People's Democratic Republic of Algeria

Ministry of Higher Education and Scientific Research

Oasis as an adaptation referential to the hot extreme Conditions

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Preamble

Despite its centuries-long history, we have been reluctant to write this reflection about the Oasis. Indeed, it is the result of in-situ observation for thirty years through a comparative approach of the oasis alongside the different agricultural production systems introduced in the Sahara. Knowing our agricultural products needs constantly growing and socio-economic changes recorded, our investigations are carried out around a central question "What Saharan agriculture for tomorrow?".

Further analysis of Spatiotemporal evolution of Saharan agriculture, in terms of its socio-economic and environmental impact (just confused system)backed by the results of the research allowed us to define the oasis, as an integrated development model combining the socio-economic and environmental dimension, as a living space and not just a farming system (LAKHDARI, 2014).

Its principle of organization and functioning is essential in extreme conditions of the Saharan environment. In terms of sustainability, the oasis has proven its worth.

The issue that was brought up today is that of promoting and preservingit,which remains dependent on our ability to provide it with scientific and technological support (or strategic)and make the best of its ancestral knowledge.

However, there is currently climate threats related to the anthropogenic greenhouse effect and economic crises, the quest for coping strategies is recommended. The oasis model demonstrated the human capacity to adapt to the most severe environmental conditions: this is what also motivated this reflexion as a note of hope for humanity.

Introduction

In the past, ancient civilizations in arid regions especially in the Sahara, have innovated an operating system of the environment to meet their daily needs, for the establishment and stability of populations. This gave birth to living spaces "Oasis" in a naturally hostile environment for human settlement.

This is a centuries-old system based on the rational management of water and soil resources which is associated with an efficient biological material "the date palm." Under these conditions particularly harsh in its effect "Oasis". It created a favorable microclimate for tree and herbaceous species most sensitive to the introduction of livestock and human settlement. Life cores have emerged in the Sahara (see Figure 01). Over time, integrated development and organization of social and economic activities associated with the rational management of space and resources, helped to establish a sustainable economic basis around the date and date –producing derivatives.

The system works like a real ecosystem in the biophysical sense and at the same time as a socio-economic and cultural organization highly diversified across the Sahara. (Figure 2)

We inherit a genuine tangible and intangible heritage that we have to promote and preserve.In fact, its basic principles, and integrated mode of operation despite the natural and man-made hazards, make the oasis a sustainable development model par excellence.
That is exactly what motivated our approach to the listing of Oasis as an adaptation referential to the hot extreme Conditions.

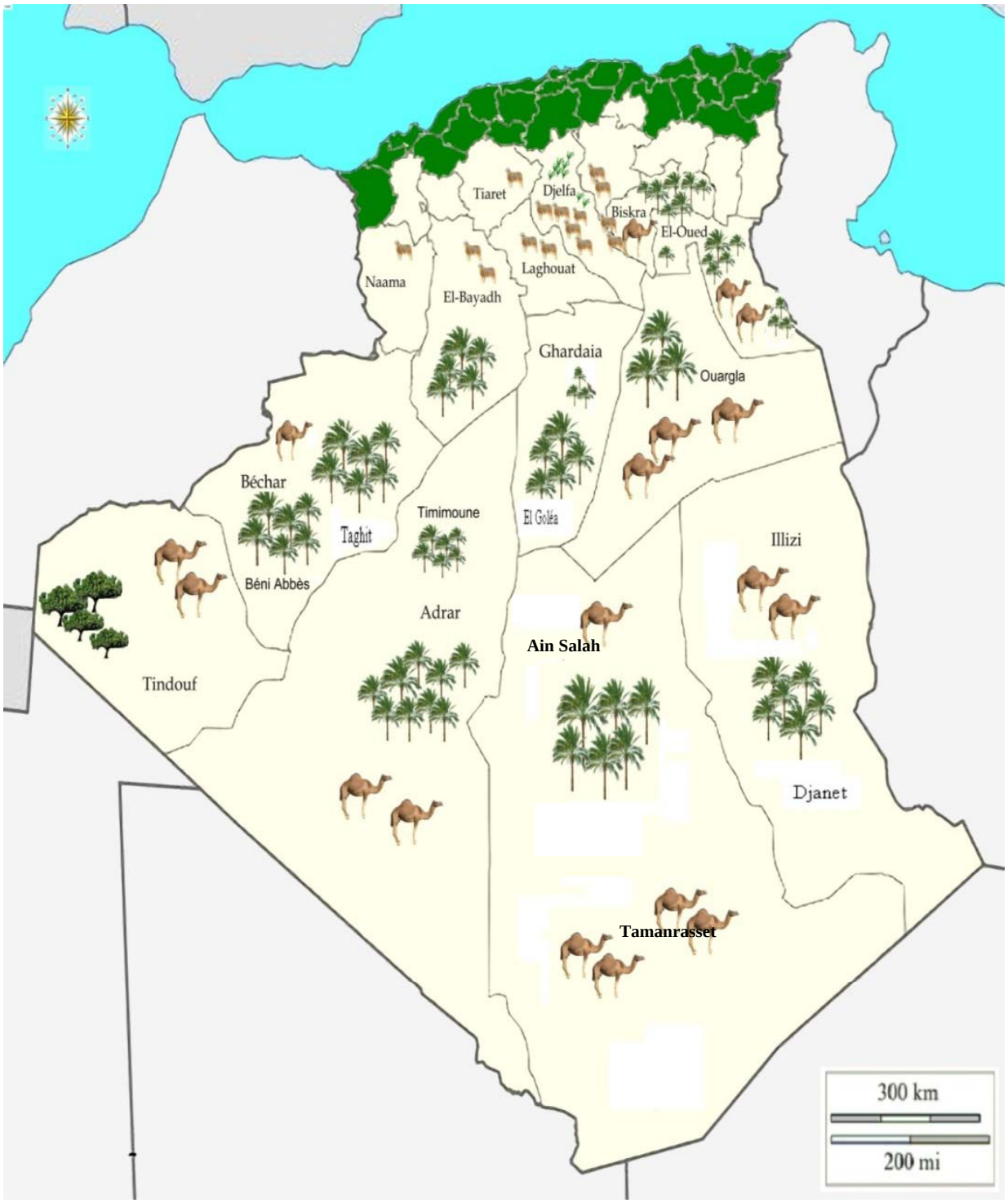


Figure 01: Oasis Network at the Sahara (Algeria)

The system works :

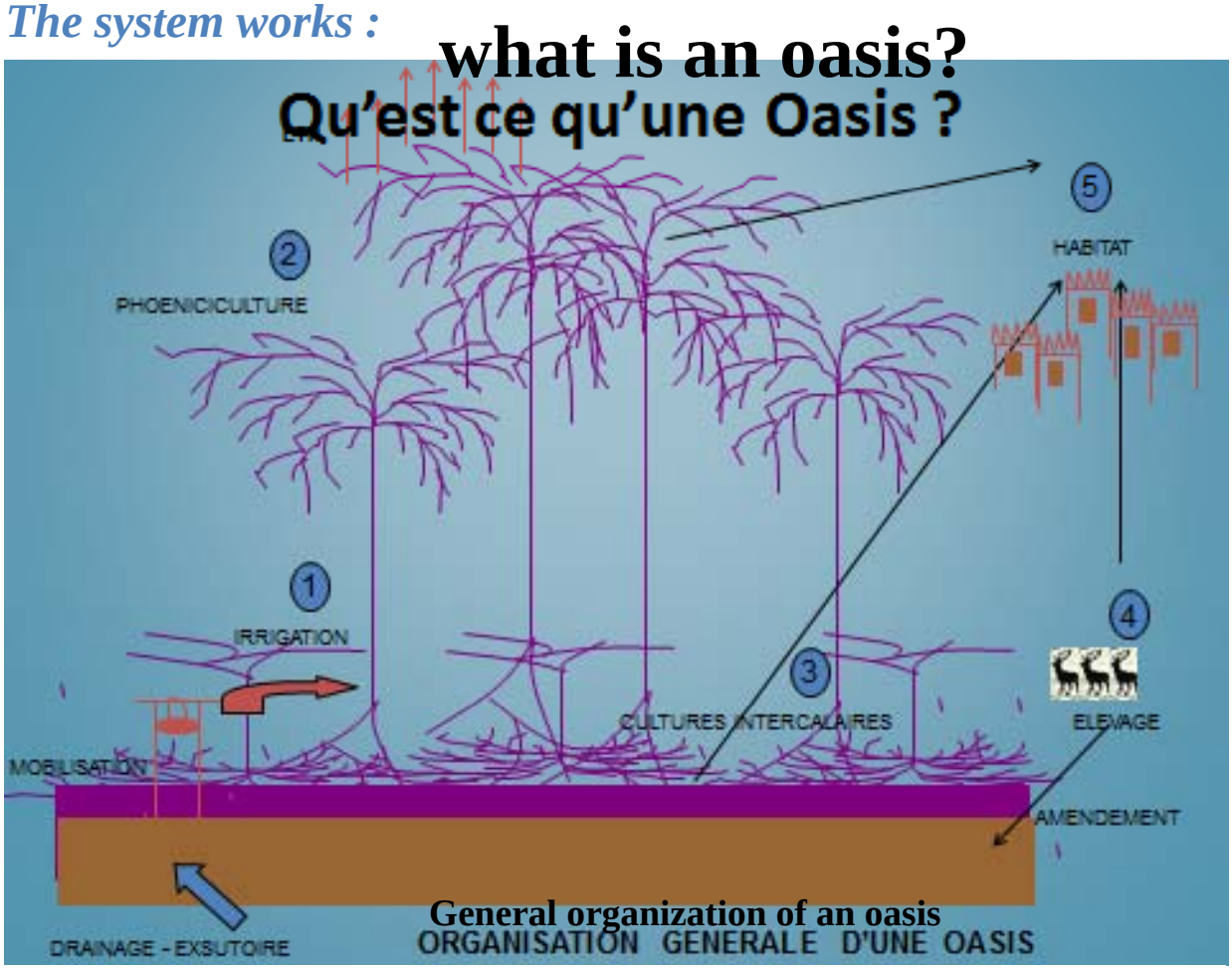


Figure 02 : General Organization of Oasis


Oasis of Taghit (Saoura)

Genesis of Oasis and a basic principle

First, it bears recalling the natural environment where these oases are located: we are right in Saharan desert environment marked by aridity (less than 100mm of rain / year), extreme FTE (~ 2000 mm / year on average) and scorching temperatures (50-55 ° C) in summer. It is also about windy and endorheic areas where agricultural soils are almost non-existent with the exception of a few niches (dayas, alluvial river) despite the vastness of the Sahara. Surface water is insufficient or insignificant; the use of irrigation with groundwater is required at a time when drilling techniques did not even exist at least until 1850.

The ingenuity of the system lies primarily in the judicious choice of the implantation site combining the presence of accessible water resources and soil suitable for irrigation, drainage and cultivation. According to the hydrogeological location of water resources, relief, geomorphology, topography of the implantation site, we saw different Oasis born mainly because of their hydraulic system (complex, ingenious but fragile), but each one as fascinating as the next(see Plate 2 and 3 typology of Oasis) with proven know-how regarding the exploitation of brackish nutrient environment and fight against silting.

As was done with a water generally of poor quality (2-5 g / l of salt), pioneers of the system had to step up their ingenuity to the choice of an uncommon species "date palm" for the expression of an agricultural practice in these conditions. Indeed, by its ability to thermal, water and salt stress (Dubost 1991), the date palm is still the fruit species cultivated by man and the best suited to agro-pedoclimatic conditions prevailing in the Sahara. This is explained at the same time the anatomical characteristics and physiological mechanisms (see Plate 01), some of them are not yet well understood especially those involved in its high tolerance to salinity allowing it to support up to 20,000 microhms (Table 01). Anyway the practice of date palm cultivation has allowed crop diversification led under cover of palm fruit from (pomegranate, apricot, fig) to culinary and aromatic plants hence the name intercropping or through three-stage system.

Anatomical and physiological characteristics

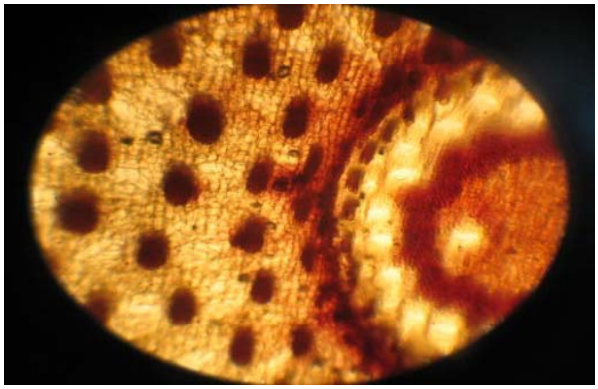
Ability to aridity and extreme FTE (2000 mm / year)

leaf crown(50 to 200 palme)

-Leaf area with waxy cuticle
stomatal regulation
Tree species woodfree
Trunk or fibrous stipe without branching
Tissue reinforced by sclerenchyma / Silica deposits

Mineral composition of tissues /Scanning electron microscopy

ORGANE	Na %	Mg	Al	Si	P	S	Ci	K	Ca	Fe	cu
Couronne extérieure	1.57	2.17	0.82	51.4	2.07	5.51	11.1	14.1	8.75	1.26	1.30
Couronne centrale	3.81	2.71	4.76	16.6	0.93	4.75	18.1	27.7	10.1	1.94	8.66
Cœur	1.56	4.83	0.95	8.36	1.42	5.72	22.9	44.7	8.18	0.53	0.79
Racine	6.13	11.9	3.8	25.6	0.38	11.4	19.3	9.1	9.32	1.64	1.42



dense root system

Anatomy of a young date tree root

Well organized: (Breathing / R Nutrition / Absorption.)

Depth - 17m
Pressure ≈70bars

+ Aptitude au stress hydrique et à la salinité

Plate 01 : The date palm a powerful biological material in extreme conditions

(a) s Oases of Souf country of sand

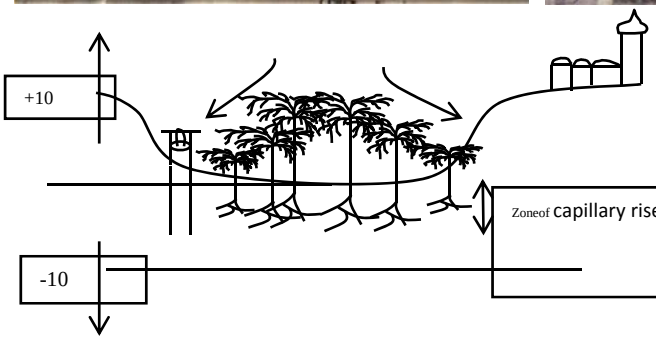
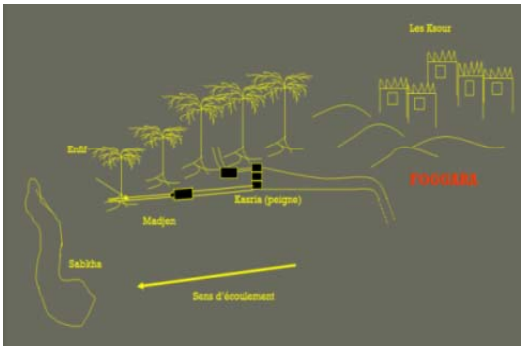


fig: the system of Ghotts
Irrigated agriculture without pump and hoses = an ingenious system
(A know how / Fight against silting) [2]

(b) The oases of TOUAT Gourara, TIDIKILT and SAOURA irrigated with foggaras



- Profondeur de la foggara 10 à 15 m → Acheminement de l'eau par des seguia très étroite
- Longueur des galeries 10 km → minimisant les pertes l'eaux
- Diamètre des galeries 1.20m

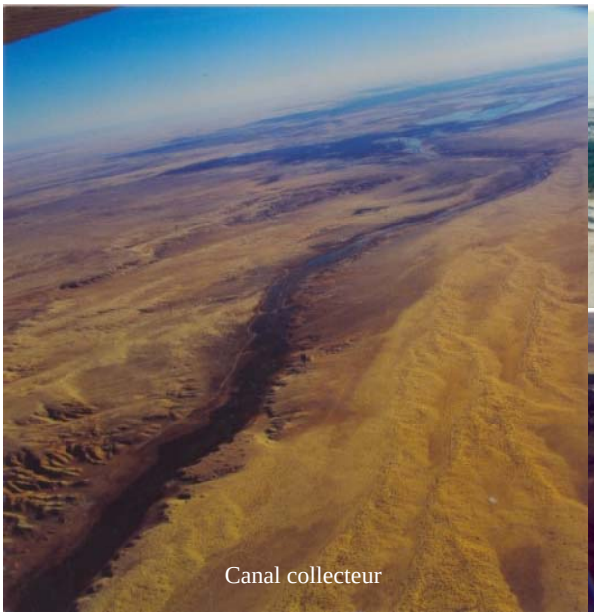
Oasis de Taghit (Saoura)

Foggara en rénovation

Plate 02: Typology of Oasis according to territorial characteristics (a) and (b)

(c) The Oasis of the Oued RIGH (land of salt)

Offering a whole string of palm of both sides of the manifold channel / chaining of excess water leaching of salts # role of main artery, one of the oldest cultivated areas in the Sahara / The first wells dug by human hands /clear expertise despite the salt and depressive effects (cultural practices, preservation of agro biodiversity).



(d) The Oasis of Piedmont: The Ziban Use of surface waters

Rainwater harvestingof the Wadi (double derivation)

-Palm grove on the banks of the river and the habitat on the hills

Plate 03: Typology of Oasis as territorial characteristics (c) and (d)

The introduction of forage crops has facilitated the practice of livestock (goats, sheep, poultry, ...) previously operated solely by pastoralists generally backed the palm grove, where in the same habitat as it is an integral part of Oasis whether villagers habitat, isolated ksours or simple houses. As an example, Mazouz, 2005 in "The city and the desert," explains how talented was the bioclimatic adaptation of old housing in Lower Sahara design using local materials thermo physics, architecture (roofs, courtyards, terraces and ventilated alleys) to direct relations with the palm area while questioning on mutual forms of housing and urbanization in the Sahara.
Definitely, the palm has played the role of living spaces generator for plants, animals and humans. (see plate 04)

Oasis of BENNOUR/Oued Righ

TABLE 1 : Characteristics of irrigation and drainage water in the valley of the Oued Righ Lower Sahara (Algeria)

Les éléments dosables	pH	CE(mS/cm)	Chlore [Cl^{-1}]	Calcium [Ca^{+2}]	Dureté totale TH	Magnésium [Mg^{+2}]	Carbonate CO^{-2}	Bicarbonate HCO_3^-	Nitrate [NO_3^-]	Sulfate [SO_4^{-2}]	Na+	K+
Origine et point de prélèvement	méq/l											
Ain Alkablia F65-60	7.37	7.73	43	24,8	40	15,8	0,08	0,56	0,471	29,735	33,89	1.36
Ain Wilaya D46-F81	7.35	7.03	39	22,5	41.2	18,7	0,12	0,54	0,456	31,061	32.74	1.19
Ain Messaouda P1110	7.3	6.47	35	23,2	38.4	15,2	0,12	0,48	0,438	23,485	28.15	1.15

Drilling water

Les éléments dosables	pH	CE(mS/cm)	Chlore [Cl^{-1}]	Calcium [Ca^{+2}]	Dureté totale TH	Magnésium [Mg^{+2}]	Carbonate CO^{-2}	Bicarbonate HCO_3^-	Nitrate [NO_3^-]	Sulfate [SO_4^{-2}]	Na+	K+
Origine et point de prélèvement	méq/l											
R1	7.83	14.95	88	39,4	80	40,6	0,06	1,94	0,057	55,492	66.025	2.1
R2	7.82	14.62	88	35,2	74.8	39,6	0,1	1,44	0,043	52,273	62.58	2.02
R3	7.88	16.8	99	36	78.8	42,8	0,12	1,5	0,027	66,477	75.21	2.19

Drained water of Plot

Les éléments dosables	pH	CE(mS/cm)	Chlore [Cl^{-1}]	Calcium [Ca^{+2}]	Dureté totale TH	Magnésium [Mg^{+2}]	Carbonate CO^{-2}	Bicarbonate HCO_3^-	Nitrate [NO_3^-]	Sulfate [SO_4^{-2}]	Na+	K+
Origine et point de prélèvement	méq/l											
C1	7.82	15.06	88	35,2	81.2	46	0,1	1,66	0,024	65,151	60.29	2.24
C2	7.87	18.00	111	36	83.2	47,2	0,12	1,56	0,076	55,114	77.50	3.39
C3	7.89	18.10	111	37,2	85.6	48,4	0,14	1,54	0,047	61,364	77.50	3.51

Water of collecting duct

Organization and functioning of an Oasis:

In oasis environment,the activity is certainly diverse, but still remains centered around the date palm whose conduct requires tasks at the rhythm of agricultural season which also generates permanent and seasonal jobs through various maintenance, irrigation, draining plantations, pollination, harvesting, packaging and marketing of date products at nationally and internationally (to the northern and southern countries).

In this regard, the date palm involves both the intervention of man than the woman. The latter occurs especially in downstream of the sector (sorting of dates, processing of dates and its derivatives).

The date is the basis of the Saharan economy, oasis dwellers live at the biological rhythm of the date palm.

It must be said that the date palm cultivation heritage has been bequeathed to us by the first planters of rich and diverse palm (about 900 cultivars),offers a wide range of fruits from the date soft or semi-soft to the dried dates with as a display of the maturation schedule depending on the cultivar and soil. The varietal inventory carried out by Hannachi et al (1998) and Belguedj (2002) provide evidence of this diversity of oasian entity and according to degree of frequency.

More recently, the date palm CRSTRA team reports that the targeted marketing has focused on Deglet Nour over other cultivars for more than a century and has only grown in recent decades (Dakhia et al. 2013) in the date- producing basin in Northeast (Ziban, Souf and Oued Righ) area known by Deglet Nour.However, a significant date -producing diversity is still in progress, it benefits from planting programs, and they are backed by an economic base of preservation, processing, marketing, for better marketing.

According to its consistency, its aroma and sugar levels, the date is preferably intended for a particular use (such as fresh table fruit, such as dried fruit fit for transport through the wilderness traveler, or for processing in local products (rob, vinegar, honey, confectionery etc ...)

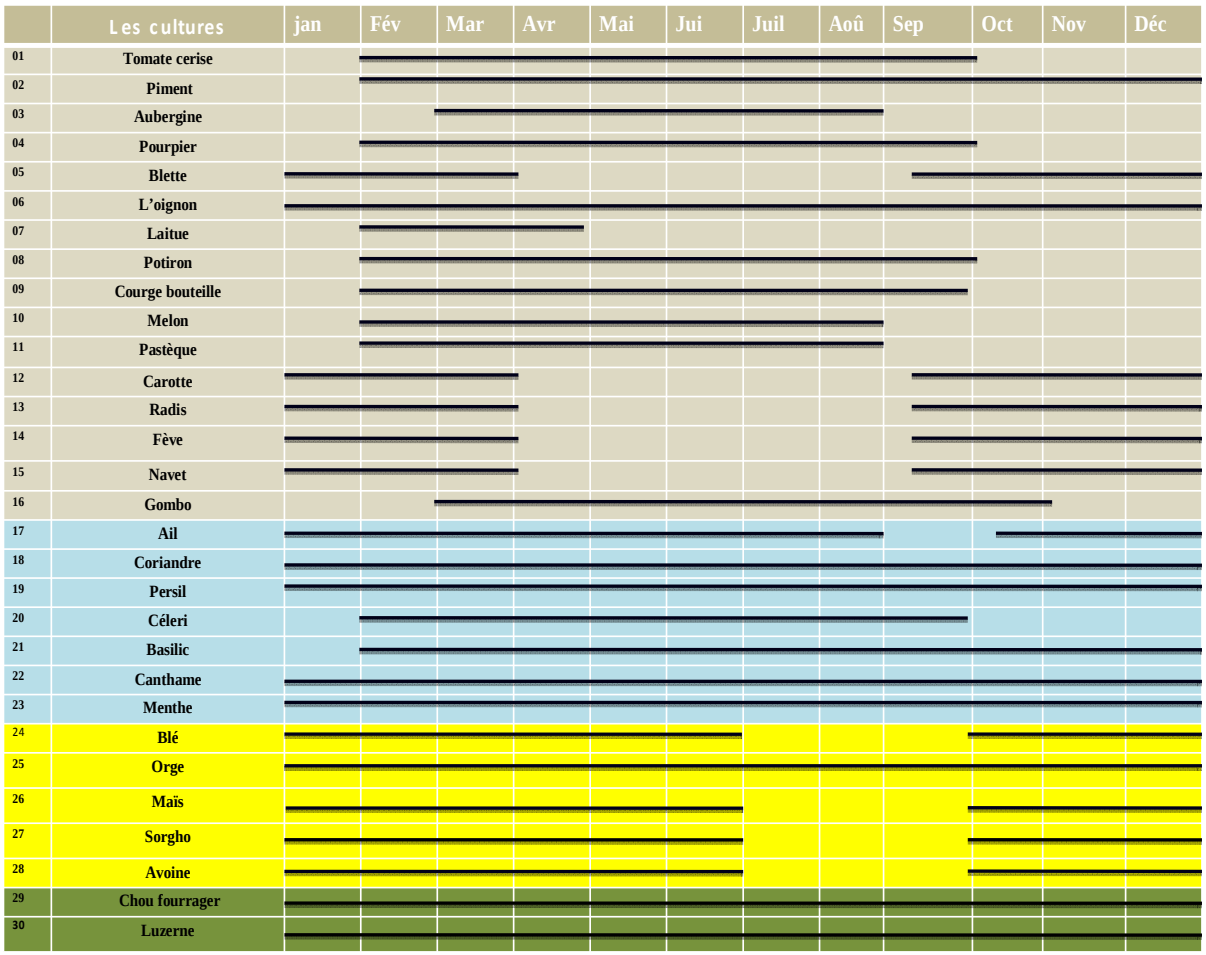
Another important aspect is that all derivatives of palm cultivation find use in the Oasis:
-The Downgraded dates and pits as livestock feed,
-The Biomass depending on its condition, it is directed to crafts (basketry), the structures at the palm grove as fences, wind breezes and / or to protect young plants (djebbar).

Basketry using palm (craft room of Biskra 2014)

Fence with the byproducts of the date palm and local ground

Through the Oasis effect, the date palm cultivation has introduced other crops such as perennial (pomegranate, fig or apricot) annual and multiannual, which follow the rhythm of seasons according to a crop calendar based on the principle "crop rotation " (see Plate 04). This helps the enhancement of the m3 of water used to overcome the soil depletion and mitigate the ubiquitous salinity across the Sahara. Soil fertility is maintained by cyclic organic inputs of animal origin but also by the use of the rotation system -crop rotation and the practice of some restorative crops such as legumes including alfalfa.

This mode of exploitation requires some resilience from the milieu.



Schedule of intercropping

LAKHDARI et al, 2010

Land Use

-valuation of m3 of water
-maintaining soil fertility
-decreasing the salinity

Rotation

crop rotation

-The food ration balance
-Improvement of household income

Plate 04: Management of space and species

The Date Palm tree as an generator as living places for:Other plant ,animal species and for human being

While being seen as secondary crops, they contribute significantly to dietary balance and improve family income.

This explains that until today in every oasis, a peasant area is reserved for the local market, selling products of the palm grove.We may find also tomato cherry, fresh salad, alfalfa as herbs but still exceptional quality products.

It should also be noted that this practice practice was the reason for is the cause of conservation of agro-biodiversity of local and / or acclimatized species to the environmental conditions, like the valley of Oued Righ (and Lakhdari al); one of the oldest cultivated and saltier areas in the Lower Sahara (see Table 01).

In addition to domesticated plants and animals, the Oasis has also a spontaneous rich flora and fauna biodiversity (insects, reptiles, amphibians, avifauna...) It also ensures the role of relay for migratory birds in search of nourishing and mild nests in winter season .Biodiversity is backed by various scientific works (Doummandji-Mitiche B. et al. 1982), (b Doummandji-Mitiche. Et al . 1985), (b Doummandji-Mitiche. et al. 1997), (b Doummandji-Mitiche. et al. 1999) (Idder m. A., 2011) (Chouihet Noussiba, 2013) (Farhi, 2014).

With its original concept based on integrated management of space, natural resources, its own productions and their derivatives, Oasis generates practically no waste. Everything is used and / or is recycled between the palm grove, breeding and habitat and / or flow outside the Oasis through trade and exchanges: it functions as a self-regulating system, while being very open to the world.Along its history, the Oasis has capitalized tangible and intangible heritage in terms of specific know-how in of the arid and hot environments in all areas of human life (hydraulic, dryland farming, housing, environment, crafts, cultural, ...) which renewed interest and take another dimension at a time of climate threat.

Thus,making it an allimportant reference point at the Sahara, which we can be inspired in terms of development as well as the scientific research.

Although it is human design at least in the base, everything works as an ecosystem biophysical sense, but also as a social, economic and cultural organization with an economic base about the date. Also, oasis dwellers are living in biological rhythm the palm tree

What makes the Oasis a form of adaptation to extreme desert conditions, a model of sustainable development, a place par excellence, combining the environmental and socio-economic dimension

Oasis de Megarine

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