The Power of a Disappearance: Water in the Jerid region of Tunisia

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Chapter 1.5
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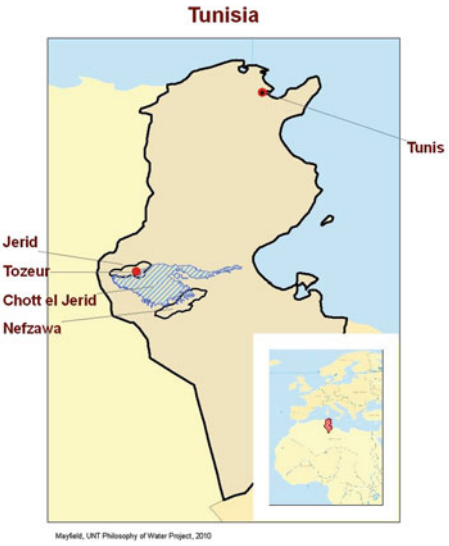
In arid North Africa, control over water has long been and continues to be central to political and economic power for a wide variety of actors. The recent history of Tunisia, and particularly that of the oasis gardens of the Jerid region, demonstrates the social and environmental consequences of the transfer of control over water from local to colonial and then national elites. The oasis is the scene of conflicts over fresh water resources; local people are constantly adapting to new situations, learning to diversify their practices and discourses.



Map 1.5.1 Tunisia

1.5.1 History of Water Control in Jerid

Just as absence of water generally defines a desert, both conceptually and ecologically, the presence of water is the essential principle of oases. However, water alone does not assure their existence. An oasis is the association of a town or village and a cultivated area, often a palm grove (of *Phœnix dactylifera* L.), in an arid or

V. Battesti (✉)
Muséum national d'histoire naturelle. Lab. Ecoanthropology & Ethnobiology (UMR 7206), CNRS (French National Scientific Research Centre), Paris, France
e-mail: Battesti@vbat.org

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desert environment. Such groves are artificial and anthropogenic places that rely upon irrigated agriculture, classically intensive and characterised by mixed farming.

Not all deserts in the world have seen the creation of oasis ecosystems, because they require the presence of people with the proper technological culture, knowledge and socioeconomic tools to build elaborate hydraulic structures such as wells, channels, small dams, and so on. Labour force and suitable land are other crucial elements. Water remains the essential, life-sustaining element of an oasis.

The technological changes of the twentieth century have transformed the immediate significance and the role of water in the oasis gardens of Jerid, in southwest Tunisia: all the springs and some '*wed*' (artificial rivers collecting the water from the springs) have disappeared and deep wells from which water must be pumped have taken their place as well as irrigation systems buried underground to avoid evaporation. These shifts in technology have marked shifts in power, as the control over water moved from local farmers to the French colonial state and then to the Tunisian national government.

The joint history of Jerid and water is ancient. Whoever wants to control local society must control the water. For settlers, nomads, or conquerors, control of the oases was always a key element enabling the domination of the surrounding areas of the desert. Controlling the oasis springs means controlling the vast territories surrounding them. For instance, the French colonization of the Sahara progressed incrementally, conquering (or losing) the oases one by one. Many palm groves owe their existence to their status as 'stopovers' on trans-Saharan routes. Jerid was one of the 'desert's doors', and its strikingly intricate water distribution systems, built over several centuries, makes visible and materialize intricate negotiations around water resources.

Prior to French colonization, collective duties concerning water by the local communities were vitally important for the survival of the oasis, particularly the annual maintenance of the hydraulic systems. Landowners sent their *khammes* (tenant farmers) to clear up the springs and dredge the drainage system. The *shorfa*, the group of families of supposedly prophetic origin with religious, economic, and social prestige, were the largest landowners in the Jerid palm groves. The wealthiest families formed local councils (*jamâ`a al-mâ´* or *miyâd*), with significant local influence – beyond the strict space of agriculture – and took charge of the running of the oasis. In Tozeur, this council was known as the '*`ashra kbâr*' (the 'ten largest' landowners, each with 5–10 ha).[1] Today, the intervention of external authorities and 'modern' management methods have changed the *shorfa*'s role in managing the oasis, which decreased its religious, economic, and social status.

Although the history of the oases is a series of struggles for control over water (Bou Ali 1982), of which French colonization in the nineteenth century is just one episode, the French intervention brought unprecedented innovations in water control that took the resource out of the hands of Jerid landowners. The colonial

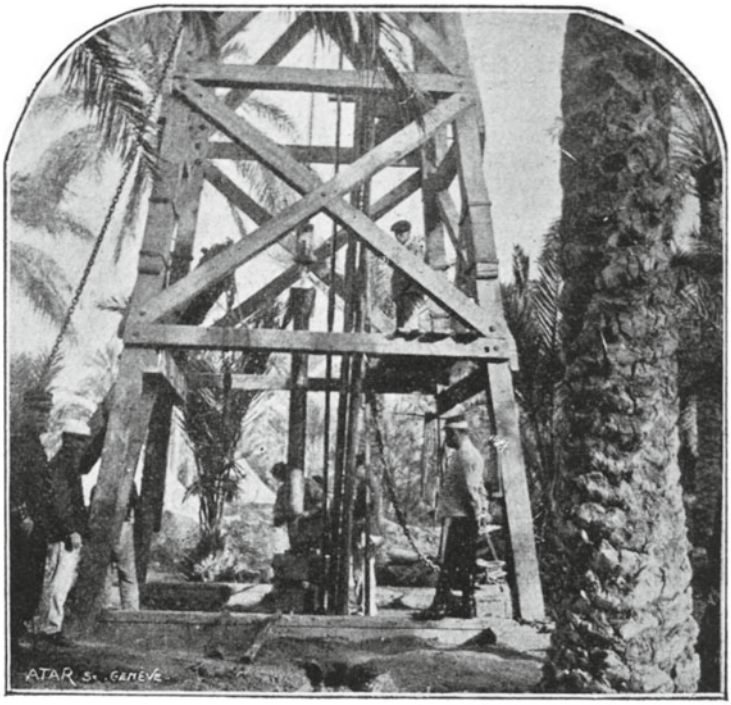
[1] In fact, in Tozeur, a decree of the 8 February 1913 already substitutes for the former council '*miyâd*' (the *Qa´id* with some close friends) a new 'Union Association of the Landowners of the Oasis of Tozeur' (Attya 1957).

administration was not satisfied with the existing palm groves because they did not reflect the French conception of productive agriculture, and were too deeply rooted in local 'negotiations' that produced gardens organised in ways that were not very intuitive to the new rulers. Therefore French colonials preferred to create their own palm plantations in the desert: they cultivated new land, drilled water wells, and implemented a new model of labour that relied upon a novel personnel and labour management – the salaried staff. In doing so, the colonial rulers freed themselves from the complex local politics surrounding the control of water, land and the workforce, the three essential elements of an oasis.

The more ambitious local colonial authorities, however, also attempted to understand the local hydraulic system in order to control it. The work of Penet (1912), for example, a name the people of Jerid still remember, in deciphering and analyzing the system at the beginning of the twentieth century was not the innocent pastime of a '*contrôleur civil*' (director of the local colonial civil service). One of the first measures enacted after the installation of the French 'Protectorate' in Tunisia was the nationalization of all the springs, including those that irrigated the gardens of Jerid.

Under the French colonial regime, unprecedented technical means were deployed to transform these 'patches of greenery kept by the stubborn digging of men in spite of the dunes, the wind and the sun', to improve these 'flocks driven as at the biblical times by nomads in search of sparse pastures' (Jacques Soustelle, former French minister of the Sahara, quoted by Gaudio 1960:104). Colonization programmes required new tools that visibly transformed the environment as well as the local thinking and practice. Quite consciously, the French settlers attempted to demonstrate the ability of the Western civilization to inscribe itself on this desert *tabula rasa* thanks to their technological prowess. 'To give life to deserts, thanks to the presence of trees and greenery, to break up with the sorrowful monotony of a bare ground, to populate those mournful and silent sands, this could be the oeuvre of the artesian wells… Nothing resists our powerful tools, whilst a thick layer of stone is, for those indigenous well-diggers, an insurmountable barrier' (Tissandier 1867:363).

Even though the French settlers and the natives cultivated more or less the same date palm, the French formalised methods, technical means, and workforce distinguished the new settlers from their indigenous counterparts (Battesti 2005). According to the French modernistic approach towards the environment and later taken over by the Tunisian engineers, nature is primarily understood as an object of technical exploitation. Unlike the Jeridi tradition, palm groves were reduced to solely productive areas, no longer 'recreational' ones. Farmers now had to consider the productivity of monoculture, the focused cultivation of a single crop, rather than the production of a multiple crops. The so-called 'salvation' of the local agriculture was bound with the importation of technical modern support (drilling, plastic coverings for protecting dates bunches, tractors *versus* hand labour) and groundwater mining, which soon turned into overexploitation. In this ideology nature is to be colonised, the desert to be fertilised: the subject stands external the environment, and this externality legitimises and authorises the scientific approach, presumed to be the only way of rational production. Nowadays, the Regional Centre for Agricultural Development (CRDA), located in Tozeur, transmits scientific information, application practices



Cliché de l'auteur, février 1900.

Fig. 1.5.1 Boring of an artesian well, '*Forage d'un puits artésien près de Touggourt*' in Feb. 1900, photo by J. Brunhes. "Every year, cultivation wins on the desert, thanks to this instrument of civilization *par excellence*, the artesian drill. Officers run the boring workshop, but this workshop works both for the military authorities and for individuals" (Brunhes 1902: 268)

(mostly through physical installations) and governmental policy to the farmers through extension services (*morshed*), to guide agricultural methods in this 'rational' way.

In the late nineteenth and early twentieth centuries,

> the French took…an interest in the cultivation of the date palm in the Saharan region and so we have seen mainly in the South of Constantine the birth of many *magnificent new oases, established,* so to speak*, from scratch* right in the middle of a desert region. (*Les produits algériens, Les dattes*, n.d. [circa 1922], emphasis added).

This trend toward removing control of oasis water from the local authorities continued after Tunisia became independent from France in 1956. Scientific knowledge and engineering became the foundation of state authority, and the state considered its intervention necessary for development. Civil engineers of the Tunisian state thus proceeded to press for 'modern progress' in Jerid, while the local peasant culture was seen as an obstacle obstructing the path of modernization. The state attached little to no importance to the local knowledge and aspirations of oasis people.

However, the transfer of power from the *shorfa* to Tunisian state officials did not occur without difficulties and regret from members of the largest landowners council. To give an example, a particular *sherîf* (member of the *shorfa*) could not understand why the local research centre for date palms[2] did not seek his opinion about oasis issues (interviews in 1996, in Tozeur). Strengthened by the modern transfer to the scientific field of the legitimacy of knowledge, the research centre no longer required the *shorfa*. The *sherîf* argued in these interviews that the tradition they embodied already empirically knew the data and models to which scientists lay claim today (for instance, about the number of litres of water a date palm needs). In this way, he attempted to demonstrate and justify their former authority while using the rival's argument.

The result of intensifying outside intervention is that springs no longer naturally irrigate the oasis gardens in Jerid. About fifty deep wells have replaced them, the first dug initially by the French colonial farmers and administrators, and later by the Tunisian Ministry of Agriculture to create new irrigated perimeters and to offset the decline of the hydrostatic level that was, ironically, caused by the construction of deep wells in the first place.

1.5.2 Recent Moves to Control Water

The replacement of springs by deep wells over the past 50 years has had serious repercussions for local lifestyle, the specific cultivation methods and environmental practices.

Before the deep wells were dug and the springs withered, the local community of landowners was responsible for managing common water resources, maintaining and preserving the oasis' agricultural activity. The disappearance of natural springs corresponds to the end of this collective management and the beginning of state control.

Water lost its local social significance: although it was still needed, water was no longer under local control. Today, collective work in agriculture is confined to the mutual aid between independent farmers concerning periods of intensive labour (harvest, pollination, and so on) or the employment of temporary workers. The CRDA has the responsibility for maintaining the drains and wells. Local gardeners ('gardener' and 'farmer', in this context, are interchangeable) only manage water inside their garden during their 'water turn' (the *nûba*).[3]

A brief study on the commonly used word '*jar*' (palm grove) shows that local etymologies suggest different social meanings of water management. The word '*jar*' in Jerid points out the palm grove or one of its parts. In the Nefzawa (bordering oasian region, on the other side of the Shott el-Jerid), Bédoucha (1987:399, 355,

[2] CRPh, *Centre de recherche phœnicicole*, now the CRRAO, *Centre de régional de recherche en agriculture oasienne*, in Degache, near Tozeur.

[3] By area of palm grove, water is supplied in each garden for a limited length of time of the 'water turn'. This amount of water nowadays is *pro rata* of the surface (the ratio may vary from a palm grove to another) while it used to be considered as a distinct property.

336) gave similar meanings; however, she added the following sense: 'the time it takes for water to go from one point to another'. Her definition reminds us of the intimate link between land and water, the fragile dependence of each upon the other. According to Bédoucha, the word *'jar'* could derive from the verb 'run' and, when applied specifically to water, means 'to flow'. Jerid people provide another etymology: the word could come from '*jâr*', neighbour. This sense of the word emphasises the composition of the palm grove as a jigsaw puzzle of neighbouring gardens; to go through the gardens, from one to another, is '*min al-jâr lil-jâr*' (Battesti and Puig 1999). Note that this etymology does not specifically refer to water. Sometimes water is invisible, but is still audible within the local discourse. If one speaks with a gardener, no matter the topic, the subject of water surfaces.

1.5.3 Diversification of Farming Practices in Extracting Water

In general, workers in Jerid's palm groves trust the common water supply system: they use it as their main water provider. However, they increasingly also use private wells dug (*bîr*) inside their gardens (thus extracting water from the groundwater aquifer) as a means to control risk. These small private wells are equipped with a small power-driven water pump (probably the most successful mechanised input within the palm groves Jerid has experienced). This technology, however, does not eliminate difficult manual pumping, but creates new maintenance issues. The private pump offsets the insufficiency of the water supplied by the *nûba* with supplementary irrigations (see Fig. 1.5.2). The use of such small wells marks the difference between the 'classic' gardens and these illegal 'extension plots' surrounding the old palm groves.

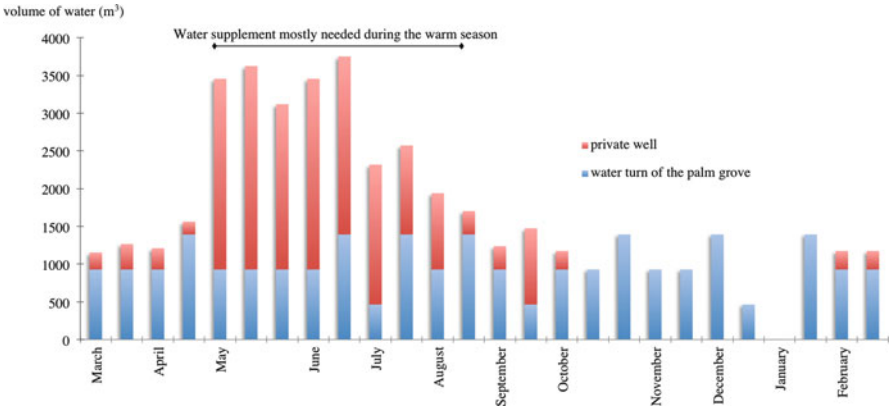


Fig. 1.5.2 Annual evolution of the water volume for irrigation in a classic garden of Nefta palm grove of 1.30 ha (years 1995–1996) (Battesti 1997)

Despite the latter's illegality,[4] they nevertheless conform to the modernistic spirit of agriculture, as determined by the state.

In extension gardens, the private well and its power-driven pump provide all the water because illegal plots cannot benefit from the *nûba*. Called in Jerid (at least in Tozeur) *maziûd* or *sênya* (plural *swânî*),[5] these kinds of gardens are the work of landowners wishing to create *ex nihilo* a garden for production purposes rather than renovating an old one. The illegal plots may also be the work of tenant farmers (*khammesa*) who thus become landowners (*mâlek*) and raise their social status and standard of living. These illegal gardens enable farmers to increase their income because these gardens were not inherited but created from desert lands: local people give to these lands an agricultural and social 'quality' that allow these lands to host cash crop (see Battesti 2005).

Even though the extension plots tend to look very similar, always equipped with a small well and its water pump, their conception and organization differ greatly from those of the 'classic' gardens inside the palm grove. The extension plots are organised according to the colonial, and now the state pattern, supposedly 'rational' and 'modern'. Here date palms are aligned following a grid of low density of plantation (100–150 plants/ha, in contrast to 300/ha in 'classic' gardens), and the ratio of the *deglet nûr* cultivar, the best-selling date, to other types is very high – sometimes 100%. Moreover, these new plots display an open vegetable structure and do not display the three vegetation levels typical of the oasis ecosystem. Although they do not reach the scale common in the Nefzawa (east shore of the Shott el-Jerid, see Brochier-Puig 2004), agricultural extensions in Jerid are quite numerous, constituting 18% of irrigated lands in Tozeur (CRDA Statistics department in 1996).

These extension gardens are evidence of a radical diversification of farmers' practices and conception of agriculture and their relation to the environment. Farmers extricate themselves from the 'classic' and complex system of water supply to depend on their private one. The use of a private well thus redefines the working time as the farmer chooses the moment for irrigation instead of being subject to the common *nûba*, which turns between neighbours on a round-the-clock schedule, all around the year. After the state seizure of the common irrigation system, this disconnection from a centuries-old system of collective agricultural management prompted the next step – individualization.

This shift means that the farmer has to deal with a different quality of water, for when water is pumped in the low-depth groundwater aquifer,[6] it is less fresh than water from the deep aquifers. The individual gardener also has to manage the choice

[4] By official decree: this ban aims precisely to hold back and avoid an expansion of the lands under cultivation in old palm grove, according to the view that the volume of supplied water is not extensible. Just about the same time, the state was creating new large irrigated perimeters.

[5] In Jerid old palm groves, the word used for garden is in general '*ghâba*'.

[6] It is irrigation water infiltrated through the soil. This water has a high level of salinity (considered dangerous for crops in the region at a rate higher than 6 g/l). Unfortunately, water reaches its higher rate of salinity in the periphery of the palm groves (where are extensions plots).

of different varieties and cultivars to plant (some are more resistant to the salinity than others) and different rotation of crops. This management requires in depth knowledge of ecosystem's patterns and preferences.

These changes have diversified the way that gardeners think about water and water use in the Jerid. First, there is a diversification of thoughts and practices between different actors (Battesti 2005) within the same 'class' of population, as when some Jeridi gardeners continue to cultivate their 'classic' gardens, while others start extension plots, assimilating the modern pattern. Second, individual gardeners diversify their practices; the owners of extension plots often also have classic gardens in the old palm grove. The diversification occurs both geographically and in the way that land, water, energy, and biological resources are used and conceptualised.

1.5.4 Water: A Rare Means of Free Expression

Technologically speaking, the people working on palm groves no longer have to worry about digging or draining the canals, cleaning up springs, or distributing water between gardens. The state, through its public departments, deals with these issues nowadays.

However, water remained one of the rare subjects on which people could express themselves freely. In Tunisia before the January 14th Revolution (2011), discussion of power and politics was forbidden; the presidency and government did not allow for divergences from the official policy. Discussions about water have become a venue for expressing one's opinions about politics and relations between local communities and the national power in North Tunisia. Hence, when speaking with a local gardener, the topic of water invariably springs forth in the conversation, many times in the form of implicit social or political protest.

This tight relationship between water and politics is especially evident in the newest palm groves built by the national government within the last 30 years. These

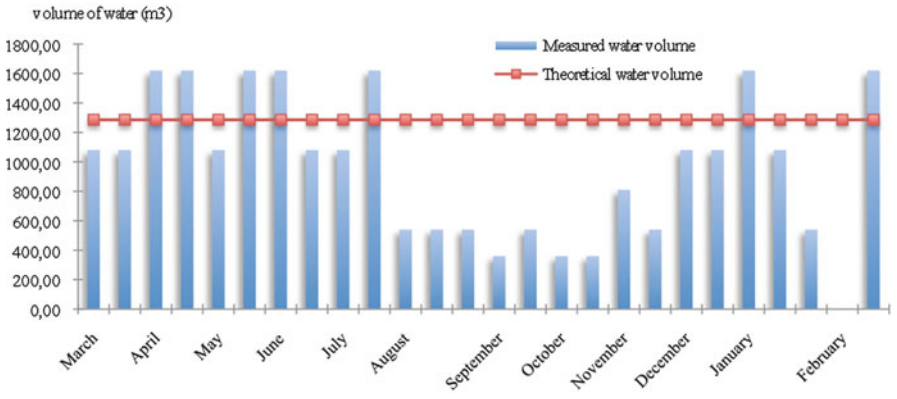


Fig. 1.5.3 Annual evolution of the water volume for irrigation in a plot of 2 ha in Ibn Chabbat palm plantation (years 1995–1996) (Battesti 1997)

newly irrigated areas were conceived and constructed by non-local engineers and technicians, with a non-local specialised technical skill set, without involving local farmers. The farmers are under an obligation to maintain the structure of *deglet nûr* date palms in line (one every 10 m) with a prescribed monoculture. Where farmers in the old palm groves do not express dissatisfaction for poor results, in the new palm plantations returns on investments are inevitably expected. Water here is seen as an investment, while in the old palm grove, water is seen as a means of reproduction. Local farmers appeared to have participated in the creation of the new areas only through paying their water bills – or, as in the case of the Ibn Chabbat palm grove, their refusal to pay the bills.

In the mid-1990s, the first settled farmers on these newly irrigated lands began to refuse to pay their water bill because the expected yields and financial income from the state modernization programme took longer than expected, causing politically charged language to form around the issue of water (see Fig 1.5.3: an evident lack of water regarding the volume promised by the administration, and still not itself sufficient.)

When the government cut off the water supply, the farmers' response (February 1996) was virulent: 'they treat us as if we're not Tunisian: they don't help us, they cut off water' and 'Even Israel doesn't do that [to Palestinian people]'. Water became a bone of great contention between the state and the farmers. The very same farmers who refused to pay their bills stated angrily: 'we're tired of this project. There are two solutions: either to burn up Ibn Chabbat, or for the State to work with the farmers.' Water issues opened the door to a more profound political sentiment: people were so desperate that they commended the 'time of the French whose 40-year-old wells still work, unlike here' (August 1995).

The state reacted in 1996 by creating an AIC (*Association d'intérêt collectif*), a Common Interest Association officially aiming at managing water resources. AICs were already present in the other palm plantations (several coexist in larger palm groves such as El-Hamma, Tozeur, and Nefta). Now, AICs deal with the STEG (the Tunisian electricity and gas company), which supplies water-pumping plants with electricity. Since the natural springs have dried up, irrigation requires wells and pumps that must have the electricity supplied by STEG. STEG signs a contract with the AIC, and if the AIC does not pay, STEG may legitimately cut off the electricity (and so the water). AIC collects money from the gardens owners to pay STEG. Thus disengaged, the agriculture services are confined to the maintenance of drilling, and STEG is no more than a service provider. The coercion formerly exerted by the CRDA has now to be performed among farmers, through a "water union" – the AIC.[7] There is no real gain of control for the local farmers through this process: they lost non-payment as a leverage strategy and still have not resolved the problem of electricity pricing.

[7] These AIC became GIC (*Groupements d'intérêt collectif*, common interest organizations), and then in 2003/2004, the GDA (*Groupement de développement agricole*, agricultural development organization). The policy remained the same, heading towards liberalization of the sector under the state's firm rule. More and more, the GDA have also had to take care of the maintenance of the drilling itself as well.

As this history shows, water is not a neutral element. Local people have lost control over it, but as a subject of conversation, political discourses in the guise of water discourses had been a kind of safety valve. Since the criticism was not frontal it provided citizens a voice within a broader crisis while protecting them from violent repercussion. Discussions on water could pass as purely technical, locally and nationally. While it was impossible to have a real debate on issues such as democratic decision-making processes, there could be debates over water.

1.5.5 Long-Term Consequences

The most significant consequences of the colonial and later Tunisian policies are undoubtedly yet to come. Drillings from the Complex Terminal, a relatively deep aquifer system – about 500 m – has dried up the natural springs. This depletion meant also that drilling became increasingly less effective while demanding greater amounts of energy to draw the same quantity of water that 50 years ago naturally spouted out. It became necessary to call upon the even deeper fossil aquifers reserves of the *Continental Intercalaire.* Consequently, springs that flowed naturally from that aquifer basin in the districts of Timimoun and Touat in Algeria are dry today (Richter 1995). At first, the drilling provided an increase of profitable surface area for new agricultural activity, but now the upkeep of these plots, combined with the maintenance of the old ones, is increasingly difficult. Deeper modern drillings have sucked up the water that sustained the natural springs of the old oases. It is important to recognise that there was not true profit, but just an expensive dislocation of the same water: first from springs, then to artesian wells, then to wells requiring large pumps (see Fig. 1.5.4). Since 2002, more than 90% of the volume of water has had to be

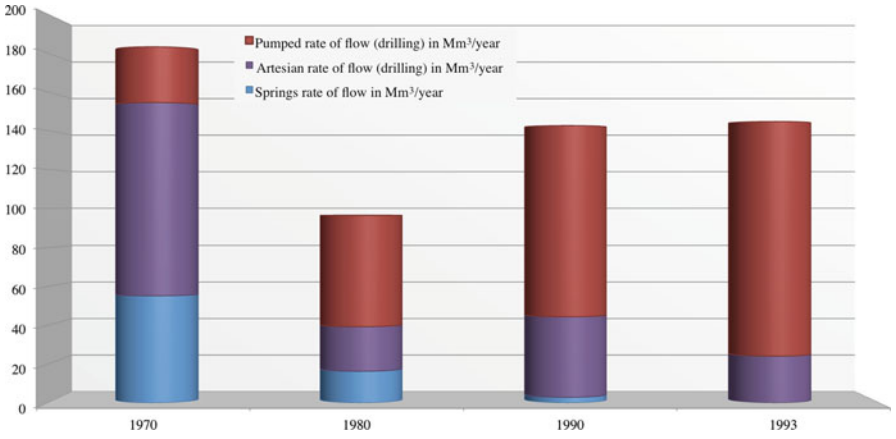


Fig. 1.5.4 Evolution of the exploitation of the deep aquifers for Tozeur Governorate (Data from Mamou 1995)

pumped in the Jerid region, and less than 10% is artesian. A tube well in Jerid is called a *bîr*, the same word used to name a private garden well. The only difference is that the tube well provided 'state water' you have to pay for, says the farmers.

People of Jerid refer to the time when water was 'free' as their golden age. However, water was never really free of charge. According to local discourse, the state simply took the water to redistribute it in return for payment. Landowners in the past 'paid' for their access to water in kind, by their participation in the collective maintenance (usually the time of work of their *khammes* invested in the upkeep of the irrigation and drain networks, and the cleaning-out of water sources). The allocation of water resources was very uneven, quite separate from property rights, which came with owning land. Those who did not need the entirety of their water could theoretically sell it to others. Today, the sale of water is prohibited since the distribution of water now depends on the surface rights.

One could say that the Tunisian Ministry of Agriculture's management of water resources is equivalent to a mining exploitation. The water exploitation – or, better, overexploitation – was made possible by adoption of methods used in mineral mining and later in oil extraction – with use of beating drilling and then of rotation drilling (Penet 1912) – and, furthermore, as in mining, the water resources exploited are not particularly renewable. Nobody knows if the volume of water reserve will last 15 or 25 years, or what its quality will be. The aquifers of the '*Complex Terminal*' and the fossil water of the '*Continental Intercalaire*' are both severely underrecharged (Mamou 1995). Nearly 70 years ago, the situation was already discouraging: 'In spite of the miracle of the multiplied water by the European technique, Algerian oases remain centres of weak life and bad production' (Capot-Rey 1944). One can seriously wonder why those oasis zones should be developed at all. It seems to make more sense to focus agriculture in the area of the '*Maghreb utile*' ('useful Maghreb'), the narrow coastal strip of North Africa, excluding mountains and deserts.[8] However, the reasons for development are political, including an effort to delineate Tunisian territory on its borders with Algeria. Oases, cultivations and human settlements mark the national territory to the border: desert territories are too open to have any significance for the neighbouring state. Furthermore, the government hopes that drilling will help to maintain, if not increase, national agricultural production.

Preserving the oases also aids two other projects to which the government is committed: keeping a balance between urban and rural populations by preventing or managing migration out of the countryside and promoting tourism (Battesti 2009b). Since the tourism opportunities on the coast are already quite saturated, the state is looking at developing Saharan tourism. The state's interest in preserving the oases meets the tourism project, and indicates that the state is open to the new sensibilities crossing the planet, namely, the worldwide environmentalist movement in favour of sustainable development. While some state engineers generate plans to restore and

[8] They take part, on the contrary, in the shadow zones (*zones d'ombre*) of Tunisia, in accordance with the presidential terminology.

Box 1.5a Climate change, water, and development in daily life in Tuvalu

—Heather Lazrus

Box Map 1.5a.1 Tuvalu

The nine islands that comprise the Tuvaluan archipelago arc across a stretch of the central Pacific Ocean between 5° and 10° south and 176° and 179° east. Running from north to south the islands are Nanumea, Niutao, Nanumaga, Nui, Vaitupu, Nukufetau, Funafuti, Nukulaelae, and Niulakita. Together, the islands cover a total land area of less than 26 km^2 and support a population of approximately 11,000 people. Settlement may have occurred as long ago as 2,000 years before present when sea levels fell during a small ice age to expose the atolls (Nunn 2007:117–125). Some archaeological evidence indicates that settlement of the islands occurred at least about 1,000 years ago. Tuvaluans have thus been adapting to atoll life over several generations.

Box Fig. 1.5a.1 Causeway: A narrow-causeway has been constructed to connect two parts of Funafuti Atoll. On one side the narrow strip is buffeted by the energy of the Pacific Ocean, protecting the calm lagoon on the other side. Sea level rise will threaten the causeway used to access Funafuti's municipal rubbish dump (Credit: Heather Lazrus)

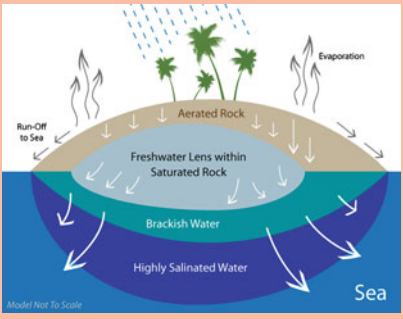
The low-lying atolls average just three metres above sea level and have only limited supplies of naturally occurring fresh water. Rising sea levels, changing precipitation patterns, and extreme events including storms and droughts are among the challenges that Tuvalu's water supply faces as anthropogenic influences transform the nature of our global climate. The Intergovernmental Panel on Climate Change (IPCC) has warned of the unequivocal threats to islands and island-dwelling communities based on their shared characteristics of 'physical size, proneness to natural disasters and climate extremes, extreme openness of their economies, and low adaptive capacity' (Mimura et al. 2007:687–716). Tuvalu epitomises these characteristics, a fact that has led to its being described as one of the most vulnerable places on the planet to climate change.

(continued)

Box 1.5a (continued)

Supplies of fresh water are one of the most essential and uneven resources for atoll life. Rain water is the primary source of fresh water, but highly variable levels of precipitation makes management of freshwater supplies difficult and renders atoll inhabitants deeply susceptible to drought. The islands receive varying amounts of rainfall according to latitude. Although the population numbers on the outer islands are relatively uniform, the southern islands may receive around 3,500 mm per year and this amount decreases to 2,700 mm per year in the northern islands (Sharp and Henson 1997). Funafuti, the national capital, receives slightly more rain on average (3,800 mm) but also houses roughly a third of the national population. On all islands, water availability is limited by the technologies available to harvest rain water.

Because much of the actual precipitation is lost through high evaporation and high soil porosity and permeability, the islands of the Tuvaluan archipelago are characterised scientifically as 'dry islands' (Mclean et al. 1991). Rainfall percolating through the porous material of an atoll replenishes the freshwater lens that floats on top of the denser salt water permeating the atolls at the level of the surrounding ocean. Rising sea levels and increased storm activity can damage the fragile freshwater lens by mixing it with salt water. Coastal mining for construction material also destroys the natural coastal buffer and may make the freshwater lens even more susceptible to storms and sea level rise.



Box Fig. 1.5a.2 Graphic of freshwater lens by Matt Story, Philosophy of Water Project, University of North Texas (Credit: Matt Story, Philosophy of Water Project, University of North Texas)

With the construction of the first communal cement rainwater catchment cisterns in the early decades of the 1900s, Tuvaluans no longer had to rely exclusively on the freshwater lens (Chambers 1984). Prior to the introduction of catchment tanks people used local knowledge to dig wells carefully where the freshwater lens was at its thickest, and they sometimes had to travel across the atoll's lagoon to bring water home in canoes for the family. They also collected water in intricate palm frond containers. Today, almost every public building and family household has a catchment tank that collects the runoff from corrugated iron roofs. Most tanks were constructed by Save the Children, a humanitarian NGO, in the late 1980s and the United Nations Development Programme, in the early 1990s. These

(continued)

Box 1.5a (continued)

Box Fig. 1.5a.3 A young boy bathes in a tub left on Nanumea Atoll by American soldiers after World War II. In the background are the household water tank and a faucet with a buoy that, with its top cut out, is now used for hauling water (Photo credit: Heather Lazrus)

Box Fig. 1.5a.4 Broken tank: Rainwater catchment tanks are prone to cracking and breaking when not maintained and kept full of water. A broken tank on Funafuti Atoll collects organic material and makes a fertile home for new palm growth (Photo credit: Heather Lazrus)

ferro-cement tanks are nearing the end of their expected 25- to 30-year life span. The government of Tuvalu also sells green plastic tanks, but these are very expensive. Desalination technology exists on the islands, but is often out of commission due to lack of spare parts and highly technical expertise needed for its maintenance.

Water, like other resources, plays a cultural role and is socially and economically mediated. The introduced technology changes how people use and perceive water. In the words of one Nanumean elder: 'we used to have one coconut shell of water in the morning, and one in the evening. We were satisfied. The kids used to be in charge of bringing in the water, and we would always be careful not to play around the bucket because if it accidentally knocked over and spilled… But now people spend all day sitting around drinking tea. They are always thirsty'.

Taste preferences have shifted away from the brackish well water used before cement tanks, and needs have increased with more clothes and dishes to wash. Indoor plumbing and flush toilets are replacing beaches and long-drops, but also increase the need for water. The improved toilets often have

(continued)

Box 1.5a (continued)

water-sealed sewage, which is less effective during droughts. Freshwater supplies are prone to pollution from ineffective wastewater management, hazardous chemical by-products called Persistent Organic Pollutants, and contamination of tanks and cisterns by dead insects and animals.

Climate change will have a significant effect on fresh water on Nanumea Atoll in different and compounding ways. In times of drought, the water from household and community catchment tanks is rationed and people also begin to make more use of the naturally occurring freshwater lens. However, when there are prolonged periods of no rain, the tanks and cisterns run dry and the freshwater lens shrinks. Changing precipitation patterns are likely to produce more intense but less frequent rain (Mimura et al. 2007:687–716). The storage capacity on the islands is not great enough to cope with this increasing variability. Unforeseen events, including funerals that bring large families together and stress water supplies, multiply the ecological impacts.

Rising sea levels and changing precipitation patterns will threaten freshwater supplies, and storm surges and prolonged drought periods will further erode the resilience of the freshwater lens. Simultaneously, higher household incomes,

Box Fig. 1.5a.5 Nanumea well: A farmer collects water from a well on his land for his pigs on Nanumea Atoll. Few wells that access the fragile freshwater lens are still maintained on Nanumea Atoll (Photo credit: Heather Lazrus)

Box Fig. 1.5a.6 Nanumea cistern: A woman collects water from a community cistern on Nanumea Atoll when her household tank has run dry after higher than usual water consumption during a family funeral (Photo credit: Heather Lazrus)

(continued)

Box 1.5a (continued)

largely from remittances earned by family members working overseas, and the growing desire for Western-style homes and lifestyles are manifesting in more intensive uses of local resource. Although Tuvalu's population remains relatively steady, uses for water are increasing and put pressure on the limited supply of harvested rain water while cement buildings are constructed of coral and sand mined from the coastal areas that protect the freshwater lens.

To a large extent, the availability and use of technology to provide water are more important limiting factors than environmental changes. In a complex interplay, compounding factors increase the urgency of enhancing Tuvalu's water supply: the catchment systems are nearing the end of their anticipated life expectancy; the socially driven needs for water are increasing, and the local effects of climate change are intensifying. The residents of Tuvalu are highly dependent on development aid for freshwater storage, yet international investment is tricky to procure for a small country facing ecological devastation from the effects of global climate change. The ability to adapt to climate change will likely revolve around the availability of adequate fresh water to support the population of Tuvaluans inhabiting these nine islands.

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modernise the oases to increase domestic production and agricultural exports, others argue that the oases should be preserved as 'tourist Edens'. In the best-case scenario, as Caratini (1994:124) reports of the Touat in Algeria: 'Order was given to

developers to develop without destroying'. A mission report of that project[9] offers a remarkable summary:

> Taking into account the historical and cultural importance of these *foggara* [which water the palm plantations], we will ensure the protection of around one thousand hectares of traditional gardens in connection with the genetic conservation of the varieties of date palm and other original species, within the framework of tourist and cultural activities.

This programme claims to support the scientific cause (which will also take advantage of the creation of 10,000 ha of new palm plantations and 25,000 ha devoted to vast cereal fields) and at the same time the environmentalist cause (by safeguarding the oases and promoting tourism). In the near future, Jerid may appoint 'traditional' gardeners to maintain the 'natural/tradition capital' of the old oases. This capital is also at the root of the tourist industry – a movement which could be called 'patrimonialization' (Battesti 2009a).

The environmentalist or protectionist concern emerges as a third way of practicing and conceptualizing water and its use. Young people who refuse to work or even to set foot in their father's garden will defend the palm grove, or rather will advocate for the safeguarding of its aesthetics. For example, when the agricultural administration tried to line the main *wêd* (wadi) bed of Tozeur with concrete to reduce losses by infiltration (February–March 1996), the *wild sûq*[10] criticised the project, saying: 'the landscape will be spoiled', and 'they should do this only in the hidden places of the oasis', that is, places where tourists do not go. Criticisms of the ugliness of recent construction merge with concerns about the loss of the 'authentic character'. The *wild sûq* defended the traditional 'landscape' object since it draws tourists, but they also expressed genuine feeling for safeguarding heritage. This was made possible thanks to their perception of the oasis from an outside perspective, that is, imagining first the foreigner's representation of water and environment rather than the farmer's.

In response to the growing interest in tourism and the preservation of heritage, municipalities of Jerid oases might begin to treat agricultural land as 'patrimony'. To give an example of this process: drilling has begun (with cooperation from Monaco, 2006–2009) in the area of Nefta's palm grove where the springs used to be, before they dried up during the 1980s, with the intent of channelling water into the former wadi beds. In the 1970s, a German project had buried all these traditional irrigation systems to avoid evaporation. Despite the shortage of water for agriculture, the goal of these new drillings is not primarily to water the gardens. It is rather to create a 'visual and sound re-enchantment' of this small part of the palm grove to attract tourists to the '*corbeille de Nefta*' (former springs location), overhung by the famous Sahara Palace, which is now a hotel zone. The authorities wanted to restore the picturesque attributes of an oasis palm grove with a wadi like the one that still exists at Tozeur. Nefta people laugh at the new concrete and oval water tank built on

[9] About Algerian French project of agricultural planning for the *wilaya* of Adrar, region of Touat. Mission report of D. Dubost quoted by Caratini (1994:124).

[10] 'Sons of the centre town' is a term to designate idle young persons who spend their days there, looking for business opportunities with tourists rather than working in the agricultural sector.

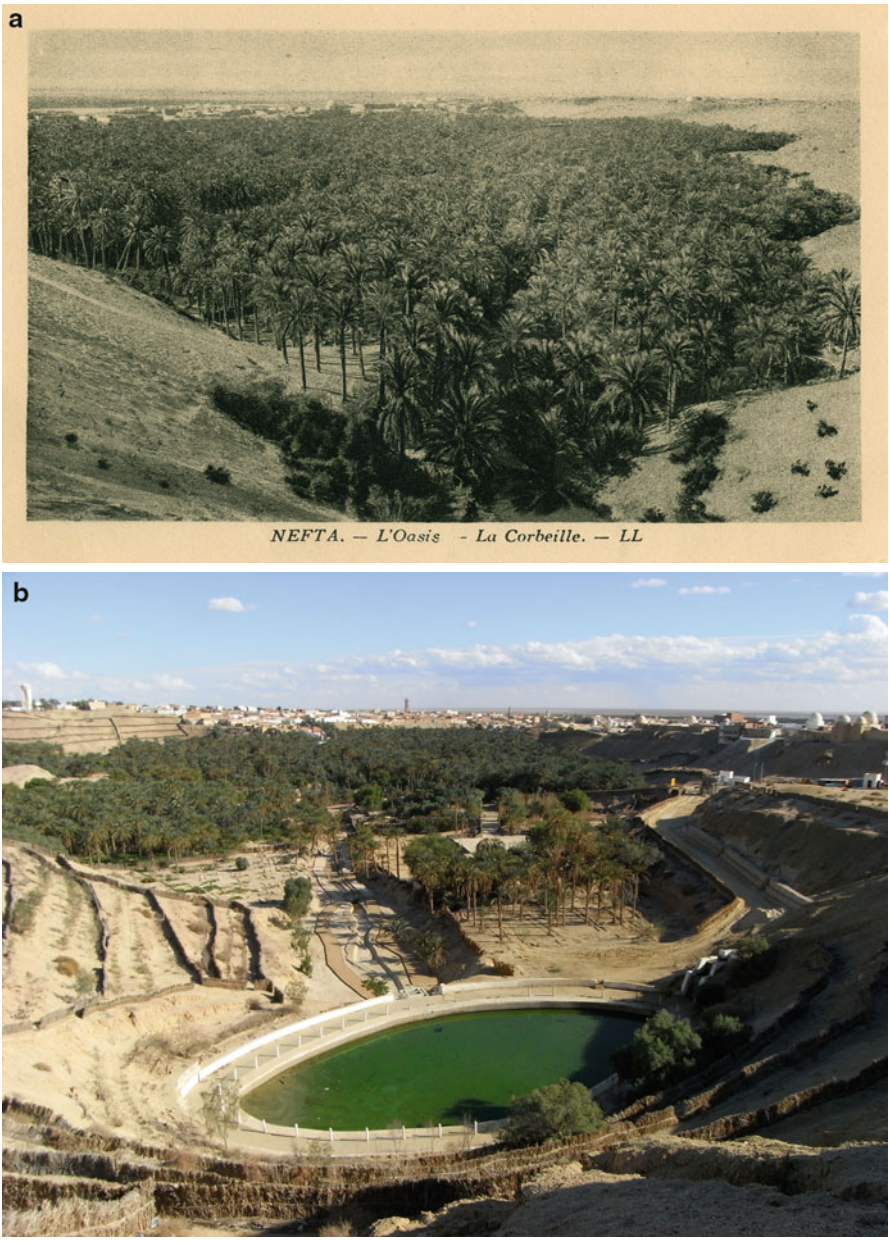

Fig. 1.5.5 (**a**) at the *top*, *Nefta, l'oasis, la Corbeille*, 1920 ca, LL. (Lehnert & Landrock) Lévy & Neurdein réunis, Paris, édité spécialement pour les hôtels "Transatlantique" (coll. V. Battesti) and *below*; (**b**) the new *Corbeille de Nefta*, November 2008 (V. Battesti)

the *corbeille*, calling it the *besin lahthem* (the egg pool). The project, now completed, includes a waterfall, a promenade, and '*aménagement de bon goût'* (a tasteful layout),[11] but does not primarily serve agricultural production.

However odd the Nefta project may seem, there is actually an even more 'eccentric' project: a golf course. Experts working closely with the Minister of Tourism offered a 50 ha golf course in the desert (150 ha planned), opened in November 2006 on the edge of the palm grove, also near the former springs area (now dry). Along with thalassotherapy (seawater therapy) and cultural tourism, golf was part of the Tunisian government's new strategy to diversify the tourism product. On the Tozeur Golf website,[12] the company boasts that the greens are 'irrigated with recycled water to preserve the water table' (A New Golf 2009). This was less than true at first, but even if completely realised, it comes to the mind of people that this recycled water could still be used for agriculture. Although tourist guidebooks still say that the Jerid has 'over 200 springs' (Lonely Planet Guide, Hole 2007:256), no more springs naturally irrigate the oasis gardens here. In this region, where farmers complain about lacking water, projects such as the *corbeille* and the golf course are good examples of the competition between agriculture and tourism for water resources.

In the desert Southwest of Tunisia, rainfall is not sufficient to maintain cultivation, not even to grow date palms: local people and officials have to manage underground water and irrigation. Jerid is a perfect example of a hydraulic society. Water shapes the palm groves and the design of the gardens. The complex geometry of the old palm grove garden with the numerous and overlapping beds of cultivation requires a technical *savoir-faire*, a distinctive feature of Oasians.

During the last century, means and scales of intervention on the water resources have changed considerably, from a local control to national control. A complex mixture of shifts in water availability, changes in social practices, and conceptions of 'nature', and ecological, political, economical, or geographical situations and pressures are all intricately interwoven to create an ongoing dynamic landscape in the desert.

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[11] Quoting a tourist. See (with pictures): http://www.nachoua.com/Nefta-avr-2009/Corbeille.htm (accessed July 2009).

[12] See http://www.tozeuroasisgolf.com/en/ (accessed July 2009).

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