Oases in Southern Tunisia: The End or the Renewal of a Clever Human Invention?

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Abstract Today, we do not know how to define oases or how to classify them due to the diversity of their situations and changing routes on which they are situated. We may eventually keep this name for the small islands of greenery now irrigated by wells. They may have lost their trees, and may have been cut off from their network of exchange, or even been abandoned by farmers who have become urban dwellers. Do the new features of these spaces completely transform the age-old notion of oasis, even if the oasis landscape remains? Is then the notion of an oasis only linked to its superficial image? In looking for a more modern and dynamic definition of these spaces, it is relevant to propose new typologies. Once we assume that future oases will never look like they did in the past, this may imply not just an evolution of the term, but its demise.

Keywords Oasis · Tunisia · Evolution · Traditional landscape

In the last twenty years, some oases have become the focus of programmes of safeguard, protection, acknowledgement and even enhancement. These local and international projects highlight the cultural and social characteristics of such spaces as well as their great biological and genetic diversity. In fact, they are isolated in a hostile environment but, at the same time, part of a very extensive network of exchange. Oases are also the site of specific knowledge developed by native peoples. However, these sources of water have undergone significant changes since the second half of the twentieth century, changes that began earlier but had remained less visible. Can we speak of the degradation, decline or even death of oases as

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Mainguet does (2003)? Moreover, oases are no longer the only inhabited and cultivated areas in the immensity of the desert.

Thus, as the oasis landscape in southern Tunisia has greatly evolved, and its purpose seems to have changed a great deal, with oases no longer being the only "daughters in the desert", we may wonder whether the term oasis is still relevant. Are oasis spaces about to disappear or are they already defunct? Or are they a concept that needs updating? In the southern Tunisian local language, as well as in official documents, different terms are used to refer to "traditional oases", "modern oases" or "new irrigated areas". At the same time, does the definition of an oasis correspond to what it was before and not what it is today? A more modern and dynamic definition seems essential, in order to take into account the various types of landscape. Such a more open-minded outlook could help provide a more specific and efficient management of these areas at every level. Is the term oasis still adapted to the varied states of the landscapes? Are we witnessing the death of a clever human invention or are we on the brink of a rebirth but with new shapes and functions?

We shall attempt to answer these questions on the basis of two key elements: first, the age-old definition of an oasis, its use and its image and second, the observation and systemic analysis of oasis areas, their evolution and their functions, mainly in southern Tunisia.

1 The Use of an Image Suited to a Consensual Definition

An oasis conjures up visions of travelling, a change of scenery, associated with recurrent elements: palm trees, the presence of water and possibly the presence of men through music and traditional artefacts. Spontaneously, the layman sees an oasis as an untouched area, a potential refuge for men in a hostile environment, a place of serenity and eternity and a place where nothing ever changes. It is this mixture, this ambiguity, which is put forward when the image of an oasis is used for tourism and trade purposes (dates). Posters in tourist offices and travel agencies show photographs of oases to promote genuine natural locations in the middle of the Sahara desert or on its fringe.

1.1 A Basic Definition of an Oasis: As Always it is a Threefold Water–Men–Vegetation System

Oases have been described and analysed from an agronomic as well as from a social point of view. Their biological wealth (great diversity of vegetation and animal life, endemic species) has only been acknowledged internationally more recently. Many writers have shown interest in oases, either to understand them as a whole or to describe and analyse some of them in particular.

During the seminar on the agricultural system of the Nefta oasis in 1988, several typological elements were established as being particularly important to define oases

and their agricultural systems: implantation in an arid environment, the existence of a microclimate linked to a man-made cultivation in strata, an intensive but isolated agro-ecosystem and a place where a settled population lives and where economic and social cultural activities are intense in a desert environment (according to Skouri 1990). To complete such elements, Kassah (1996, 2010) put forward the diversity of oases in the world. He underlined the permanence of their situation in arid or semi-arid environments, the fact that they are threefold water–men–vegetation systems, and their multiple functions. However, at the local level, the borders between oases and desert landscapes are sometimes hard to define. As time has gone by, elements have been added and others have disappeared. Battesti (2005) emphasised the difficulty of marking the fluctuating boundaries of such locations.

We focus on the threefold idea. First, it enables an oasis to be differentiated from the spontaneous presence of vegetation in a desert landscape. This man-made landscape is a complex and specific anthropo-ecosystem. Although the palm tree is the first visible landmark, it is associated with other vegetation in three vertical layers. The highest stratum is constituted by palm trees. It plays an essential part in the protection of cultivated lands by creating a wetter microclimate than in the outer boundaries, limiting solar radiation and the drying effects of the wind. Besides, irrigation maintains a certain level of moisture. The second intermediate stratum is composed of other species of fruit tree such as lemon, orange, pomegranate, peach, apricot and olive trees. The last and lowest stratum consists of market gardening (carrots, lettuce, onions, etc.), fodder such as alfalfa and industrial crops (tobacco and henna).

Secondly, in the places where rainfall is scarce and where surface water is rare, irrigation is necessary to grow crops. The maximum average rainfall in southern Tunisia occurs in Gabès with 180 mm a year. Such irrigation is made possible by the collective management of water resources. It is used to come from springs, natural resurgences of underground water rising to the surface or *foggara*, a system of draining galleries in mountains. Water is then driven through the oasis by a system of *seguias* or irrigation channels.

As a result, the very shape of an oasis is defined by its water system and distribution network. Moreover, the ownership of the best plots of land reveals the power of the rich local families. Their plots are situated next to the main dispatcher leading to the major *seguias* giving easy access to the water resource. Thus, the shape of an oasis can be considered to reflect the social organisation of the community (owners managing the water).

Consequently, man is at the root of oasis landscapes. Oases are defined by the tangible and marked presence of vegetation under control and a complex system of irrigation and drainage.

1.2 A Specific Anthropo-Ecosystem

An oasis is a common space for multiple uses and functions, where recurrent elements are water/man/vegetation. They structure the landscape with the aim of

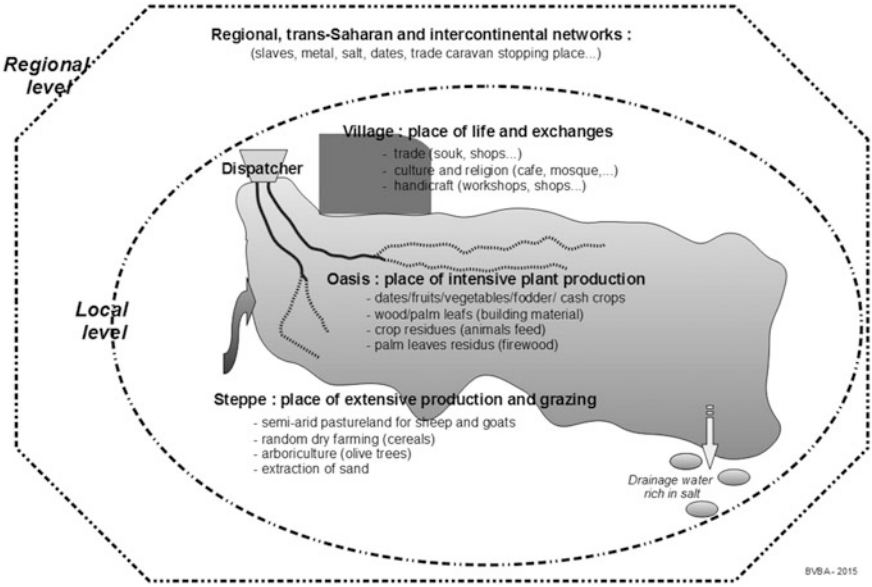

Fig. 1 Spatial positioning and organisation of traditional oasis system at the end of nineteenth century

production. An oasis is thus a place to produce crops and also rear animals on the fodder grown for the flocks that graze outside the oasis limits. An oasis is also a location of handicraft industries (wickerwork, pottery and woodwork).

Thus, complementary activities illustrate the connection between human settlements (the village), the nearby environment (oasis) and the overall environment (steppe) (Fig. 1). Such a diversity of production makes it a favoured place of exchange with the outside world. Due to all these factors, oases fit in with an economic, social and cultural network of commercial exchange, both trans-Saharan and Mediterranean. Even if oases are defined in relation to a much wider space, they have some specific characteristics, a particular farming population and a typical social organisation.

An oasis is a very special "anthropo-agro-ecological" system where man plays a central part, shaping the landscape horizontally (complementarity of steppe/oasis, urban spaces and rural spaces) and vertically (3 vegetation strata). To sum up, not only is man a factor in the evolution of oases but also an essential element in their creation, giving these ecosystems their originality. Without man, there would be no oases.

Because oases have been relatively isolated for so long, they have developed their own characteristics: there is great genetic biodiversity among species (i.e. a variety of palm trees on a regional scale). In many oases, some varieties are endemic. However, this diversity also has a strong anthropic character. In an environment where natural conditions are particularly hard, even hostile, men have

been forced to developed ingenious systems of adaptation. Thanks to intercontinental and transcontinental networks of exchange, men have discovered and imported species and techniques that they have gradually adapted to meet their requirements. Such adaptations have taken centuries, as in the case of alfalfa. "Gabesi" alfalfa can now grow despite being irrigated by very salty water (2 g/l).

1.3 An Anthropo-Ecosystem Identified as an Inheritance?

Oases appear to be unchanging but in fact they are not. This apparent stability is linked to the constant search for a balance between the environment and man, and between resources and constraints. The recent and very rapid changes seem to have upset and destroyed this apparent stability.

Today, oases no longer correspond to the definition given in the 1980s, which does not take into account recent developments. There is a discrepancy between the present-day state of oases and what international organisations want to preserve as an inheritance of the past. They wish to safeguard the genetic and cultural heritage of oases, but they refuse to see that their degradation is well underway.

So, are oases still a reality or are they definitely defunct? Must we limit the use of the term of oasis to the threefold system of water–man–vegetation, and do away with the consequences of interactions between these elements? If we retain the term oasis only in relation to the threefold system, then all the irrigated agricultural areas, including the more recent ones, can be named oases, at least those in the making. With their recent changes, can the oldest oases, such as "traditional oases" in southern Tunisia, still be defined as oases?

2 Recent Expansions and Age-Old Creations of Irrigated Areas in Southern Tunisia

In southern Tunisia, in the last century and particularly in the last few decades, irrigated agricultural areas have greatly expanded: from 49,421 acres (nearly 20,000 hectares) in 1962 to 98,842 acres (nearly 40,000 ha) in 2010 (Kassah 2010). In the region of Gabès, irrigated areas increased from 6671 acres (nearly 2700 ha) to 33,853 acres (nearly 13,700 ha) between 1900 and 2005 (Abdedayem 2009). Agricultural land has become multiform and complex.

2.1 Diversity of Irrigated Agricultural Areas

Deep drilling techniques have enabled cultivated areas to be established due to irrigation techniques in the steppes. Formerly, these zones were only used for extensive breeding or even for dry culture (very haphazard).

The term oasis is thus mainly used to describe those that already existed at the time of colonisation and are called *oasis traditionnelles* (traditional oases). The new forms of exploiting irrigated plots that are developing in southern Tunisia are in turn called *oasis modernes* (modern oases) and then *nouveaux périmètres irrigués* or NPI (new irrigated areas).

Irrigated lands are increasing, and farming techniques for exploiting steppe zones are diversifying, and yet the new ways of working the land have not replaced earlier ones. They coexist side by side with them or create new small islands of cultivation. Based on the dates of irrigated areas appearing in official documents, they can be classified into three distinct groups. Several expressions in everyday language enable these areas to be differentiated.

2.1.1 Traditional Oases

Traditional oases were created before 1900. These areas represented 6671 acres (nearly 2700 ha) in the region of Gabès and 16,062 acres (nearly 6500 ha) in the whole of southern Tunisia. It is about the same nowadays. Their water supply used to come mainly from springs. The supply was managed collectively by an association of landowners and then by farmers. Most of these springs have run dry since 1980 or 1990. In this type of area, a landscape with three vegetal strata is usually found. The surface is divided into small plots like a honeycomb because of successive inheritances and is clearly visible on aerial photographs. The Gabès coastal oasis, Chebika and El Ksar mountain oases and the Tozeur Saharan oasis are found in this classification.

2.1.2 Modern Oases

These were created after 1900, due to new deep drilling techniques by colonial authorities and then by the Tunisian state. Water is managed collectively by a farmer association subsidised by the state. It used to be called *Jamia el mâa*, then AIC, GIC and now GDA (Organisation for Agricultural Development). The area was managed rationally to ensure a better output: the fields were laid out like a chessboard. Palm trees were aligned and paths drawn in a straight line to enable easy access to plots and the water supply. These modern oases represent 10,625 acres in the Gabès region and 61,825 acres in southern Tunisia. The spreading zones of Tozeur and Nefta, where the cultivation of the Deglet Nour is practically a single crop, are part of this category. The Deglet Nour is a variety of date that is particularly appreciated for export since it brings in foreign currency.

2.1.3 New Irrigated Areas

After 1970, some new irrigated public and private areas were created around surface wells, individual or collective drilling or alternative water supplies. Water

supplies are often managed privately, but farmers can combine the use of both individual and public systems. For the Gabès region, these new irrigated public areas represent 7487 acres (nearly 3030 ha), while new irrigated private ones are estimated at 9068 acres (nearly 3670 ha). To this group can be added the recent spreading zone of Ben Ghilouf in El Hamma (geothermic greenhouses) and private irrigated areas created by Ghannouchiens (Ghannouch native farmers) around 1990, like in Tenesli created at the beginning of 2000.

2.2 Spatial Organisation of the Various Irrigated Perimeters

The area occupied by earlier oases is currently smaller than other irrigated areas. Modern oases have provided access to ownership for new groups such as former nomadic populations and farm workers, also called *khammès*. For this reason, they are often found in the vicinity of earlier oases. The new irrigated areas are either next to earlier islands of greenery or perimeters created *ex nihilo* (Chenchou, Kettana).

According to the definition of oases given previously, three strata of vegetation are essential to the genuine landscape. Everyday language classifies oases by their creation date. In that case, there would be a match between the term "traditional oasis" and that of oases as defined previously. However, traditional oases have greatly evolved through the ages, as shown by the strata and diversity of vegetation, the composition of the soil and traces of social organisation of the water supply. In fact, by their creation date and their characteristics, they correspond to what is expected of an oasis.

However, in southern Tunisia, if the geographical distribution of irrigated areas is compared according to their status or their age, or even their landscape characteristics, they should be similar, but this is not always the case. To understand the reason for such differences, it is necessary to describe and analyse their diverse changes. Incompatibility between age and landscape could question the supposed linearity in the evolution of oases.

3 The Oldest Traditional Oases and More Recent Ones: Towards a Simplification of the Multistratum System?

Traditional oases are often composed of an earlier historical nucleus, which can be referred to as the "mother oasis" as opposed to extensions called "daughter oases" (Abdedayem 2009). These later ones can be related to modern oases as they have been irrigated since they were set up thanks to deep drilling. Generally, they are no more than a century old (created during the colonial occupation). Such extensions may have expanded gradually over the course of time, but they were always set up

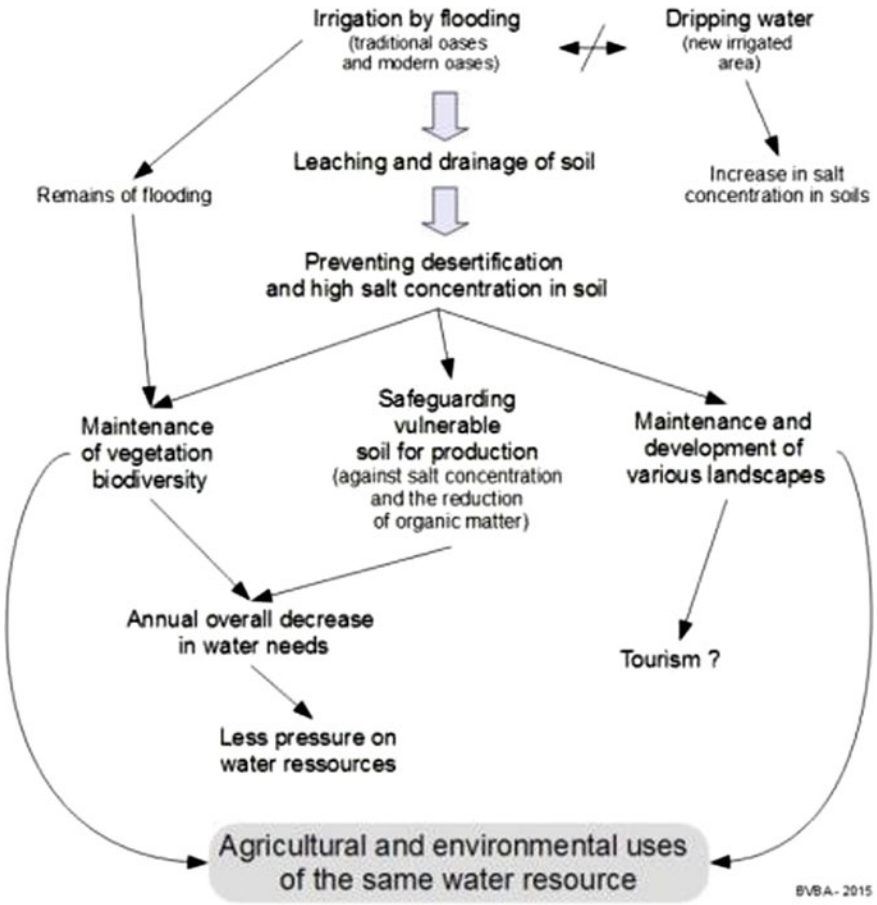

Fig. 2 Agricultural and environmental enhancement of the water resource in traditional and modern oases via traditional techniques of irrigation (flooding)

in the immediate vicinity of neighbouring plots of land. The older such extensions are, the harder it is to tell what is historical in them since their landscape is so similar. The division of the plots of land makes access difficult for some *fellahs* (farm workers) in modern oases as well as in older ones. Exploitation and agricultural techniques mainly associated with irrigation are similar (Fig. 2).

Only more recent extensions are visible to the naked eye, due to their smaller number of palm trees and the use of modern agricultural techniques (mechanisation and drip watering). However, they can be confused with earlier renovated plots, reorganised in order to increase production. The deliberate reduction in palm trees lets the light penetrate the plantation. It minimises the competition with other vegetation strata with a view to providing a more profitable crop.

In fact, the cultivation system of an oasis is not becoming more intensive since it is already intensive by nature. The issue is rather a complete change in the objectives of production. It is now aimed at the regional market or urban customers whose needs have become standardised. For instance, they would rather buy a fashionable brand than cheaper local seeds. Farmers are becoming increasingly dependent on hybrid seeds. It is easier to find carrot seeds from "Vilmorin" than "Arbi Carrots", local seeds that are more resistant and require less watering.

The three-stratum landscape in traditional oases is thus less and less obvious owing to the evolution of cultivation techniques and farmers' own decisions to choose other options. Previously, slow evolution and isolation had enabled a great variety of crops as well as endemic species to develop. However, the decline in the consumption of varieties of dates too basic or unfit to be exported has resulted in the removal of many palm trees, mainly in coastal oases. In fact, ideal conditions of maturation for the Deglet Nour variety are not found in such areas. Palm tree diversity specific to coastal, mountain or Saharan oases has tended to shrink considerably. Such a phenomenon is also true of varieties of trees and gardening crops, which are threatened by extinction (Ben Salah 2012).

In some cases, earlier or traditional oases have turned into a two-stratum system: palm trees with fruit trees or fodder plants, or fruit trees with fodder plants as in Mareth. There, palm trees are gradually being replaced by pomegranate and olive trees.

However, most oases have been assimilated into irrigated areas and managed according to the "concept of PPI" (PPI: irrigated public areas) owing to the drying up of natural springs and their replacement by deep drilling. As a result, they have started to lose their special features and other functions they used to fulfil throughout their history. Traditional oases were considered archaic, non-profit-making and wasteful for natural resources (Kassah 2002). The concept and principle of the self-management of water resources by the community is used to comply with the inalienable rights accepted and respected by all. It enabled everyone to have access to free water. This form of management has been replaced by new rules dictated by local government and national government. The focus is on intensive agriculture, economic growth and speculation (monoculture, speculation on land sales), which are detrimental to other aspects specific to oasis ecosystems. Thus, the rules and principles of the setting up and management of natural resources have been disrupted (social organisation, management and cultivation techniques).

Small farmers, since they do not have access to large financial investments, cannot compete with a commercial market from which they are excluded. As an indirect result, they cannot maintain a viable activity. Consequently, multifunctional agriculture in oases is disappearing (shaping of the landscape and social and cultural environment).

This evolution of older traditional oases, considered genuine, has resulted in their losing some of their specific landscape identity. Moreover, these areas are now in competition with other activities, mainly residential or industrial. The proximity

of urban centres increases the demand for building land, as well as more competition for water consumption and pollution of the environment, harmful to the oasis.

4 New Irrigated Areas: An Easier Implantation System for Easier Production?

The most modern oases, dating back to the post-colonial period, have often been set up in the vicinity of traditional oases, without a spatial continuity between the two stretches of land. New irrigated perimeters started to be created in the 1990s, mostly on semi-arid pastureland, some far away from old oasis nuclei. They were established following hydro-geological and oil exploratory drillings by the government or by private investors with or without prior legal authorisation.

These new irrigated perimeters are very different from traditional oases and older irrigated perimeters in their management, size, existing production and also farmer investment and involvement. Production in these areas is mainly single stratum. It is intensive, mechanised and uses a great deal of chemicals and more or less developed technologies (e.g. irrigation by drip watering and geothermic greenhouses in order to produce out-of-season tomatoes in Chenchou). In fact, the land is exploited like a mine, that is to say until available natural resources (water and soil) are exhausted.

The targets of such production are the regional, national or even international markets. Cultivated species and varieties are limited to those whose sale is more profitable: potatoes, tomatoes, peppers and onions. Varieties are often hybrids. The aim is to produce graded homogeneous crops. As a result, genetic diversity is very low. It can sometimes be increased by introducing alfalfa to enrich the soil or mitigate the adverse effect of salt in order to enhance the production of plots too rich in salt. Owners can request farm workers to plant fruit trees or olive trees when setting up a market gardening enterprise.

However, in these perimeters, the most favoured vegetation stratum is expected to generate crops corresponding to the standards required by the national and international agro-alimentary market without delay. The second stratum, when it is there, is rather neglected. It is only tolerated on condition that it does not compete with the commercial stratum. This second stratum can be used to supply food for the family. They benefit from the irrigation and the farm work required by profit-making crops. Thus, the areas of Zerkine 1 and 2 usually associate fruit growing with vegetable growing or the production of fodder (tomatoes, onions, garlic and alfalfa).

Finally, the initial one-stratum system is made more complex by the exploitation of a second stratum. It could be considered an alteration of the initial agronomic planning and so a failure of the laying out of the land. However, some farm workers enjoy a more personal involvement, which goes beyond just a financial investment. So, within new irrigated perimeters, various situations can be found side by side:

some plots are partly or totally neglected, whereas others are well cared for. This adaptation of the one-stratum system makes one wonder whether these perimeters could potentially evolve towards a more complex agro-ecosystem and a management similar to the older oasis system.

Nevertheless, one of the main characteristics of these new perimeters remains their low initial biological diversity based on the supply of outside cultivated species, often hybrids, and their high consumption of non-renewable and overexploited resources (water and soil). The evolution towards a multistratum system increases the number of species cultivated without favouring diversity among species.

5 Irrigated Areas Versus Oases?

In the context of rapid evolution and profound changes, irrigated areas in southern Tunisia show a great diversity of shapes and functions. The recent changes in the various perimeters blur the identification of the landscape. Those undergone by traditional oases question the very definition of an oasis and the way it is run. Indeed, traditional oases bear a both a social and a biological legacy. Thus, they can be considered real anthropo-ecological resources through their genetic diversity and the knowledge and management of this diversity by the population concerned.

Whether the evolution of oases is considered an adaptation or a direct disappearance, it is associated with several constant elements. The oasis agro-ecosystem loses its complexity and is weakened when faced with the constraints of an adverse environment and the impact of climate changes to come. The local genetic heritage, with its diversity and its ability to adapt developed over the course of time, represents a very important genetic potential that can be coveted by some people. Although the argument for the urgency of safeguarding a rich ecological legacy has been put forward, the tendency to recording oases as an international heritage corresponds to a social requirement, which takes into account a new use of the landscape for the tourist trade. However, this so-called conservation of the heritage ignores the causes and the continuation of oasis degradation. An "anthropo-agro-ecosystem" is being set aside and safeguarded at all costs without taking into account relevant outside elements linked to this system.

The decision to set up new irrigated perimeters based on rational agronomic planning is a factor of evolution. However, interweaving these spaces (steppe, traditional oases, modern oases and new irrigated perimeters) and the existing relationships between the functions attributed to them are very important. This is one of the keys to understanding overall and regional evolution and that of oases in particular. In fact, all the roles played by oases, until the end of the colonial era, are now shared between various perimeters, different locations and entities, which are in competition (Fig. 3). This competition is linked with the use of a single water resource: the Djeffara (regional complex of middle depth water layer). The functions of an oasis are used to be complementary and set in one local area. Nowadays,

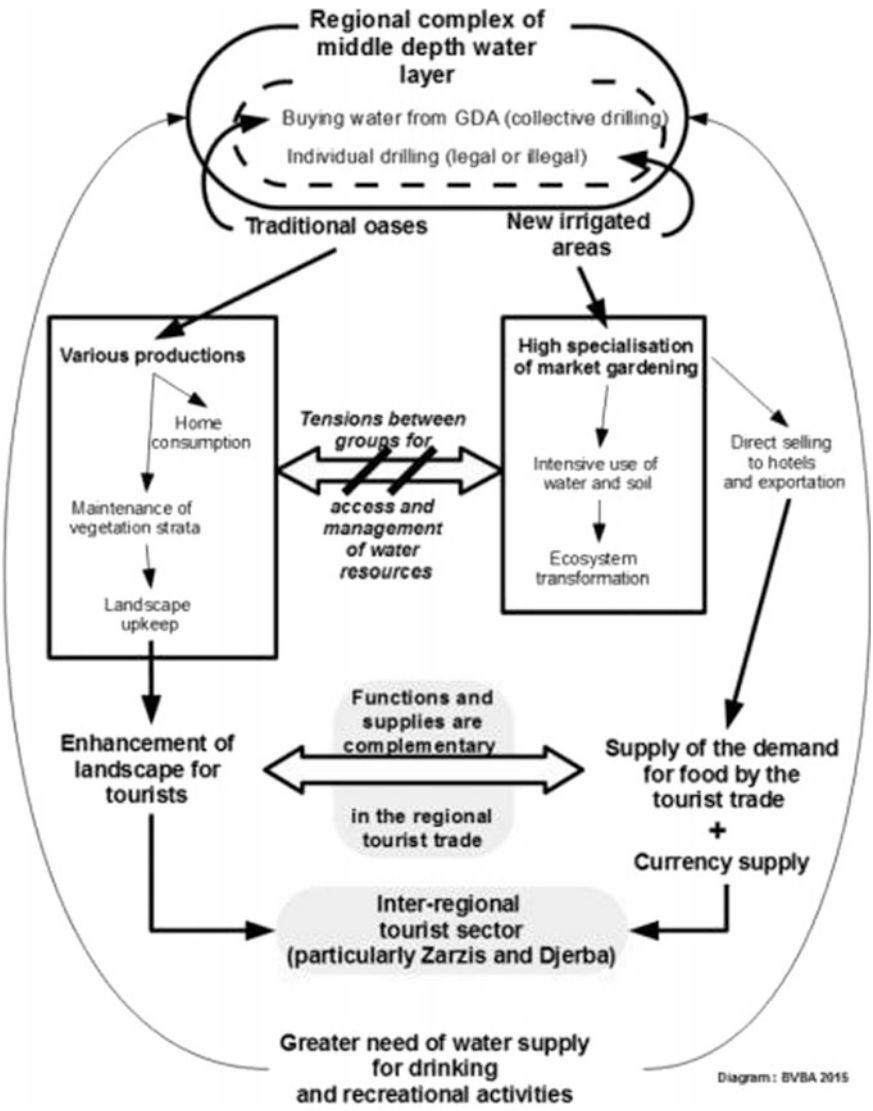

Fig. 3 Division of functions of agricultural areas and competition around the use of a common resource in the region of Gabès

they are spread out over a regional scale. As a result, the complexity of the oasis system is impoverished. Oases could become agricultural areas among others.

By losing their multiple functions, oases have shed a key element of their identity, which is used to define them as unique entities. Consequently, can we still use the term oasis in southern Tunisia? Should they not rather be called "areas with some oasis traits"?

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