

Palm Trees in Kerkena Archipelago (Tunisia) Natural Heritage in Degradation

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Abstract: In South Tunisia's oases, palm trees are the main irrigated crop. However, in Kerkena, a Mediterranean archipelago located off the east coast of Tunisia, they represent a natural vegetation and a key element, along with the sea, in the natural landscape and the island's economy. The palm tree is "the king tree of Kerkena" according to André Louis, because all of its constituents were used in traditional fishing techniques, especially fixed fisheries, and in the daily life of kerkenians. Yet today, this natural vegetation is in degradation because of natural and anthropogenic factors. Soil salinization and sea level rise are the main natural causes, while the change in the palm tree's position in the island's economy is what humans are responsible for. In this work, we will be treating the issue of palm trees degradation. Therefore, a first part will be dedicated to the natural causes of the deterioration of this natural heritage, a second will be an analysis of the anthropogenic factors, and a third will be devoted to the enhancement of this natural heritage to preserve it and restore its importance in the economy of the archipelago.

Keywords: Palm Trees, Fixed Fisheries, Soil Salinization, Sea Level Rise, Man's Role

1. Introduction

The archipelago of Kerkena, located on the East Coast of Tunisia, at about 20 km from the city of Sfax, is characterized by the importance of palm trees in both its heritage and geography. The land occupied by palm trees extends almost over a third of the islands' area which covers 150 km². Palm trees and the sea are the main elements of the natural landscape in Kerkena (Figure 3). The palm tree is "l'arbre roi de Kerkena": "the king tree of Kerkena", according to André Louis, because all its constituents were used in the traditional fishing techniques, particularly fixed fisheries, and also in the daily life of the inhabitants of Kerkena [1]. However, today this natural vegetation is deteriorating because of several natural and anthropogenic factors. What are the natural and anthropogenic causes of palm degradation in Kerkena? How is it possible to preserve and enhance this natural heritage for sustainable development?

Carte 1: Localisation de l'archipel de Kerkena en Tunisie

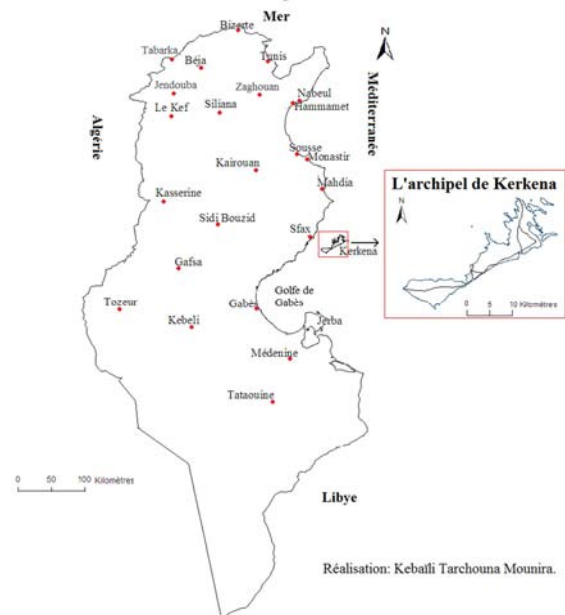


Figure 1. Location of the Kerkena archipelago in Tunisia.

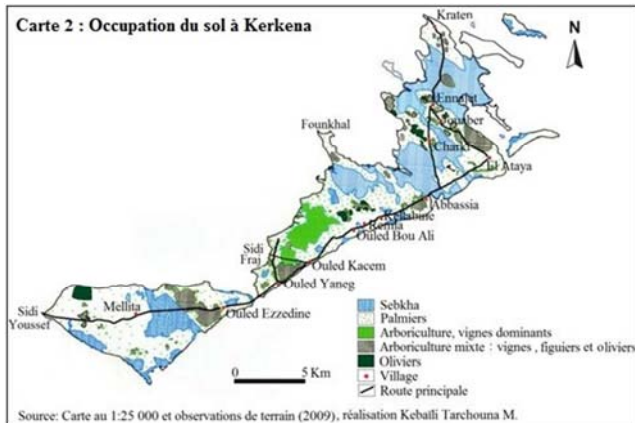


Figure 2. Land occupation at kerkena.



Figure 3. The sea and the palm tree in Kerkena, village of Remla august 2018.

2. Natural Factors of Palms Degradation

Kerkena has an area of 150 km², that is to say 15 thousand hectares. Agricultural land covers 8300 hectares, with 5500 hectares that are uncultivated and occupied by grass and palm trees, which represents, itself, more than half of the whole area [2]. These lands of palm and herbaceous vegetation occupy almost a third of the archipelago, and sebkhias occupy more than one third of the area. (Figure 2). However, palms are degrading and sebkhias are expanding due to sea level rise and soil salinization.

2.1. Sea Level Rise

The Archipelago of Kerkena is a naturally vulnerable environment, due to the active subsidence of the land and sea-level rise, as well as the presence of low coasts. It emerges from a very extensive deep seabed area and is surrounded by shallow sea that does not exceed 0.5 meters deep, at several hundred meters from the shore. Its relief is flat, and its highest attitude does not exceed 13 m. It is one of the most sensitive areas to variations in sea level in Tunisia and the Mediterranean because of the subsidence of the land, at least since antiquity [3].

The work on the question of neotectonics at Kerkena is numerous and we can cite those of P. F. Buroillet [4], R. Paskoff and P. Sanlaville [5], then A. Oueslati [6]. According to A. Oueslati the first subsidence movements at Kerkena are

very old since they go back to the Tyrrhenian and have continued afterwards. This geographer has shown that the Douira formation, the oldest Tyrrhenian formation (120 to 125000 BP years), observed in Cape Bon (Menzel Temime) and in the Sahel of Sousse, is completely absent in Kerkena and that the Rejiche and Chebba formations, deposited respectively by the eothyrenic and neotyrrhenian cycles, are at lower altitudes than in the Sahel and Jerba [7].

The subsidence has been extended during the historical period causing sea level rise. In fact, since antiquity up to today, the level of the Mediterranean Sea has an elevation estimated at about three decimetres, but this average is exceeded in Kerkena. According to Buroillet, this archipelago has been submerged by three meters during the last 2400 years and this results in a remarkable retreat of the coast line [8]. Sea level rise in Kerkena exceeds the average in Tunisia and the world because of the subsidence of the land. "The results of the analysis of tide gauge recordings of the port of Sfax (18 km from Kerkena and belonging to the same geological province), show that the marine lift is well underway and that it was made (in the twentieth century) at a speed of the order of 5, 7 mm / year, ie a rate 3 to 4 times faster than the world average." [9]. It should be noted that the global rise in sea level is estimated at 13 cm during the 20th century, 1,3 mm / year and that the speed measured for 30 years is 30cm / century, an acceleration of the speed of the rise.

Several indicators, such as archaeological data, show the withdrawal of the shoreline at the expense of the archipelago's land and prove that this withdrawal is greater than in the rest of the Tunisian coast [10]. The collaboration of archaeologists and geomorphologists provides the geo-archaeological approach that has demonstrated the changes in the environment during historical times. The most important archaeological indicator is the part of the Roman city of Cercina that has been submerged by the sea. The ruins continue a few hundred meters ahead of the shore. We find "Hajrat El Baou" (hajra in Arabic: stone) which emerges partially at low tide (Figure 4). It is quadrangular and made of reinforced concrete with small rubble. But all around and off this "Hajra" there are several structures still immersed, including alignments of blocks in place under 2 meters of water at high tide, and the most important continues for a distance of 100 m parallel to the coast. According to Chelbi, this "Hajra" was a base of the port complex of Cercina. He thinks it can be a checkpoint or maybe even a beacon [11].

On the other hand, we notice in the field many palm trees caught or slaughtered by the sea, added to constructions on the seashore that were attacked and partly damaged by marine waters. These negative environmental changes are mainly due to natural causes, which are ground subsidence, sea-level rise, and the absence of large streams to feed the coast in sediments. The absence of rivers and the often-muddy nature of the coastline explain the weakness of sandy accumulations on the shores of the archipelago. The sandy beaches are rare and small, they are found mainly on the west and north coast of the archipelago, as Sidi Youssef on the

island Gharbia, Cercina Sidi Fraj where there is the tourist area, and Mkaren Khelifa to the end of the peninsula of Sidi Founkhal.

With sea level rise and marine advancement to land, the sea could reach the palm trees and contribute to their degradation (Figure 5). This Picture was taken in 2005, but after a few years the palm tree shot down by the sea no longer exists.



Figure 4. Hajrat El Baou, remains of a Roman construction, emerges at low tide about 200 m from the shore of Borj El H'sar, August 2009.



Figure 5. The sea reaches the palm trees in Mkaren Khelifa, 2005.

2.2. Soil Salinization at Kerkena

The sea has gained space at the expense of the land, sebkhas are extending by salinization of the soil and the vegetation of the low ground in contact with the sea is deteriorating. Under the effect of the salinization and extension of the sebkhas, palms are gradually eliminated, and

halophilic plants are multiplying and approaching sebkhas and the sea. Field observations confirm this idea, such as the remains of palms that have been found in the middle sebkhas and salicornia vegetation, following the degradation of the soils on which they grew (Figures 6 and 3).



Figure 6. Degradation of the palm tree by salinization, Ouled Ezzedine 2015.

The weakness of the topography (13 m highest altitude) and the subsidence of the land in Kerkena contribute to soils salinization, because, on the one hand, the shallow water table is affected by marine intrusions, and it outcrops in cases of heavy rains and stagnation of water in the lowlands, especially in the sebkhas. "The piezometric level of the salty groundwater is very close to the surface, especially in the lowest ground where it is a few decimetres deep" [12]. The role of sea advancement in soil salinization is greater in lowland areas. In fact, the east coast of Kerkena is more sensitive because it is lower and the sea is limited by sebkha, from the village of El Ataya to the village of Ouled Kacem.

On the other hand, soil salinization is aggravated by human activities, particularly the extension of the El Abbassia salt pans causing the degradation of palms. Man also has a responsibility in the degradation of this ecological heritage and in what follows we will treat anthropogenic factors of the degradation of palms.

3. Anthropogenic Factors of Palm Degradation

3.1. Salt Activity in El-Abbassia Sebkh

The salt activity in the sebkha of El-Abbassia started since the end of the 19th century until the beginning of the 1990s. Its operation was intermittent, and its spatial extension was very limited without any real damage to the soils and the vegetation.

"In the early 1990s, the salt business resumed on private initiative. Large saline basins were then developed... Covering an area of about 84 ha in 1976, salt marshes now cover an area exceeding 402 ha" [12]. In this article N. Fehri

presented the result of his field work in March 2006: He carried out a systematic counting of dead palms, between the road (RMC 204) and Bardouna. "On a strip of 200 to 300 m wide, the palm trees were almost all exterminated. No less than 300 trees, of which only the trunk had remained, have been enumerated" [12].

In August 2018, I chose the same space between the road (RMC 204) and Bardouna to the evolution of the situation of palms in 12 years and I noticed that the phenomenon of degradation and death palm trees is increasing and expanding. I also carried out a systematic count of the dead palms and found 362 trees of which only the trunk is remaining.

The extension of saline or salt marshes has negative impacts on the environment, that are indicated by rapid salinization of the soil and severe degradation of palm trees around the village of El-Abbassia. However, the degradation of palms do not only concern this village, it is a general phenomenon which concerns all the archipelago. This phenomenon is also due to the change in the value of palms for the inhabitants of Kerkena.

Human responsibility is related to the change in the role that the palm trees play in the economy of the island in Kerkena, particularly in the diminishing role of the palm tree in fishing.

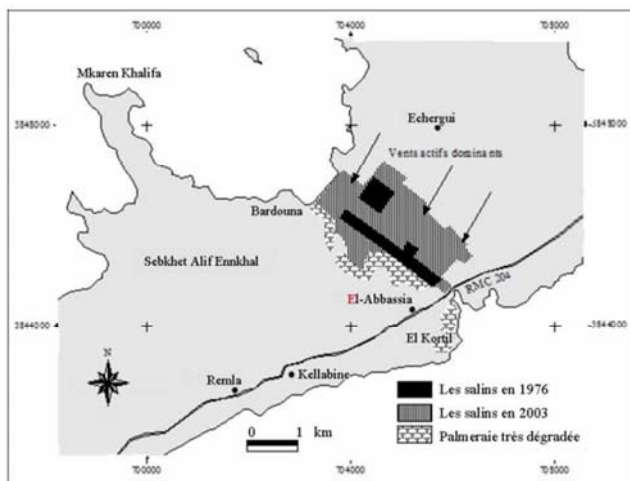


Figure 7. Extension of the salt works of El-Abbassia between 1976 and 2003 and its consequences on the palm grove, N. Fehri. 2011.

3.2. Decrease in the Role of the Palm Tree in Fishing

3.2.1. Importance of the Palm Tree for Fixed Fisheries

Jean Despois said that the palm tree "is the tree of the fisherman" [13]. André Louis calls the palm tree "the king tree" [1]. Speaking of this tree, he does not hide his feelings of respect and appreciation of the fishermen of Kerkena and he calls them fishermen saying, "How these fishermen, by necessity as well as tradition, know with ingenuity, how to take advantage of the least parts of this blessed tree, that Providence has thrown on its soil: the palm tree... If the fruits in the palm are of relatively little interest to the inhabitants of Kerkena, although it is used for animal food and even for its

preservation, the same is not true with the regime which bears them" [1].

The importance of the palm tree in Kerkena, is not for the nutritional value of its dates as it is the case in southern Tunisia, but rather for the usefulness of its constituents for fixed fisheries, especially palms used for the installation of these fisheries and the regimes for the production of traps.

In fact, for centuries and until the 1980s, all the constituents of the fixed fishery came from the palm tree. The fixed fishery called *charfia*, is a traditional fishing technique that has been used in Kerkena for centuries. It consists of an expanse of sea on shallows limited by artificial partitions made up of fins, and where the fish are caught in the traps. Each year, the fishermen renew the fins, they bring them in a boat after they clear them from their thorny and appointed leaflets. At low tide, they plant in the mud flats of the axial path of the fishery which represents the way to go called *rejel* (Figure 8). The sinking of the palms in the mud must be done quickly. Therefore, it requires the collaboration of fishermen. The height of the fins, which measures almost 1,5 meter, must never be exceeded by the water at high tide. The fisherman must calculate this height and the space between each palm planted and the other, which is estimated at 15 or 20 cm.

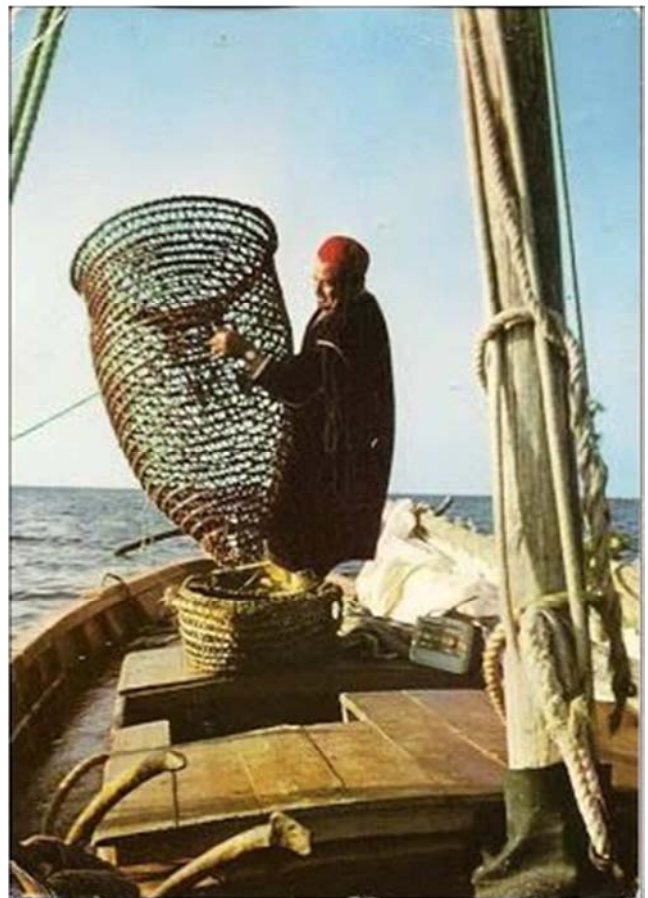


Figure 8. Fixed fishery at kerkena, M. Kebaili 2008.

At the end of the axial path, the fisherman forms a door (in arabic *bab eddar*) composed of two racks and opening on the

capture chamber (*Dar*). Then the fisherman plants his second line of fins at an angle of 60 to 80° with the axial path, thus, forming with it a large V. This line of fins extends to the entrance door of the capture chamber and it is called *Mankab*. This is the way back (Figure 8). The angle is well calculated between the axial path and that of the return. The two paths narrow, meet and overlook the entrance door of the capture chamber to direct the fish towards it and precisely trap them in the fish-trap.

The raw material used for the manufacture of traps is drawn from the natural resources of the archipelago, mainly from palms and alfa: the palm diet and the cord of esparto. The trap has a cylindrical shape but narrows at one end. Its length varies from 0.80 m to 1.40 m, and its diameter from 0.50 m to 0.60 m. The body of the trap where the fish will be trapped, is made by the braiding of the seedlings drawn from the palm diet, mounted on hard support circles also drawn from the spadix and well tightened by the cord of alfa (Figure 9). The job of mounting traps requires a lot of time and patience. That is why at present the traditional trap made from the natural resources of the archipelago is replaced by the iron or plastic trap [14].



Figure 9. Traditional fish-trap.

3.2.2. Gradual Abandonment of Local and Plant Materials

Today, there is a gradual abandonment of materials from of local and vegetal sources in favor of synthetic materials that are easier to use. These modifications affected several elements of the charfia and especially the traps. The traditional trap made from the natural resources of the archipelago is replaced by iron or plastic traps, meaning industrial products. However, the fisherman kept the shape of the trap, its dimensions and its instructions for use.

This gradual abandonment of materials from the palm tree led to the abandonment of this tree considered as "the king tree" by André Louis. This is related to the change of lifestyle in Kerkena and the integration of fishing into the market economy. Fishermen are now using modern techniques such as large nets to increase the production of fish, cuttlefish and seafood in order to sell these products inside the archipelago or outside. They also use iron and

plastic traps for octopus fishing, mainly for export.

The tradition of keeping dates has also disappeared. Before and until the 1980s, women in Kerkena kept dried dates in jars throughout the year for the provision of the family and especially for fishermen when they go fishing.

Today the palm tree is no longer the king tree in Kerkena as it was the case until the 1980s. It does not have the same economic utility as before. That is why a large part of the local population does not hesitate to destroy this natural heritage to meet other needs, particularly to extend the irrigated perimeters.

3.3. Destruction of Palm Trees by Farmers

The inhabitants of Kerkena have expanded their irrigated areas at the expense of palm trees. The phenomenon is apparent especially in the irrigated area of Mellita where the number of palms was very important. Mellita in Gharbia Island which benefits from more than half of the palm groves of the archipelago: 58% in the 1980s [13]. The owner of each parcel rents a bulldozer (Figure 10) to pull out this natural vegetation and replace it with olive trees, but this operation has negative impacts on the environment because the palm trees act as a windbreak due to their height and the extent of the space they occupy, and tearing them away, deprive the archipelago of this natural protector of strong winds, the climate would become more windy and erosion would be faster.

This action is disturbing the environment by replacing palm trees with olive trees that cannot play the role of breeze, but which are of food and economic value. Farmers think about their needs and have no concern for the environment. For them the olive tree is profitable, and it is logical that it takes the place of the palm tree. However, the palm tree is no longer profitable today as before when all its constituents were used for fixed fisheries. The question of economic profitability is clear to farmers, but their perception of the environment is limited.



Figure 10. Bulldozers tearing palm trees, 2007.

Figure 10, that was taken in 2007, shows Man's aggression towards palm trees in the El Borj irrigated area in Mellita.

The palm tree is no longer "the king tree of Kerkena", as André Louis said, but it is threatened by anthropic action [1]. How to preserve and enhance this vegetation?

4. Valorisation of the Palm Tree in Kerkena and Preservation of This Natural Heritage

4.1. Maintenance and Preservation of Palms

Palm trees form the charm of the landscape with the sea in Kerkena, and the devastating action of man against this vegetation, deprives the archipelago of a major element of its natural landscape, so this operation must be controlled by local authorities and the environmental associations of the archipelago. It would be useful for the municipality of Kerkena to prohibit another extension of the salt pans of Abbassia and for environmental associations to make contact with the inhabitants to convince them not to tear up the palm trees. It would be effective to maintain palms by launching clean-up campaigns with the local population to preserve and enhance this natural heritage.

4.2. Valorisation of the Palm Tree and Economic Profitability

The palm tree has lost its economic profitability, but it can become profitable again thanks to its valorization for the archipelago sustainable development by:

The use of its constituents in handicraft: It would be interesting to encourage the use of palm tree materials for making nets for decoration, baskets, bags, night lights and beach umbrellas. But the development of craftsmanship could only succeed with the development of ecological and cultural tourism.

The development of ecological and cultural tourism: Ecological tourism or ecotourism is a type of tourism favorable to the environment and the local population, and cultural tourism is a tourism for the discovery of the culture of the local population. These are two forms of alternative tourism where the tourist seeks to discover the natural and cultural heritage of the local population [15]. In addition to palm trees, Kerkena has a rich and diverse natural and cultural heritage. Previously palm tree trunks were used in the roofs of the rooms of the Arab houses, today we can use the elements of the palm tree in the decoration of guest houses and small hotels, for example nets can be used for the decoration of the lamps thus offering traditional chandeliers. But the valorization of the palm tree could not succeed without being connected to all the other heritage elements and the handicraft heritage in Kerkena; a rich heritage whose palm tree makes Kerkena so original. Thus the tourist enjoys the sea and palm trees scenery, discovers the remains of different civilizations in Kerkena and fixed fisheries based on palm trees, and finds a range of various local products from traditional activities, culinary art and handicraft.

Improving fixed fisheries on an international scale: The

fixed fishery or Charfia is an artisanal fishing technique on the shoals in Kerkena for centuries linked to the weakness of the depths, the rugged underwater topography and tidal movements. This particular technique deserves to be included in UNESCO's cultural heritage. Tunisia has just submitted an application for the inscription of "Charfia" in the Kerkennah Islands on UNESCO's World Heritage List. The nomination dossier was submitted on 28 March 2019 in Paris to the Secretary of the 2003 Convention for the Safeguarding of the Intangible Cultural Heritage of UNESCO. Because, it is a richness of the cultural heritage of Tunisia as it goes back several centuries and it is also recognized as a method of biological and sustainable fishing which preserves the environment and the marine resources. The inscription of the charfia on the list of the heritage of humanity would be beneficial for the preservation of palms and for the development of cultural and ecological tourism.

The valorization of the palm tree organs by a bio-compost allows natural fertilization (dried palms, diets, petioles and abandoned fiber). One can imagine organic agriculture, by the valorization of organic waste like the use of palm tree organs in soil reconstitution and fertilization. Indeed, compost is an excellent soil amendment. It has a high concentration of organic matter.

In 2013, the local development association KYRANIS proposed a project to maintain the Kerkena palm grove and recycle its waste in order to obtain compost, ie a natural fertilizer. Kerkena palm grove has several hundred thousand palm trees. The size of a palm tree gives about 10 kg of waste. The project is intended to recycle 40 tons of palm waste per year. This corresponds to cutting 4000 palm trees / year which is less than 4% of the palm grove. Crushed waste is treated for 6 to 7 months to obtain compost. This treatment requires the addition of 33% or 12 tons of animal fertilizer. The total quantity thus obtained is 52 tons / year. The calculation hypotheses studied by KYRANIS association are based on the successful experience of the conservation association of the Chenini oasis in Gabes in southeastern Tunisia. This experiment consists in palm trees maintenance and trimming, then the transformation of the waste in biological compost and its distribution to the farmers of the region at a symbolic price to encourage them to use the compost. But the KYRANIS association failed to realize this project in Kerkena for technical, administrative and material reasons. Today after the municipal elections of May 6, 2018, the local authorities in Tunisia have more independence than before, so the municipality of Kerkena could play an important role in the maintenance and valorization of palm trees in collaboration with the associations of the development and protection of the environment and the local population.

5. Conclusion

Palm trees situation in Kerkena is alarming. In addition to the causes linked to the natural vulnerability of the archipelago and soil salinization, humans are encroaching on

this natural wealth for economic reasons. The area occupied by palm trees will further decrease and the risk of erosion will increase. The abandonment of the archipelago local products and precisely the palm tree elements for the manufacture of the nets led to the neglect of this tree. Local associations insist on the maintenance of this tree which is the main element of Kerkena's landscape. Approaches by these associations, Kerkena municipality and all local stakeholders to address a serious program for palm trees maintenance and the encouragement of handicraft would be beneficial for the local population and for the ecological and cultural tourism. Good governance is essential to preserve the natural and cultural heritage of Kerkena. The preservation of the palm tree is linked to the sustainable development of the archipelago, particularly the development of ecological and cultural tourism and handicraft.

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