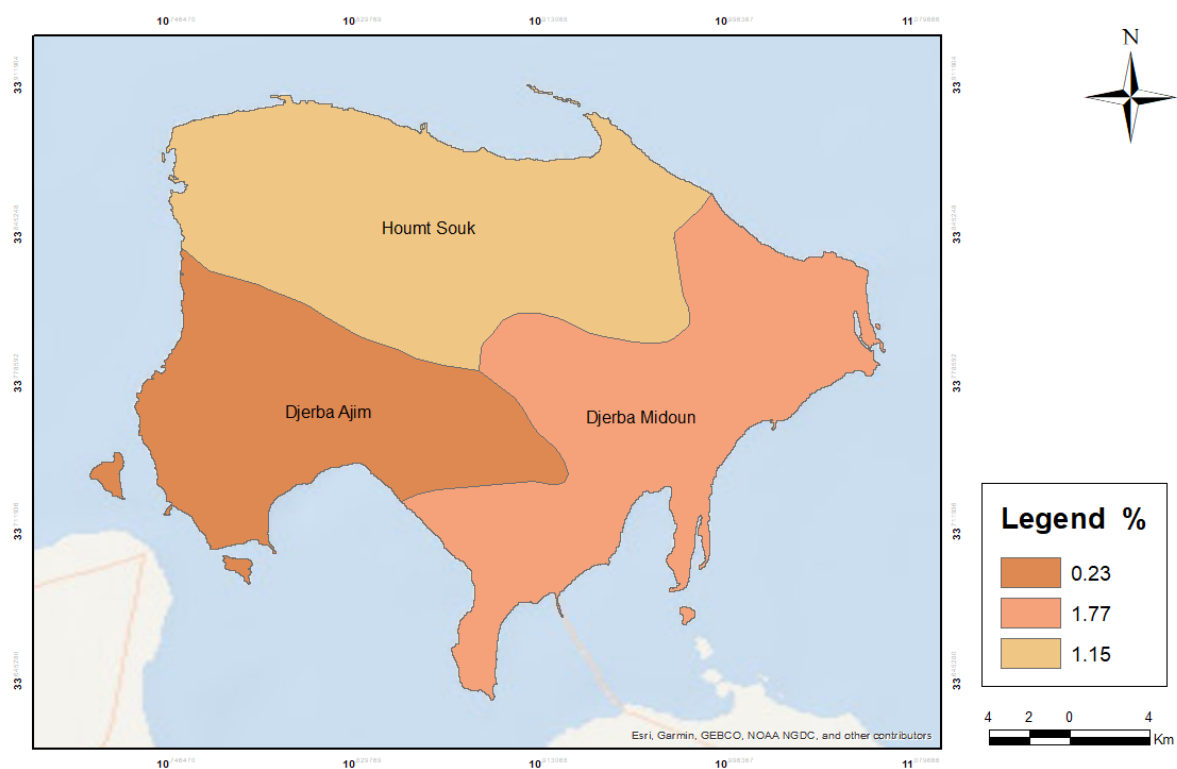


Figure 12. Urban Population Growth in Djerba Island

IV.4.3. The prospects for urbanization of the island of Djerba

The growth of the population and the number of households implies an increased demand for housing and subsequently for urban land. To manage urban development effectively, municipalities are still trying to revise development plans for the larger settlements and to draw up new ones for the smaller settlements.

Distribution of coverage areas in Djerba Island

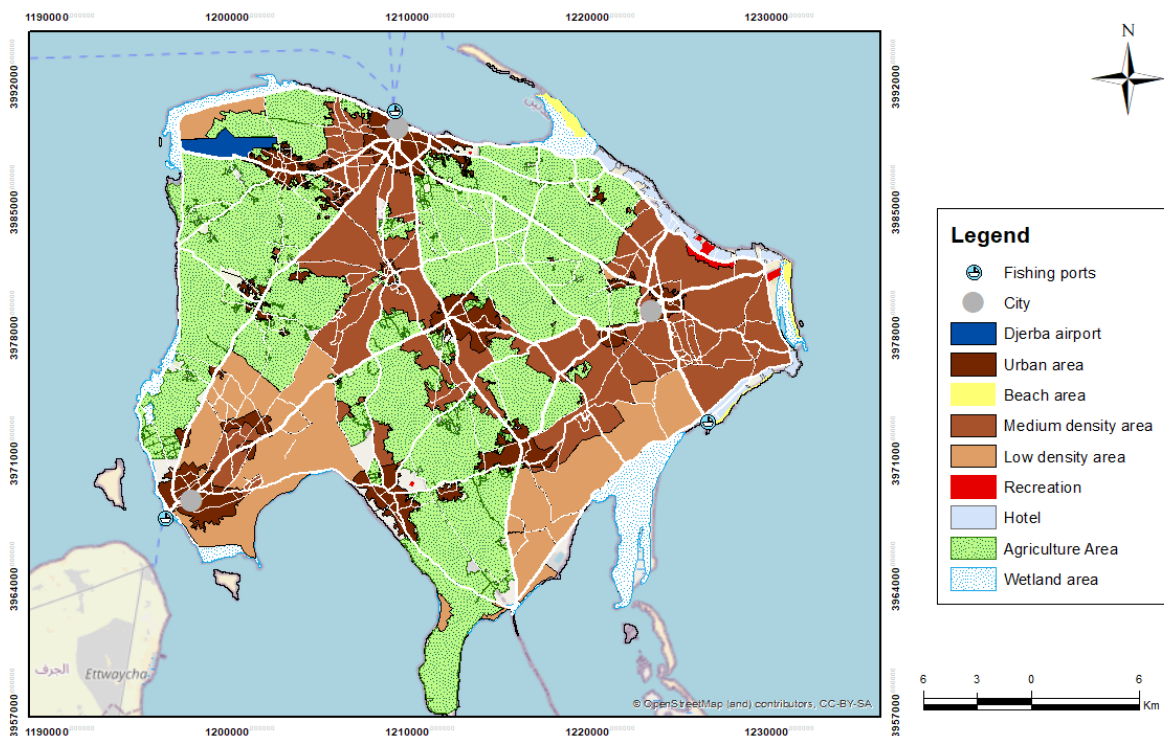


Figure 13. Distribution of coverage areas in Djerba Island

Table 15. State of coverage of the island of Djerba by urban planning documents

	Commune	Area (ha)	Start of the study	Situation
Houmet Souk	Houmet Souk	1,550	01-09-2000	Approved 2007
	Tourist area	512	22-05-2001	Old Plan 1976
	Mellite	443	01-05-2008	Old Plan 1999
	Erriadh	168	22-05-2001	Pending approval (used as an official document)
	Walegh	90	22-05-2001	Pending approval (used as an official document)
	Hachene and Bassatine	198	22-05-2001	Pending approval (used as an official document)
	Sidi Jmour	890	22-05-2001	The studies were completed in 2010
Midoun	Midoun	795	20-02-2001	Decree 2008
	Tourist area	1,600	15-07-1976	Arrested 2000
	El mey	253	May 2010	Arrested 1994
	Sedouikche	450	April 2015	Pending approval
	Beni Maaguel	60	April 2001	Pending approval
	Mahboubine	62	April 2001	Pending approval
	Ouersighne	62	April 2001	Pending approval
	Robbana	40	April 2001	Pending approval
	DhahretEllemsi	150	January 2015	Pending approval
	Arkou_Tezdain	763	May 2010	under study
Ajim	Ajim	800		Decree 2008
	Guallala	400		Arrested 1994
	Tourist area	700		Decree 2018
	El Groo	80		under study
	Ouadzbib	75		under study

Manual digitization with ArcGIS of Djerba Island which divides into 3 types: Agricultural zone which has the highest percentage of coverage, the urban zones (high density area, medium density area and low-density area); the tourist area which also admits the leisure zones (bars, golf, tennis, *etc.*).

Table 16. Distribution of urban development plans by commune in Djerba

	The development plans "Houmet Souk"		The development plans "Midoun"		The development plans "Ajim"		The development plans "Djerba Island"	
	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%
Landscaped Area	3,851	23.67	4,235	23.97	2,055	13.01	10,141	20.39
Undeveloped Surface	12,419	76.33	13,434	76.03	13,746	86.99	39,599	79.61
Total	16,270	100.00	17,669.00	100.00	15,801	100.00	49,740	100.00

The island of Djerba is covered by about twenty urban development plans and tourism. Nevertheless, 80% of its territory is not covered. The commune of Ajim is the least favored, as more than 86% of its territory is not covered by a document. Moreover, each commune has several separate urban plans; each settlement grouping belonging to the same belonging to the same commune is governed by a document, which results in discrepancies. It is necessary to make them consistent. In addition, the urban plans are supposed to delimit urban and non-urban areas but given the specificity of the occupation of space in Djerba. This delimitation is very random and incomprehensible. Today, the capacities of the urban plans of the main cities are consumed at about 80%. In the tourist zone, consumption is around 75%.

Table 17. Capacity of urban development plans in Djerba and consumption of land capacity

Commune	Total area of UDP (ha)	Consumed area (ha)	Consumption rate (ha)	Residual area (ha)	Rate in relation to the total area of the municipality
Houmt Souk	3,961	2,268	57%	1693	22.5%
Midoun	4,078	2,965	72%	1113	21.0%
Ajim	2,055	1,063	52%	992	15.0%
Total	10,194	6,296	62%	3798	20.0%

It should be noted that many of the PAUs under study, their perimeters, already show a high rate of consumption (see details in the table above). However, the slow approval of the urban plans means that they are sometimes overtaken by time. Moreover, the new Urban Planning and Development Code currently being approved provides for lighter procedures in terms of partial revisions of urban plans.

For the sustainability of the island territory, it is interesting that the development plans are updated and adapted to new needs.

IV.5. Impacts of urbanization and littoralization on the coastal/maritime environment

IV.5.1. Impact of urbanization on the island ecosystem

Djerba ecosystem is a fragile environment where the coastline is both the most coveted and the most threatened of the various concentric zones that make up the Djerbian territory. The coastline, which is almost 150 km long, is made up of different forms of accumulation and erosion, the dynamics of which are determined both by natural factors and by different forms of human intervention. The most spectacular of these interventions was the exploitation of the sandy coasts for tourism purposes. On the northern and north-eastern coasts of the island, the destruction of the coastal dunes by hotel installations, the exploitation of sand for construction, and the degradation of the *Posidonia* meadow by trawling and chemical pollution, have accelerated the erosion and degradation of the beaches, leading to the destruction of the installations closest to the current shoreline.

The Djerbian coastal ecosystem is extended inland by an area of lagoons and sabkhas bordered by halophilic vegetation and surrounded by a ring of low-lying land occupied by scattered palm trees grouped together in majestic clusters and constituting one of the basic elements of Djerba's characteristic landscape heritage. This circum-littoral area is now seriously threatened by the second line of hotel installations and by the spontaneous para-hotel installations induced by the development of beach tourism on the coast. Furthermore, the unorganized exploitation of the limestone ridge that surrounds the island and protects the Menzel's has aggravated the phenomena of silting up and salinity of the water table over a large part of the island. The destruction of part of the tabias in favor of the modernization of paths and the construction of roads has aggravated soil erosion and the risk of flooding.

The limited resources of a small and over-exploited island were put to the test tested. The loss of plant and animal species due to human activities continues at an alarming rate. The resulting threat to biodiversity is also due to the abandonment of traditional local varieties of many plant species, such as barley (*Hordeum*), commonly known as "beldi", which is well adapted to the island's climate and resistant to salinity, as well as the milfoil, which is a very popular plant millet (*Pennisetum*), better known as "droo", which used to be a food crop, but which only survives in a few limited areas, as well as chickling vetch (*Lathyrus*) used for human and animal consumption, as well as the "matata" variety of the palm tree which exists nowhere else but on the island of Djerba and is threatened with extinction by actions of man. The destruction by uprooting or burning of ancestral palms, olive trees and carob trees and carob trees constitutes a serious attack on the ecosystem.

As an integral part of the Mediterranean Sea, the marine environment surrounding Djerba is seriously affected by various forms of environmental aggression. However, three specific problems that can be attributed to man over the last thirty years are worsening day by day and require priority action and emergency measures.

The fixation of dune strips and the overexploitation of marine sand quarries have accelerated the degradation and erosion of beaches. The risks to the lagoons and coastal sabkhas are also great if lagoons and coastal sabkhas are also at risk if intensive tourism development continues the coast and in the development on the coast and in the circum-littoral zone.

IV.5.2. Protection and artificialization of the coastline

The protection of the coastline requires the consideration of three elements: bathymetry, the evolution of the beaches and the artificialization of the coast (Paskoff, 1987).

Bathymetry: Near the island, the bathymetry is almost always lower than -10 meters. Off the southern and northern coast, the -5-metre isobaths only appears beyond about ten kilometers from the coast.

Thus, Djerba was called by the Roman navigators “the island of the deep”. The destabilization of the seabed, mainly due to the degradation of Posidonia meadows because of fishing, is a determining factor in the erosion of the beaches.

The beach: Djerba’s beaches extend mainly along the north-eastern side of the island, which is well exposed to the prevailing wind and backed by a relatively well-developed dune field (Paskoff, 1994). They cover a coastline of about 30 km. These beaches have been the object of intense tourist development, which has isolated them from their hinterland. They are fragile and vulnerable areas where erosion phenomena are sometimes significant but vary greatly depending on the sector. A distinction should therefore be made between the sector to the north of Lella Hadhria and that to the south:

- The beaches in the first sector are long, thick and backed by dunes.
- The beaches of the second sector are narrower, sometimes without a bordering dune, and they show rocky outcrops.

To deal with this phenomenon of beach erosion, several works have been launched since the early 1990s:

Riprap: Three sectors of riprap have been subject to this technique.

- Between Ulysses Palace Hotel and El Jazira Hotel (Sidi Mahrez beach), which has been eroding since the mid-1980s.
- Near Les Sirènes hotel (Sidi Zekri beach), eroding since 1990.
- Along the stretch of coastline south of the “Djerba la Fidèle” hotel.

Overall, where riprap was used, the coastline was stabilized and quantities of sediment were trapped.

Retaining walls: This technique has been frequently used. It is the private initiative of hoteliers who thought it would protect their establishment (Les Sirènes Hotel, Dar Djerba Hotel, Aghir Youth Hostel). Wherever they have been installed, vertical retaining walls have accelerated the erosion phenomenon by promoting the agitation of water and amplifying the energy of the waves. Sloping walls resist scouring longer than the sloping walls resist the scouring of the sea water at their base for a longer period, but they are not a sustainable solution.

Groins: Introduced in the early 1990s, groins are much more common than riprap and retaining walls, especially along the eastern coast. Here, every hotelier has rushed to have his own and to take advantage of the little sediment carried by the southward drifting shoreline. The result is the existence today of a very segmented coastline where narrow beaches develop at the foot of the northern façade of the groins which intercept the little sediment brought by the littoral drift.

Artificial beach nourishment: This solution is the most effective today according to the State's technical services and local authorities. It remedies the fundamental cause of beach erosion, a lack of sediment, while protecting the seafront from wave attack. It can be carried out from underwater deposits or from continental sand inputs. This technique has no impact on the aesthetics of the landscape or on the attractiveness of the beach.

Rehabilitation of the coastal dune: The method commonly adopted is that of a grid using palm fronds and sometimes palm tree trunks. Locally, for example on the stretch between the El Jazira Hotel and the Ulysses Palace Hotel, this method seems to be effective. This is confirmed by the amount of sediment trapped and the vertical development of the upper beach dune.

Strategic retreat: This is the establishment of the DPM which is the best response to beach erosion, both from an environmental and financial point of view. This vision has been echoed by some hoteliers who have voluntarily and courageously destroyed the outer part of their establishments, leaving a strategic distance from the coastline of more than 40-50 m. This may also be the best economic calculation, as protection measures are costly (DGAT/APAL/UNDP, 2019).

Tourist urbanization and protection works have generated a certain amount of artificialization. The observation of this phenomenon, which is limited to a reading of the number of kilometers of coastline occupied, is a simple observation: 25% of the coastline of the two municipalities concerned by the study is artificialized (DGAT/APAL/UNDP, 2019). A more detailed analysis should consider the strategies for setting up tourist activity and spatial planning policies, both of which are linked to endogenous and exogenous reasons.

In the 1960s, an uncontrolled development of tourism led to a “bad littoralization” with some scattered hotels along the coastline, characterized by a very low occupancy rate of the plots (20 beds/ha). The result was a scattering of coastal space and a depletion of natural resources.

From the 1970s onwards, a reflection on the evaluation of the potentialities of tourist locations and on the possibilities of bringing infrastructure networks in terms of financing was carried out. This led to the creation of tourist zones, including that of Jerba (decree 73-162 of 5 April 1973), which was covered by a development plan; the latter took into consideration the number of beds per hectare (100 beds/ha) and the number of bathers on the beach (12/m²). This resulted in a concentration of tourist activities in the coastal

area (Miossec, 1976). Thus, the municipalities concerned by the study, Houmt Souk and Midoun, have a coastline of about 120 km, of which only 30 km are concerned by the tourist zone, *i.e.*, 25% of occupation (DGAT/APAL/UNDP, 2019).

But beyond the artificialization of the coastline, an even more worrying phenomenon is the degradation of the hinterland of the coastline. The dune fields on the coast, which were largely responsible for the balance of the coast, have in most areas been eroded without care to make way for constructions. Dunes far from the shore, which formed complexes of about 4-5 meters in height, have been almost destroyed. In the interior of the island, in an area not covered by the study, but which is important in environmental terms, large excavations and quarries have been opened for the extraction of sand and stone for construction purposes. In the north-eastern part of the island, there are at least 55 large quarries, of which only 33% have been authorized. The opening of these quarries means a great loss of land and topsoil. Some quarries are used as dumping grounds, which further contributes to some quarries are used as dumping grounds, which further contributes to the degradation of the environment and leads to ecological degradation.

IV.6. Blue Economy and littoralization in the context of sustainable Coastal/Maritime Tourism development

IV.6.1. Preservation of the ecosystem and streamlining traffic

The preservation of the island ecosystem of Djerba depends first and foremost on the protection of the northern and north-eastern coastal areas, which have been severely affected by hotel construction. The measures taken to limit construction in the immediate vicinity of the coast must be reinforced and strictly applied in the various development operations in coastal areas. The protection of the area against silting up and the fight against the salinization of the water table presupposes the protection of the limestone rim and the rationalization of quarrying. Urgent action must also be taken to stop the destruction of tabias and to encourage the repair and maintenance of existing tabias.

The protection of the coastal ecosystem also involves the classification of all sensitive areas (coastal dunes, beaches, sabkhas, lagoons, salt-works, palm groves, *etc.*) and the acquisition of fragile areas most at risk of disruption, thanks to the action of the Agency for the Protection and Development of the Coast (APDC) and with the aim of creating natural reserves to be protected from all human action.

The protection of the island environment must also ensure the promotion of biological diversity by drawing up an exhaustive inventory of all the species of the specific biological heritage of the terrestrial and marine environments of Djerba. In addition to the inventory, the preservation of biodiversity requires the in-situ conservation of ecosystems and natural habitats as well as the maintenance and reconstitution of viable populations of species in their natural environment.

Protection of the ecosystem also requires a ban on the uprooting and burning of trees that are part of the island's floristic and landscape heritage. The creation of arboreturns and nature reserves housing the island's plant and animal species has environmental, economic, and social advantages, and should be integrated into the circuits to be developed to promote ecological and cultural tourism.

The identification and conservation of biological diversity and the sustainable use of its components require the implementation of awareness-raising, education, and technical and scientific training programs. All this vast work can be carried out with the help of the skills and capacities of researchers and specialized academic institutions.

The rationalization of traffic within Djerba with a view to reducing speed will involve the installation of speed bumps, crossing lights at strategic junctions and the strict application of the speed limit currently in force (less than 70 km/hour throughout the island). In addition, the development of cycle paths for bicycles and mopeds will help to reduce the serious accidents that frequently occur on the main roads. Similarly, the development of unpaved tracks with a view to integrating them into ecological and cultural tourism circuits will reduce the current tendency to cover almost the entire network of tracks on the island with asphalt. To limit the nuisance of road traffic, the collective transport of passengers (by bus, mini-bus, and collective taxis) will have to be developed and reinforced on the most frequented lines.

IV.6.2. Promoting sustainable agricultural, rural, and marine development

Due to its position occupies in the rural environment and in the concerns of many Djerbians, and because of its direct and indirect contribution to Djerba's landscape heritage, agriculture is an essential component of any sustainable development strategy, despite its low contribution to the island's overall income.

However, Djerba has experienced phases of unsustainable agricultural development, as evidenced by the abandonment of land; palm Ghabas and tree plantations (fraoua and jnène). The phases of regression of dry or irrigated crops are evidence of the fragility of certain lands and the insufficiency of water resources in comparison with the needs of irrigation and intensification made imperative by the growing weight of the resident and visitor populations. Any present or future agricultural development is therefore subject to the limits of soil and water resources.

The extreme fragmentation of land subject to permanent or occasional exploitation, as well as the complexity of property rights on modest plots, makes the idea of a dry farm of sufficient size to ensure minimum profitability illusory. As a result, dryland farming is destined to be a supplementary resource. Moreover, in the past, agriculture has only provided a complement to the resources derived from artisanal activities (weaving, pottery, jewelry, *etc.*) and resources from the sea (fishing, coastal shipping, distant trade, *etc.*). Commercial activities very early on led to a specialization that made the Djerbians famous in the field of grocery and weaving.

Agriculture, which in the 19th century still accounted for 30 to 40% of total resources, today represents only 2 to 4%, depending on the year. The abandonment of cultivated land and wells, as well as the absence of any progress in productivity, explain the relative decline in the agricultural contribution to production.

Paradoxically, for the past thirty years or so, agriculture has been called upon to support the progress of tourist activity, either by meeting the growing need to supply quality agri-food products or by preserving the typical richness of Djerba's landscape. The care given to dry farming would result in the beautification and increased profitability of crops.

The irrigated areas, which cover nearly 600 hectares, are mainly located in the central zone (Ouallagh, Cedghiane, El May, Robbana, Mahboubine, Midoun and Oued Zébib). Irrigation water has always been of great agricultural value. Its exploitation beyond the capacity of the aquifers, which has become the rule today thanks to electric pumps, has fatally led to the salinization of land with little water, as well as that of marginal areas irrigated from the lenticular aquifers of the center of the island. This has led to the disappearance of hundreds of small palm groves and fruit gardens protecting food crops.

The abandonment of former public irrigation schemes and boreholes for asparagus cultivation requires the rehabilitation and restoration of the land to be integrated into the island's agricultural and tourist economy.

Furthermore, the lack of irrigation water could be relatively compensated for by water from 10,000 m³ of wastewater after appropriate purification. In addition to this potential for irrigating 150 to 200 hectares, there is the Miocene water with 4 to 6 g/L of salt. The cost of desalination, although expensive, is bearable by profitable projects.

The shortcomings of Djerbian agriculture also stem from the shortcomings of agronomic supervision. Apart from isolated cases of success or failure resulting from the initiatives of private promoters, there is no technical reference, even basic, to guide those who want to create viable projects. The absence of associative groups does not favor collective initiatives for the commercial development of production. The limited financial means of individuals and their families do not favor large-scale investments.

Despite the general tendency to limit the intervention of public authorities, a real renewal of agriculture cannot be conceived without a solid incentive from the State. The current resources of agriculture alone are insufficient to undertake such an action. Tourism, which benefits indirectly from the action of the Djerbians to preserve a legendary landscape, will have to contribute a modest part of its resources to maintain the rural environment and the tree landscape which constitute one of the bases of its prosperity.

The rehabilitation should start with the repair of the tabias and their consolidation with agaves. This action requires technical and financial support on the one hand, and a strict ban on the construction of walls in place of tabias on the other.

The repair of the to be subsidized along the tracks and roads could be complemented by the parallel planting of one or two lines of almond, apricot, and peach trees, which would take advantage of the excess moisture along the tracks, and which would, after about ten years, transform Djerba into an immense flower garden, thus enriching the landscape heritage and providing a backdrop for tourism.

A ban on vagrancy and uncontrolled grazing would restore the inalienable right to private property. The only thing that must be restored is grazing on a picket line in cultivated and residential areas.

The search for solutions to the problems of land ownership fragmentation requires the creation of a cadastral file with updated land maps on an optimal scale of 1:2500. The objective of this operation is to make an inventory of all the existing land parcels and to arrive at a cultural classification giving all the characteristics of the current and previous land occupation. The precision of the legal status of the parcels is a prerequisite for any restructuring operation. The computerized management of this cadastral database by a geographical information system will facilitate the management of negotiations between owners and potential buyers and any development operation.

The profitable marketing of the products of dry crops, and above all of olive growing, could be done advantageously through the promotion of controlled appellations. With new equipment and on condition that only fresh olives are delivered to the oil mills, oils of perfect taste could be produced under the label.

The label “exclusive product of Djerba, without artificial fertilizers, without chemical treatments, from hand-picked olives processed under pressure and cold”. Such a label, accompanied by promotional packaging, would make it possible to sell a significant part of the production at prices that would guarantee double or triple income. Marketing on targeted markets would be done through a service cooperative representing the interests of the producers. Harvests of other products (almonds, dried figs, lentils, *etc.*) could benefit from comparable promotion provided they meet strict quality criteria.

The protection of the landscape and agricultural heritage also implies the absolute prohibition of the uprooting of old olive trees and, at the very least, the relocation of uprooted olive trees in case of absolute necessity imposed by a public utility development.

Concerning the development of irrigated crops, these require the promotion of irrigation systems that consume little water and allow significant savings. This development could benefit from the contribution of new resources which could come from:

- wastewater purification.
- desalination of Miocene water.
- rainwater harvesting by hotels.

All these measures would make it possible to increase the irrigated areas of Djerba.

The setting up and equipping of a Research and Improvement Station, the establishment and equipping of a Research and Improvement Station would meet the supervision needs of farmers in Djerba and neighboring regions. It should be more like a private pilot farm run by technicians specialized in market gardening under glass and intensive arboriculture. Research and quality production should have commercial purposes to compensate for the high production costs.

IV.6.3. Rational use of marine resources and protection against pollution

The measures to be taken to restore the balance in the marine environment must reduce the harmful effects of trawling and lead to a restructuring of fisheries resources in coastal areas. The revitalization of inshore fisheries requires adapting catches to existing resources and encouraging the promotion of fixed fisheries. Small units will be able to take catches on the continental shelf while respecting strict standards for fishing periods, territories prohibited to fishing and the sizes of the species to be caught (fish, octopus, sponges, *etc.*). Thus, the practice of artisanal fishing gives an advertising argument to this island territory in the perspective of developing a certain sustainable tourism.

The fight against chemical pollution must be carried out at two levels: at the origin, by a total stop of marine PG discharges in the Gulf of Gabes and at the arrival, in the Boughrara Sea, by activating the circulation towards the open sea through the channels to be built under the road. As soon as possible, it will be necessary to re-establish the flow with the open sea to the east to facilitate the dilution of the PG and the rehabilitation of the Posidonia grasses. Channels must be dredged, and multiple bridges built under the roadway. A toll on traffic at this level would help to finance part of the cost of this expensive operation.

It is recommended that an awareness and education program on the protection of fisheries resources be undertaken for fishermen and marine operators. In addition to the efforts to be made in education and training at the basic and secondary school levels, it is imperative for the future of Djerba to strengthen higher-level training capacities that are adapted to the needs of the island and neighboring regions. The prospects for the development of diversified production and high-level service sectors in the various fields of activity argue in favor of promoting university training on an island whose worldwide reputation is an asset to be developed in the field of research and advanced technology. The SDA for the sensitive areas of Djerba recommends the creation of combining research laboratories in advanced technologies and industrial activities using such technologies. To this end, we recommend that this construction be specialized in blue economy technologies.

IV.6.4. Promoting sustainable tourism

The tourist development of the island has been carried out in a first phase in perfect symbiosis with the natural and human environment. So far, this desired and desirable development has taken place without any great damage to the very particular ecology

of the island, where the dunes along the coast, which are characteristic of the Djerbian landscape, play a very important role in the natural balance of the region. The restriction of the coastal dunes is one of the most important causes of beach erosion. This erosion has accelerated due to the densification of hotel units in the immediate vicinity of the coastline.

The revision of the development plan for the tourist zone and its extension has resulted, among other things, in the conversion of fragile agricultural and natural areas into hotel zones. As a result, fragile natural sites of exceptional ecological quality, which cannot be densely urbanized without irreparable degradation, are destined to receive large-scale facilities.

Among the consequences of unintegrated tourism development, the absence of accompanying measures to accommodate the workforce employed in the hotel units in good conditions has led to the destruction of part of the island's heritage and to the development of anarchic and uncontrolled housing. To develop and promote a diversified tourism, respectful of the environment and of the specificities of the island, it will be necessary:

- Improving the integration of tourist units into their island territory.
- Relaxing the urban planning regulations in the development plan to convert closed hotels into clinics, retirement homes, inns, apartment hotels, etc.
- Revising the tourist regulations to safeguard the local architectural character, the adoption of the color white, low COS (Coefficient of Land Use) and CUF (Coefficient of Land Use), etc.
- Improving signage and introducing signs to explain and encourage good environmental practices.
- Developing specific regulations and standards for urban planning, quality of construction concerning energy and water consumption and wastewater treatment.
- Recommending environmentally friendly construction methods (bioclimatic or vernacular architecture, use of local materials, etc.).
- Improving the ecological and environmental performance of the tourism industry by- contributing more directly to environmental protection, aesthetic improvement, and the rehabilitation of ecologically damaged environments.
- Encouraging hoteliers to collect and use rainwater.
- Properly managing the water used by ensuring water purification and recycling at the level of each hotel unit or group of units.
- Develop and promote a diversified and environmentally friendly tourism system (cultural tourism and health tourism), deconcentrating tourism from the seaside areas and opening it up to the interior of the island.

- Finishing the archaeological excavations at the Meninx archaeological site and build an interpretation center there.
- Developing a coastal park at the site of Lella Hadhria, whose tourist resort project is not accepted by civil society.
- Upgrading all the wastewater treatment plants and building new ones to treat all the island's wastewater.
- Encouraging tourism promoters to engage in a labelling process.
- Encouraging promoters to invest in cultural and ecological tourism and quality.
- Creating the basic infrastructure necessary for the development of circuit tourism and nature tourism.
- Upgrading the Houmt Souk marina project to integrate it with the fort and the promenade, as part of an overall project.
- Developing a specific tourist portal for the Djerba destination.
- Developing a specific label for the island of Djerba.
- Developing a territorial marketing strategy based on the specific characteristics of the island of Djerba.
- Develop alternative tourism accommodation structures: guest houses, rural gites, charming hotels, eco-Lodges, etc.

It is in this sense that the council of the municipality of Djerba decided to renovate the 25 fondouks of the island for tourism purposes. They will be converted into either hotels or youth hostels, while others will house commercial activities (sale of handicrafts, weaving, *etc.*). The objective of the island's municipality is to perpetuate this historical and civilizational heritage and turn it into a product that will contribute to improving the island's attractiveness. It is, therefore, an intelligent preservation of a heritage for a young clientele.

V. Conclusions

The island, like the east coast of Tunisia, shares an era and intensification of regional resource development, but depends on the vulnerabilities of the island's ecosystem in the face of increasingly intensive development activities. The limited resources of small island space and the increased density of people and activities based on the development of resources of coastal ecosystems are major obstacles to the sustainable development of Djerba. In the future, we need to respect these limitations and look for forms of development based on diverse resources. Therefore, we have moved from an integrated development system born from human behavior according to the environment, needs, and resources to a system imposed on human beings who are increasingly required to adapt to survive.

Additionally, domestic tourists arrive at the island by ferry or the Roman Road. It is well known that tourism itself is characterized by a high degree of motorization, so urban sprawl, concentration of facilities in major centers, and many of the activities in tourist areas are responsible for high mobility. Sustainable islands can only be considered by promoting alternatives to individual transportation with motors, coordinating various forms of movement in intermodal systems, and promoting the use of public transport and soft movement. Improving road network connectivity and internal accessibility is essential to reduce the need for transportation and avoid the use of private vehicles.

Besides, improving the southwestern link is essential to provide a framework for the island's economic and sustainable development.

Such restrictions justify a new strategy for the development of new sustainable tourism that integrates with the blue economy sector. A systematic vision may have made it possible to highlight the various elements of each system in dynamic interaction, organized around the purpose, here sustainable tourism, and blue growth. However, reductionism is an obstacle to solving complex environmental problems and, as a result, hinders sustainable development.

VI. References

DGAT/APAL/UNDP, 2019. Schéma Directeur de la zone sensible de l'île de Jerba, Bilan, Diagnostic et problématique de la situation actuelle, Livrable 3, Rapport final de phase 1, 341.

Dribek A., 2013. Vers un tourisme durable en Tunisie: le cas de l'île de Djerba, 423.

Institut National De La Statistique, 2014. Données statistiques pour le gouvernorat de Médenine, Annuaire Statistique de la Tunisie

Italconsult, 1975. Programme d'infrastructure pour le développement du tourisme en Tunisie, Vol. I, analyse de la situation actuelle ; vol. II, options fondamentales du programme ; vol. III, programme d'investissement. Tunis : Ministère du tourisme et de l'Aménagement du territoire.

Minister of Economy, Finance and Investment Support / Office of Southern Development, 2019. Gouvernorat de Mednine en chiffres.

Miossec, 1996. Le tourisme en Tunisie, un pays en développement dans l'espace touristique international, Thèse de Géographie: Université François Rabelais à Tours, encadré par TROIN J.-F., 1333.

Paskoff R., 1987. Plage et tourisme en Tunisie. In Le développement du tourisme dans les espaces voisins des grandes zones de fréquentation touristique. UGI / ONTT. 276-287.

Paskoff R., 1994. Développement du tourisme et préservation de l'environnement en Tunisie, Projet METAP, II, Rapport d'expert n°1.

TONT: Tourisme tunisien en chiffres, 128 p.

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