

Transport and Accessibility

Djerba scale, Tunisia





Co-Evolve4BG

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

Transport and accessibility

Djerba scale, Tunisia



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OVERVIEW

The present document was produced within the framework of **Co-Evolve4BG** project “*Co-evolution of coastal human activities & Med natural systems for sustainable tourism & Blue Growth in the Mediterranean*” in relation to Threats and Enabling Factors for maritime and coastal tourism development on a national scale” Co-funded by ENI CBC Med Program (Grant Agreement A_B.4.4_0075).

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REVIEW

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Abstract

Djerba is an island known for its proximity to adjacent land. Its international airport has contributed to the development of mass beach tourism. In addition, national tourists access the island by ferry or the Roman road. In terms of traffic within the island, tourists use taxis. On the other hand, the local population uses buses and private cars.

In terms of internal mobility on the island, some nuisances to the urban environment are induced by the mobility system: noise, pollution, danger, loss of energy, not to mention accessibility and parking problems. A sustainable island can only be introduced through the promotion of alternatives to individual motorized transport, coordinating the different forms of mobility in intermodal systems and encouraging the use of public transport and soft mobility. In this sense, a bicycle plan, currently being drawn up, is an opportunity to be seized, but also an overhaul of the public transport organization remains essential. To contain the need for transport and to avoid the use of private cars, it is essential to improve the connectivity and internal accessibility of the road network. East-West bypass roads could prevent the need to travel between urban centers.

I. Introduction

This chapter deals with the transport infrastructure and existing networks in Djerba Island. It examines the functioning of the infrastructure within the island, the different modes of connectivity between the island and the mainland and between the island and the international transport network.

Transport is widely related to industrial services, cultural services, education, health services, shopping and other services that can significantly impact people's lives. Local traffic congestion is a growing problem particularly at peak commuting times, during school holidays and during the holiday season when the influx of tourists means that the Island's population increases.

The means of transport were developed to improve and maintain our transport networking, enhance accessibility and safety to promote economy, improve quality of life and sustainable tourism in an enhanced and conserved environment. It undoubtedly contributes to touristic activity development. Air transport has an important role to play in developing international mass tourism. Thus, the infrastructure and all the means of land transport (except for the train, which is absent from our study area) allow tourists to travel to the island of Djerba. However, they constitute an environmental nuisance that could have an impact on tourist activity.

At the end of this chapter, we will present a perspective for the development of environmentally friendly transport that serves sustainable tourism and is integrated with the blue economy. This fits perfectly with the sensitivity of this ecologically fragile island territory (PNU/PAM, 2011).

II. Main issues of transport and accessibility

II.1. Accessible transport infrastructure

The island is very close to the mainland through two outposts: one to the west of Jorf, on the mainland, at Ajim, and the other to the east of Zarzis, on the mainland, at El Kantara. Jerba can be seen as a peninsula rather than an island. However, the main tourist flows arrive in Djerba by plane.

- The Roman Road: It connects Djerba to the continent, from the south of the island to El Kantara up to the peninsula of Zarzis. It is 7.5 km long and has existed since the Punic era. After the Roman era it was transformed into a real communication road. Since 1973, it has been widened, by about 10 m, to allow the drinking water pipes to reach the island of Djerba (PNU/PAM, 2011).
- The ferry between Jorf and Ajim, which is the fastest route, is mainly used by travelers coming from the north. The crossing, about 2.5 km long, takes 30 minutes. In fact, there is a ferry every 30 minutes, between 5 am and 10 pm.
- The airport: In Tunisia, airports have been set up both in all touristic areas near all accommodation to which holidaymakers are transferred as the airport-hotel transfer should never exceed 60 minutes. Air transport represents a key element in the touristic package. Accordingly, each tourist needs a bed, and each bed requires a plane seat. Thus, the air transport development has been the main factor contributing effectively to the destination's development (Miossec, 1996).

The international airport of Djerba-Zarzis is located 9 kilometers west of Houmet Souk, near the town of Melita. 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 thanks to the development of mass tourism that has obviously been at the basis of this evolution.

The South-East region is served by both the airport of Djerba-Zarzis, the international airport of Sfax Thyna, and the airport of GabesMatmata. On the other hand, the airport of Djerba remains the most touristic and the most active one. 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. In fact, the airport's activity is essentially linked to the transport of tourists visiting the island. The Office of Civil Aviation and Airports (OCAA), which is the public company which operates in the civil aviation and commercial fields, is mainly responsible for managing the airport. In fact, the airport has a capacity of 4,000,000 passengers per year and its activity is essentially linked to the routing of tourists visiting Djerba and its surroundings. It is served by 20 airlines, including 3 national ones: Tunisair, Tunisair-express and Nouvel air.

II.2. Land transport and accessibility of the island

The 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) (Tables 1 and 2).

Table 1. Lines of the Irrigation Services for the transport of people (DGAT/APAL/UNDP: 2019)

Location	Company	Destination		
		Gabes	Sfax	Gafsa
Bus station of Djerba	SRT of Medenine	3	1	1
	SRT of Gabes	4	-	-
	SRT of Sfax	-	1	-
	SRT of Gafsa	-	-	1

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

Table 2. Lines of regular passenger transport services (National Companies) (DGAT/APAL/UNDP: 2019)

Location	Company	Destination			
		Tunis	Sfax	Sousse	Bizerte
Bus station of Djerba	SNTRI	4	1	1	2
	STC	2	-	-	-

The annual number of passengers using rentals is 1,772,280, which is much higher than the estimated 731,000 bus passengers. This suggests that the inbound flows would be used by workers who live outside the island. This rental terminus is always Tunis, but they necessarily pass through Gabes, Sfax and Sousse to ensure that they are full (Table 3).

Table 3. Average activity of bus stations (inter-governorate rentals) (DGAT/APAL/UNDP: 2019)

Location	Operating	Number of vehicles (Per day)	Annual number of travelers
Djerba car rental "louage" station	Departure to Tunis-Sousse-Sfax-Gabes	59	172,280
	Arrival from Tunis-Sousse-Sfax-Gabes	53	154,760

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

II.3. Road network in the interior of the island

The road network has 742.2 km of roads, among which only 59% are paved. Moreover, this island territory is endowed not only with few national roads, but it is also with relatively regional local roads in comparison with other regions. In fact, they account for only 3% of the total existing road infrastructure on the island since most of the road infrastructure consists of agricultural tracks, followed by numbered roads, local roads, and regional roads.

As far as paved roads are concerned, especially of the local and regional type, the commune of Midoun is the best calcified as it has the advantage of being a touristic commune. With 68.51 km of local roads, it is the best connected and integrated with the rest of the island territory. Its touristic road, which connects the hotel units located on the coast, is the most important infrastructure on the scale of its territory. We can assume that 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. The network of local roads is not as highly developed as the western part and in the municipality of Ajim (Table 4).

Table 4. The road network in 2019 (Ministry of Economy, Finance, and Investment Support/Office of Southern Development, 2019)

Delegation	Total		Agricultural tracks		local R.		Regional R.		National R		Numbered roads	
	U	B	U	B	U	B	U	B	U	B	U	B
Houmet Souk	104.94	186.91	104.94	107.54	0	50.75	0.00	28.62	0	0	0	79.37
Midoun	78.90	183.91	78.90	78.40	0	68.51	0.00	37.00	0	0	0	105.51
Ajim	78.40	115.75	78.40	70.25	0	32.00	0.00	13.50	0	0	0	45.50
Ile de Djerba	262.40	486.57	262.2	256.19	0	151.26	0.00	79.12	0	0	0	230.38
Total de gouvernorat de Medinine	2,922.68	2,563.61	2,179.90	1,293.89	703.01	549.22	49.30	549.37	0	171.06	752.31	1,269.75

U: Un-bituminized, B: Bitumen

The regional roads consist of the RR117, RR209, RR116, and RR16E. First, they ensure the connection between the main urban centers of the communes of Midoun, Houmet Souk, and Ajim. Secondly, they connect 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 Houmet Souk, crosses the center of the island, and leads to Zarzis from the south-east (see the road network map in Fig.1).

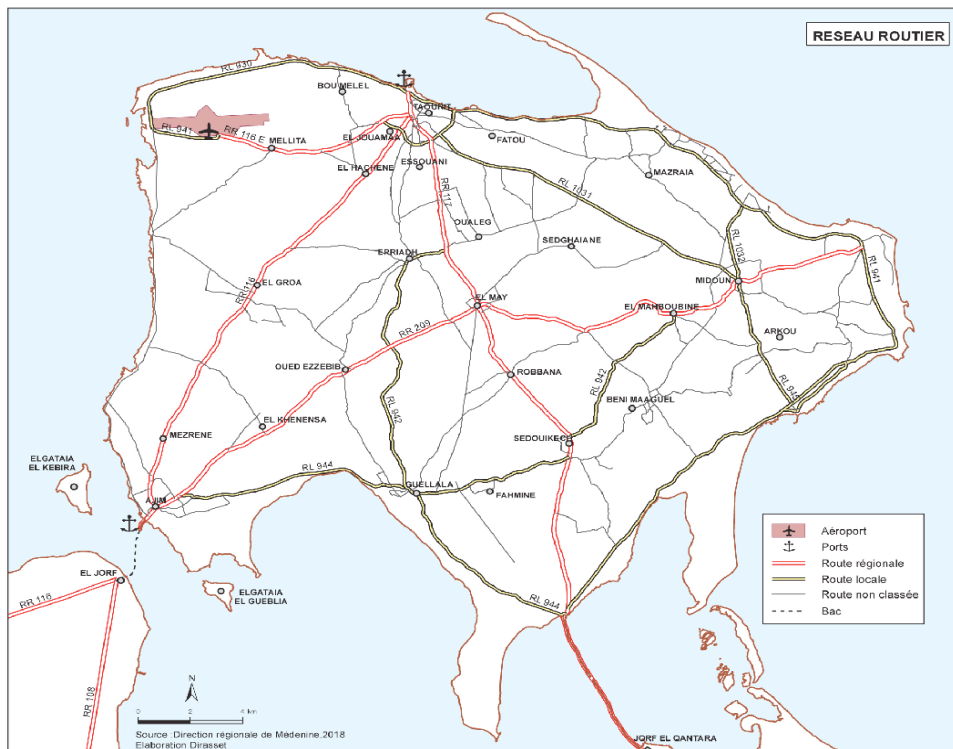


Figure 1. Road network in Djerba(DGAT/APAL/UNDP, 2019)

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. Besides, the road network organization is unbalanced, which results in an undeveloped tracks network 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 as a result of the poor spatial management of the infrastructure 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. Impacts of transport on Coastal/Maritime tourism sector

III.1. Public transport network

Public transport has local network objectives in Djerba Island as well as national and international ones. In fact, it is mainly based on buses in the local area. In fact, the total number of bus stations is about 168, among 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 unclassified road traffic is driven mainly by individual private 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. In addition, there are populated, yet 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 economic, tourist and commercial activities concentration. Moreover, the island's two main urban centers: 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: Houmet Souk and secondarily Midoun. The projected transport lines attempt to improve the integration of the southern part of the island, which remains poorly connected (Fig.2).

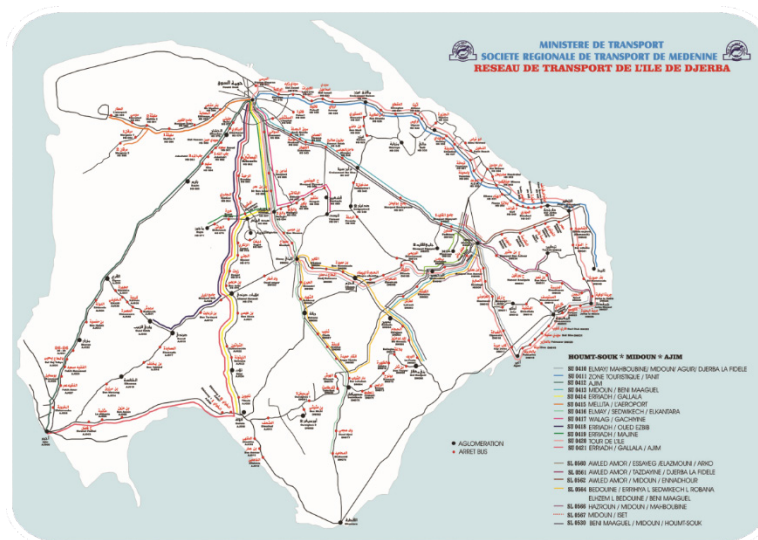


Figure 2. Bus transport network in Djerba(DGAT/APAL/UNDP, 2019)

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.

III.2. Air transport

The share of Djerba Zarzis airport does not exceed 16.50 % of the total national air traffic. The flights in Djerba airport are either regular or chartered (Table 5). The latter type concerns flights that are chartered by Tours Operators. The number of flights is almost equal between the two types. Air traffic is dominated by traffic to and from outside the national territory, linked to international tourist flows (TONT, 2019).

Table 5. Nature of air traffic in Djerba (TONT, 2019)

Air traffic (aircraft)	International		National	Total
	Regular	Non-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-Zarzis 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. On the other hand, passengers on domestic flights represent only about 8% of the total passengers (Table 6).

The stopover passengers counted only for 27,429, the majority of which are from regular flights 69% among which are from Tunis-Carthage airport (Table 7).

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

Table 6. Air transport passengers in Djerba (TONT, 2019)

Passengers	International		National	Total
	Regular	Non-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

Table 7. Air transport stopover passengers in Djerba (TONT, 2019)

Stopover passengers	International		National	Total
	Regular	Non-Regular		
Djerba	18,957	7,852	620	27,429
Total national	47,344	22,797	22,112	92,253

III.3. Functioning of public transport in relation to tourism development and road traffic

In terms of public transport, Houmet Souk has the highest number of buses with 70% of the total number. This is because the number of passengers (per ticket, subscribers, pupils and students) is the highest in Houmet Souk with a total of 6,364,000 trips and it accounts for 66% of the trips total in Djerba (Table 8). These buses, which belong to the regional transport company in Mednine, transport employees and rarely tourists. The latter mainly use private taxis when traveling around the island of Djerba (TONT, 2019).

Table 8. Transport of passengers (TONT, 2019)

Agency	Regular passenger transport of SRT on Mednine			Non regular passenger transport		
	Houmet Souk	Midoun	Total	Taxi	Rental	
Nb of passengers per ticket	2,125,000	783,000	2,908,000	859	Intra-governorate	Inter-governorate
Nb of subscribing travelers	591,000	140,000	731,000		37 cars	39 cars
Number of pupils and students	3,648,000	2,291,000	5,939,000			
Number of buses	41	17	58			

Djerba public transport and its tourist aspect weaknesses have strengthened the private car use as the primary means of transport on the island in addition to the truck traffic for the transport of all types of goods. The road traffic map below illustrates the average daily flow of motorized traffic. In fact, 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 Djerba- Zarzis international airport to the tourist area, via Mellita and Houmet Souk more than 14,000 vehicles/day are estimated. The coastal dual carriageway facilitates the flows, despite the bottleneck on the unfinished Houmet 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 Traffic flow although Ajim is the ferry docking point there (Fig.3).

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

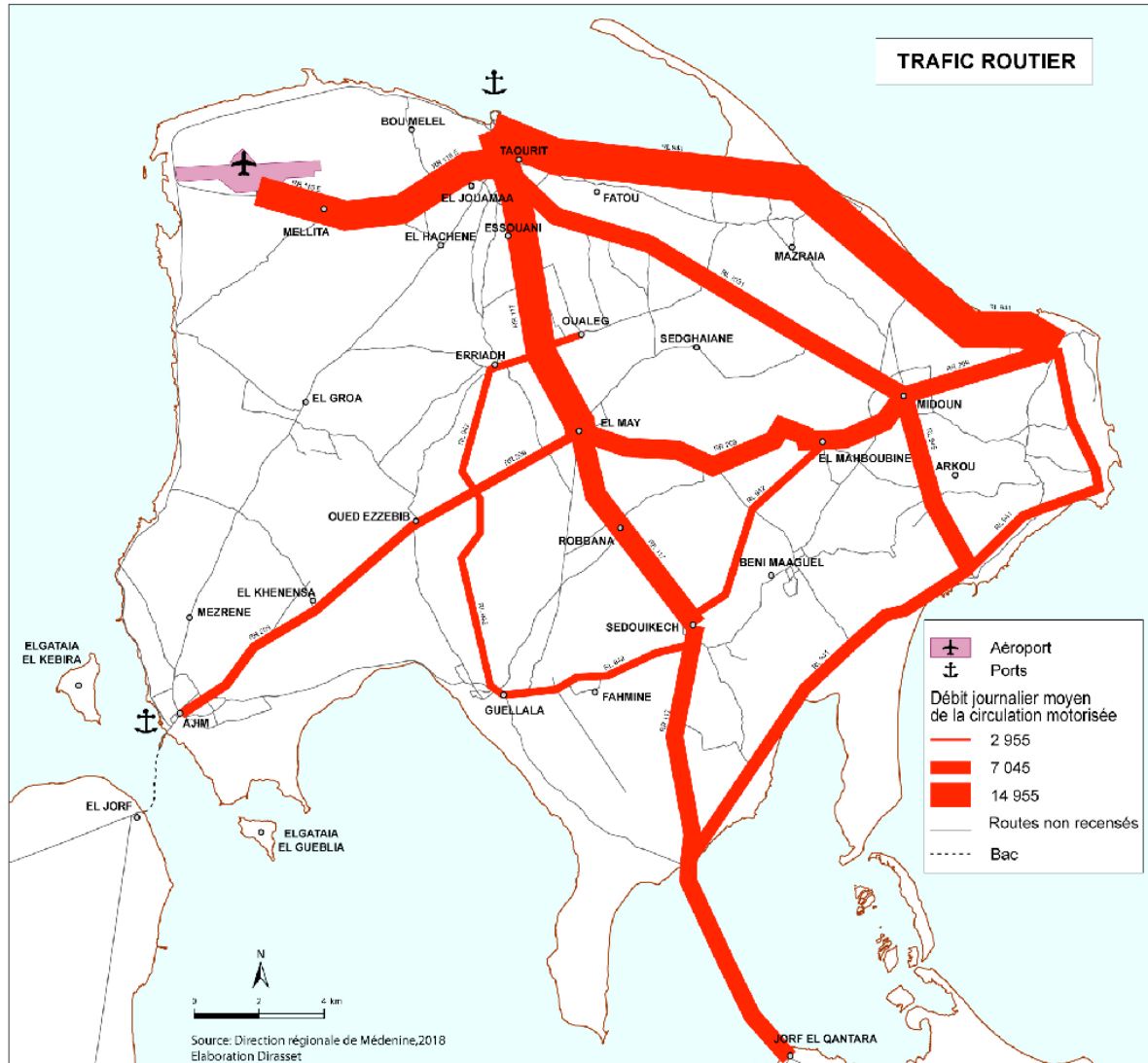


Figure 3. Road traffic in Djerba (DGAT/APAL/UNDP, 2019)

IV. Maritime transport and the effect on tourism

The island Ecosystem services have directly or indirectly contributed both to ecosystems and to human well-being since they are related to maritime activity and transport, too. In Djerba, maritime activity has greatly declined compared to what the island had known until the end of the 19th century. Houmet Souk port has not only served the island but also a large part of south-eastern Tunisia. Besides, 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 Houmet Souk amounted to 40,000 tons and outflows to 2,000 tons (DGAT/APAL/UNDP, 2019). At present, the existing port infrastructure in Houmet 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 mainly limited to tourist activities and sometimes it serves as a boarding station for yachts and pleasure or sports boats. The fishing harbor is nevertheless the most important on the island.

The marina of Houmet Souk has a capacity of 100 beds. It is the final piece in a chain of 9 marinas in Tunisia (Table 9 and Fig.4).

Table 9. Marinas' capacity in Tunisia(TONT, 2019)

Port	Rings
Tabarka	140
Bizerte	800
Gammarth	466
Bou Said	400
Yasmine Hammamet	720
Port El Kantaoui	340
Monastir	300
HoumetEssouk (Djerba)	100
Total	3266

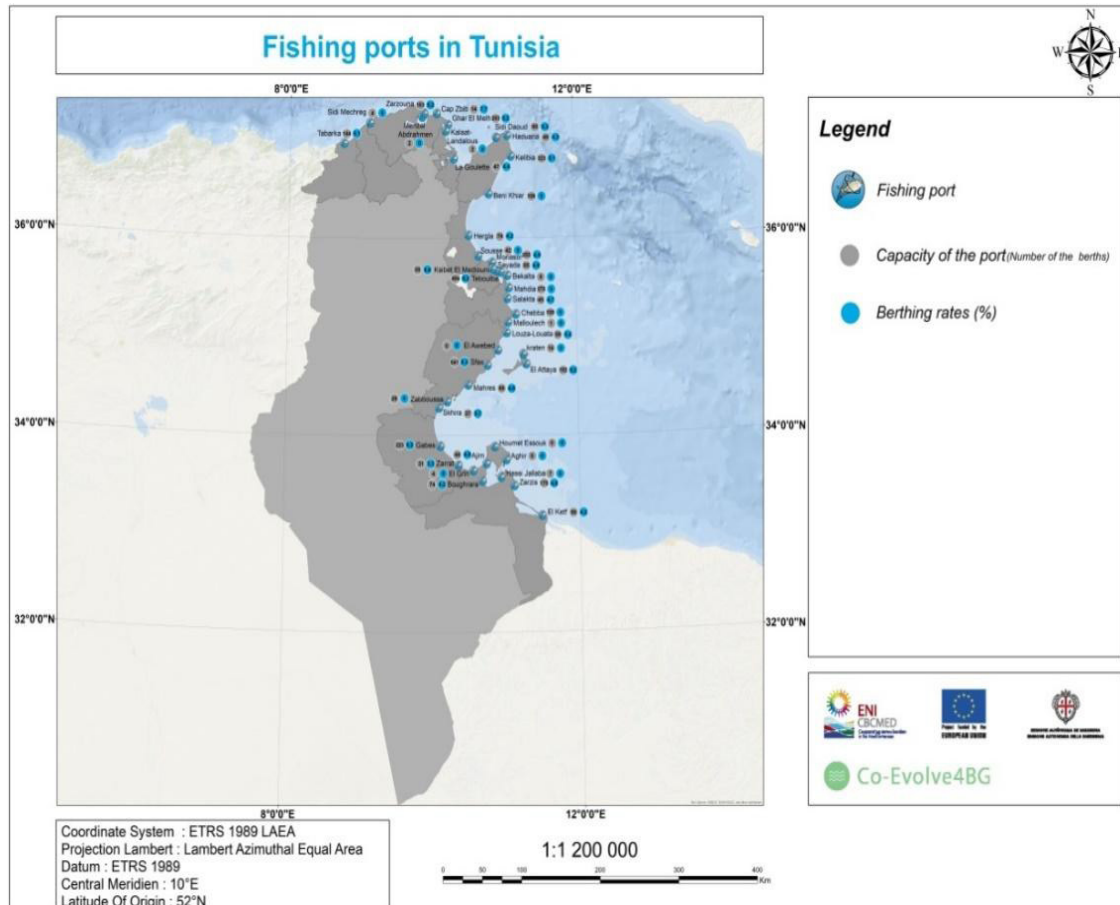


Figure 4. Distribution of fishing ports in Tunisia

Regarding expenditure, no one can deny that activity is a strong generator of foreign currency. In fact, according to professionals, a forty-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 deposit 40 thousand dinars in Tunisia, and that is a minimum figure that no hotel can achieve in such a short time. In terms of formalities which complicate the yachting development in Tunisia in terms of the issue of boat acquisition and registration. They must comply with tremendous 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 communication problem, 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 issue of procedures in some ports is due to overzealous agents.

It is true from the point of view of the State and the administration, there is a certain important awareness of yachting tourism as an activity which generates foreign currency income. Yet, while there is a desire to develop it, there exist fears linked to illegal immigration which hamper initiatives.

Communication is another crucial issue that should be handled. In fact, it would perhaps be interesting to start by talking to each other, by communicating, explaining, and raising the awareness of the law enforcement agents' necessity in terms of leisure tourism. In this context, the very young Chamber of Nautical Industries is responsible notably for the opening of debates, making people understand pleasure boating tourism, distinguishing imperatively boating tourism from the merchant navy, and explaining the rules 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.

In Djerba, a second port is in Ajim to the southwest. It has two components: maritime transport via ferries going back and forth between the island and the mainland and fishing (Fig.5).

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.

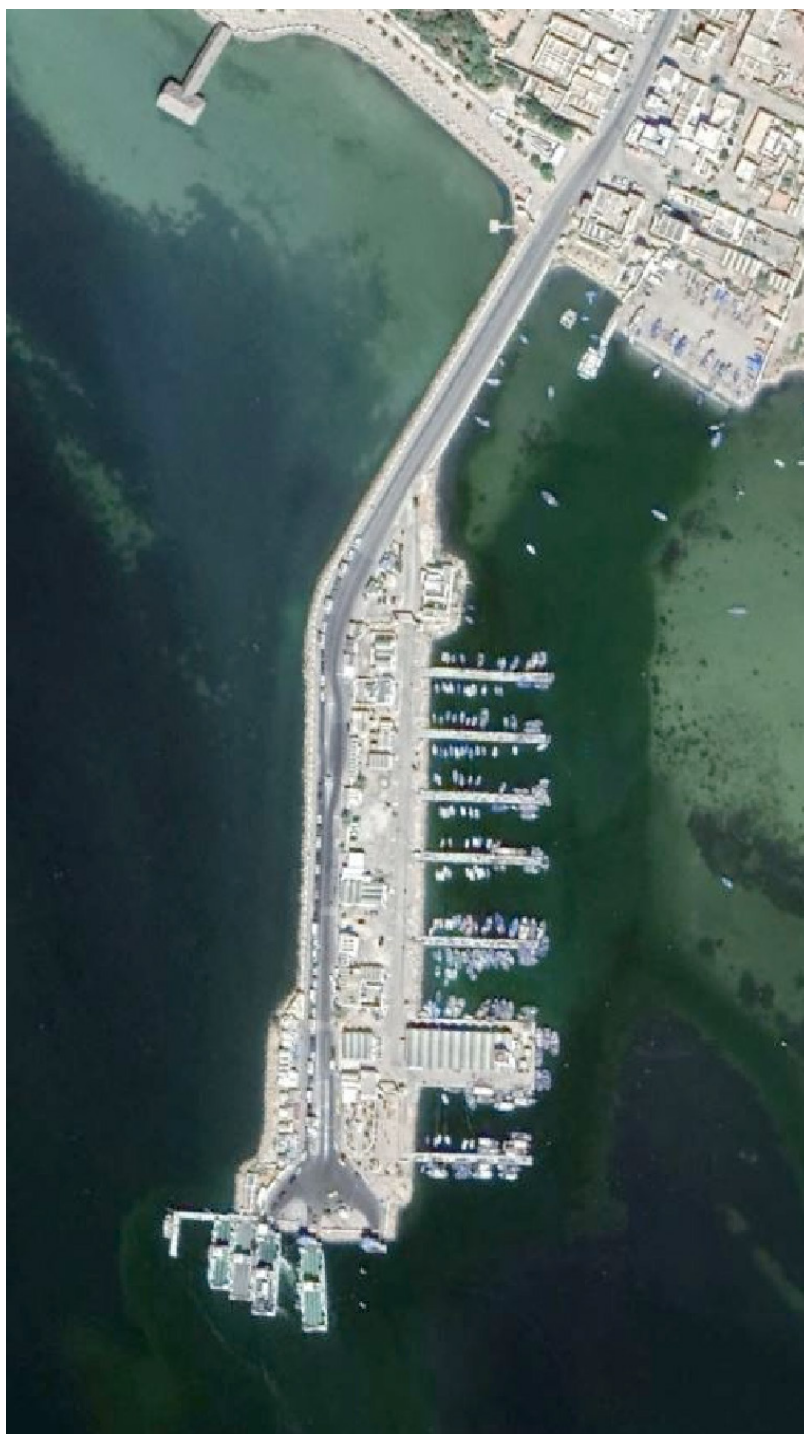


Figure 5. Le port d'Agim(DGAT/APAL/UNDP, 2019)

V. Policies and programs to manage transport issues

V.1. Accessibility and traffic problems

Transport has a fundamental role in promoting equal opportunity and in increasing social inclusion. It has a significant impact on people's quality of life and life chances. Fortunately, substantial improvements to accessibility were made during the roman period. Then, the island witnessed further improved public transport coverage accompanied with more accessible use of the Island from the nearby landscape to the island. Because of its insularity, Djerba is necessarily an area that is accessible through the sea, even if its insularity has become relative due to its gradual attachment to the mainland, both on a natural and human level. By turning more and more towards the continent, Djerba and the Djerbians have relatively tightened their ancestral ties both with the sea and the maritime relations that linked them to peoples and the overseas economies. 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 access the island by sea.

The long queues are becoming increasingly restrictive during rush periods (summer period, school holidays, festivals, *etc.*). Both the Ferries' increasing number and modernization as well as transshipment facilities have proved ineffective in limiting bottlenecks. The prospects for an increase in road traffic from the mainland in the near and distant future point to a long-term Ferries saturation is currently in use.

The existing road on the side from the Roman causeway to the south-east polarizes most of the flow's 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 Djorf is less busy, and the waiting times can be almost 3.5 hours at 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 (Fig.6).

The bridge would be an extension of the RR116 to the mainland. The investments will be provided by 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 (DGAT/APAL/UNDP,2019)



Figure 6. Link between the island of Djerba and the mainland(DGAT/APAL/UNDP, 2019)

The pre-feasibility study identified the impact area as the island of Djerba as a whole and the bridge articulation area between Jorf and Ajim. It is important to recall that the study retained that travel types are classified as follows: 42%work, 34% private business, and 23% leisure activities (DGAT/APAL/UNDP, 2019). Thus, the main objectives of the project would be as follows:

- To improve the island's accessibility and attractiveness and to promote tourism.
- To promote both the economic activities and the trade between the island and the mainland.
- To improve people and vehicles movement to provide road users with further safety and efficiency.
- To raise challenges associated with the construction of a new bridge that may impact:
 - Landscape features.
 - The Lagoon natural environment.
 - Urban insertion of the bridge's intersection points with the island and the mainland.
 - The use of existing buildings and land expropriation on behalf of the State.

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

The opportunities would be realizing a harmonious integration into the targeted areas natural and urban landscape as well as a reduction of travel time.

whereas challenges would be drastic and would lead to detrimental effects such as the inefficiency of the service due to the existing infrastructure reduced capacity in addition to the service slowness. It also leads to heavy goods vehicles passage prohibition as well as to a heavy ecological impact due to pollutants and carbon dioxide emissions discharges.

V.2. Impact of transport on the environment

The Island is widely known for its biodiversity, geomorphology, and nature conservation. Much of the Island is covered by nature conservation and biodiversity designations including several sites which are considered national and international valuable heritage.

According to the study “Tourism and Environmental Health in a Changing Climate” (Haward Kenned School, 2018), Tunisia does not have a practical system to monitor ambient Particulate Matter (PM) levels in cities. Hence, making it difficult to evaluate the impact of a specific activity such as the tourism sector in Djerba. The fact that Djerba uses natural gas as the source for power generation lowers the effects of air pollution. It was therefore more important to look at transport-related emissions. Yet, the air pollution caused by energy use for tourism-related activities, particularly transport, within a tourism destination, is generally an under-researched area.

A study in Mallorca that explored air pollution from tourism found that apart from meteorological variables, tourism is also a determinant in the island’s PM10 concentrations. Specifically, the researchers assessed that a 1% increase in tourist numbers can be related to up to a 0.45% increase in PM levels.

Particulate matter (PM), also known as particle pollution, is a complex mixture of extremely small particles and liquid droplets that get into the air. Particle pollution can be divided into two categories: PM10 are inhalable particles with diameters that are generally 10 micrometers and smaller while PM2.5 are fine inhalable particles with diameters that are generally 2.5 micrometers and smaller. Once inhaled, these particles can affect both the heart and lungs and cause serious health effects. PM2.5 is of greater concern because these particles are small enough to be deposited deep into the alveoli and trigger inflammation and even invade the bloodstream.

Thanks to the data acquired in Djerba, it was possible to roughly estimate PM10 emissions from different sources related to tourism activity. Although the results cannot be put into context, they provide a good indication of the most polluting sources. Given that the peak of tourism activities in Djerba occurs during summer, it was easy to estimate the overall PM emissions from the summer months. The activities included in this analysis were electricity and LPG, taxi use, waste transportation, and transport related to hotels’ supplies. According to the study “Tourism and Environmental Health in a Changing Climate” (Haward Kenned School, 2018). The transport of tourists with taxis is by far the main contributor to tourism related PM10 emissions in Djerba (Fig.7).

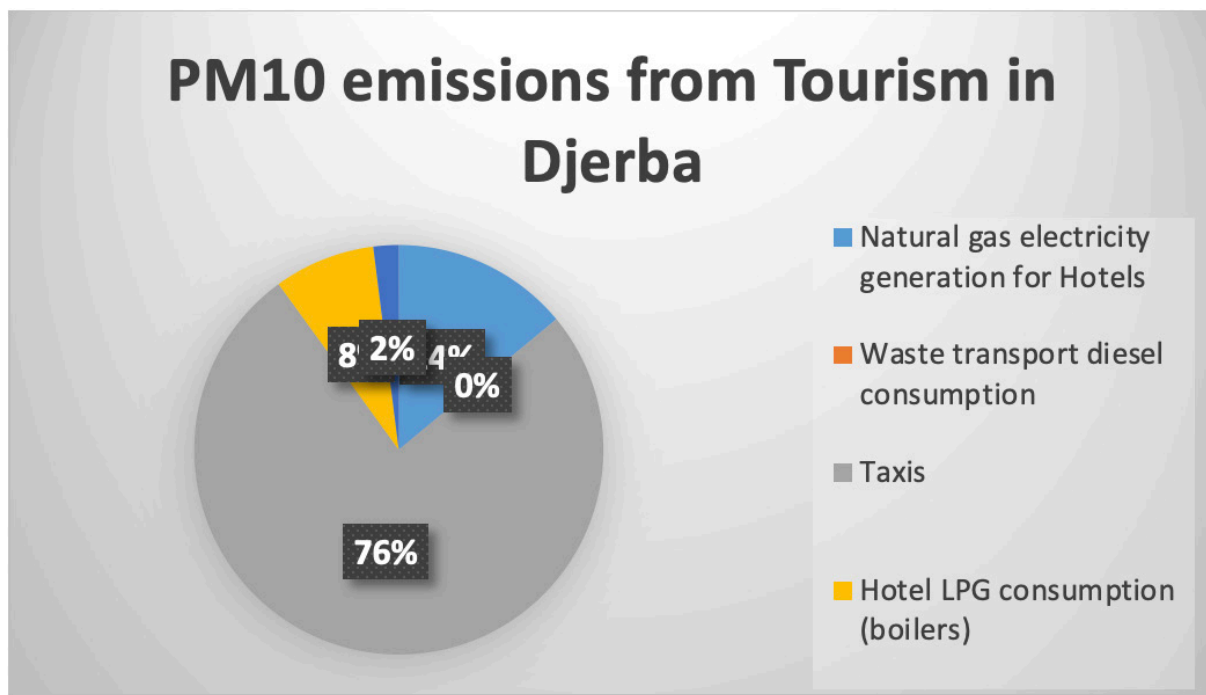


Figure 7. Land use, land use change, climate change vulnerability

Moreover, according to the study “Tourism and Environmental Health in a Changing Climate (Haward Kenned School, 2018), the average per tourist night carbon emissions in Djerba was estimated at $25\text{kgCO}_2\text{e}$ in 2017. In fact, these GHG emissions include all-important tourism-related direct emissions occurring within the destination (Scope 1), 25 plus GhG emissions resulting from power generation that serves tourism electricity demand (Scope2). According to the same study, the total carbon emissions from tourism in Djerba were estimated at $100,330\text{tCO}_2\text{e}$ per year. In fact, it was concluded that Electricity is the highest contributor, followed by LPG and tourist transport with taxis within the destination, and further by solid waste, wastewater, water desalination, and aircraft taxing emissions (Fig.8). The per tourist night carbon emissions rate is more than three times higher than per capita emissions in Tunisia (equal to $7,69\text{kgCO}_2\text{e}$). This implies that if tourism in Djerba continues with the same pace, it will fail to follow the decarbonization path that Tunisia has committed to with its NDC (41% reduction in carbon intensity by 2030).

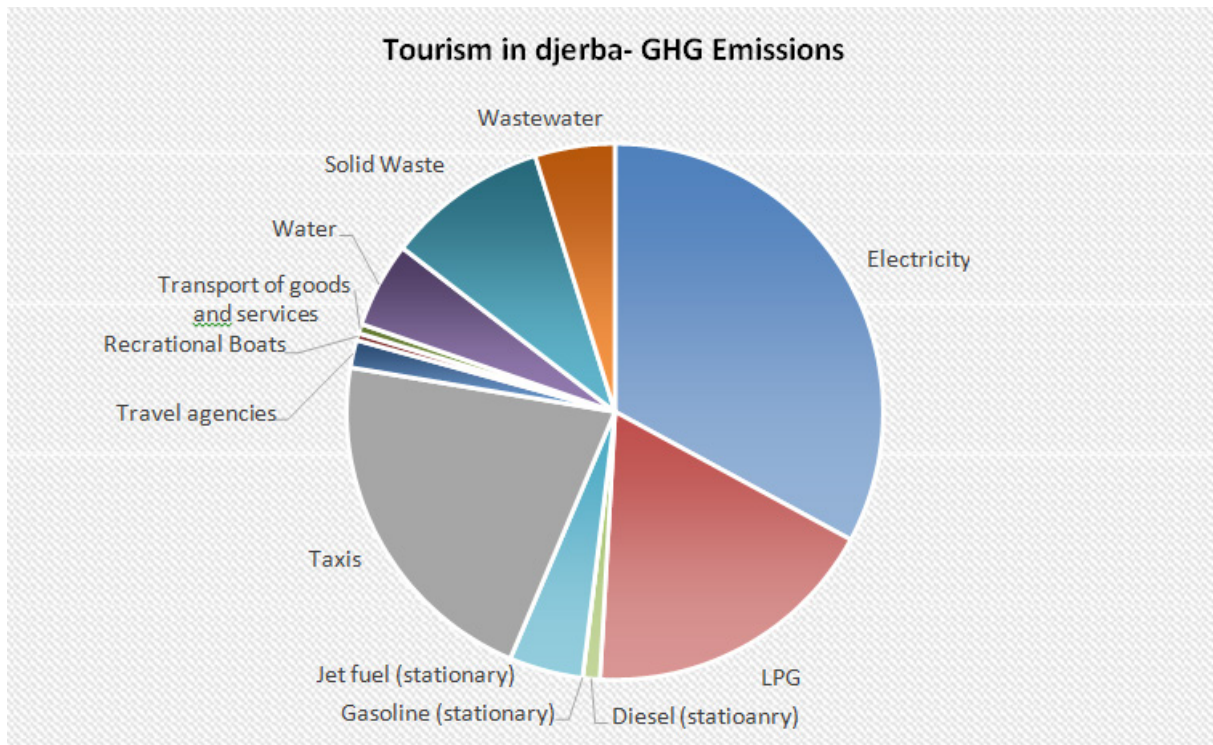


Figure 8. Tourism in Djerba-GhG Emissions

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

VI.1. Opening without nuisance

The Island has a restricted transport network with often narrow or non-finished and equipped roads and historic urban street patterns. Local traffic congestion is a growing problem particularly at peak commuting times, in holidays and during the summer holiday when the influx of tourists increases to contribute to the Island's population growth.

To reduce the insularity constraints and to revive a glorious past as a seafaring people, 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 maritime links development 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, Gabes, Zarzis, *etc.*) will make it possible to develop coastal traffic not only for travelers but also 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 island access conditions improvement for visitors from the mainland will be achieved by improving transshipment services through the rotation's optimization and the high-capacity car ferries use and as well by the land route rational development along Boughrara Gulf.

A marina project could participate in tourism development on the island of Djerba. Moreover, the marina of HometEssouk has not participated in the development of tourism, as had already been planned. It has remained a mere enclosed project that is open to neither urban environment nor tourist practices in addition to the environmental problems, particularly linked to water pollution in the dock. The yachting and fishing activities cohabitation has not been successful. As a result, the marina has been deserted by yachtsmen and it has remained 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, the latter activity needs technical services to develop the yacht's wintering and maintenance activities. Thus, leisure services (cafes, restaurants, shops) must be developed to improve its attractiveness and to create an atmosphere of wellness.

From an urban point of view, the marina of HometEssouk is well situated in relation to the fort and the promenade. It can become the pedestrian continuity of this promenade. In this way, the fort can become a setting for a larger marina and as a result, such an integrated project can be a meeting place for tourists and local citizens. Furthermore, boaters have become very sensitive to environmental quality. For these reasons, the marina of HometEssouk must undergo a major updating project and be part of a labeling process.

VI.2. Opening without nuisance

An integral part of the transport infrastructure development needs to be in coherence with Strategic Environmental Assessment (SEA), Habitats Regulations Assessment (HRA), Health Impact Assessment (HIA) and Equality Impact Assessment (EQIA) which together look at how transport could impact on the environment, air quality, landscape, water, and people (Giles. 2011).

The road traffic intensification will also inevitably affect the island's interior. In fact, it will raise the issue of equipping the island with the necessary road infrastructure to meet these increased traffic needs. Environmental pollution from exhaust fumes and noise from lorries and high-speed vehicles is a nuisance that is incompatible with Djerba's vacation and its inhabitants' desire to enjoy a pleasant 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. It is therefore recommended that one-meter-long cycle paths should be constructed on both sides of these roads.

To reduce the use of cars on the island, it is highly recommended to increase the number of public buses and improve their network and rotations to be appropriate 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 and contain pollution.

In addition 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. The intensification of human exchanges, which is in general, the basis for life and relation intensification, expects the development of the needed tools in ensuring communication over long distances, with efficiency and at a competitive cost. It requires managers training capable of mastering the advanced technology necessary for telecommunication maintenance and telematics equipment implementation.

For hoteliers and industrialists as well as for the various Djerbian and non-Djerbian promoters and businessmen who will find fruitful investment opportunities in Djerba, the new communication technologies offer the possibility of communicating in real time and at low cost with every single corner of the world. Integration into digital networks is essential for both successful business and for money and time saving which entail energy saving, too.

VII. Conclusions

Thanks to its geographical position, Djerba island accessibility has imposed a certain level of infrastructure equipment. Its international airport has contributed to the mass beach tourism development. In addition, national tourists access the island by ferry or through Roman roads.

In terms of traffic within the island, tourists use taxis while the local population uses buses and private cars.

In terms of internal mobility on the island, some nuisances to the urban environment are induced by the mobility system: noise, pollution, danger, energy loss, not to mention accessibility and parking problems. Urban sprawl, the concentration of facilities in the main centers and a good part of the activities in the tourist area, are behind the high mobility, knowing that the tourist activity is itself characterized by an intense motorization. A sustainable island can only be imagined through the alternative promotion to private motorized transport, coordinating the different forms of mobility in intermodal systems and encouraging the use of public transport and soft mobility. In this sense, a bicycle plan is currently being drawn up which represents an opportunity to be seized, yet an overhaul of the public transport organization remains essential. In fact, there is only one cycle track on the island, in the tourist area.

To contain the need for transport and to avoid the use of private cars, it is essential to improve the connectivity and internal accessibility of the road network. East-West bypass roads could prevent the need to travel between urban centers.

Moreover, the improvement of the South-West link is crucial to provide an economic and sustainable development framework on the island.

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