Siwa Oasis

Egypt

Proposal for designation as
Globally Important Agricultural Heritage Site
May 2016

Photo: View on Siwa date palms from Amrun Temple

To the people of SIWA, whose efforts made this proposal possible

ما رأى هذا العمل النور كإلى أهل سيوة، لولا

Acknowledgements

The candidacy of the Siwa oasis to be part of the GIAHS initiative is to be greatly attributed to the caring, pivotal and forward looking gesture of **His Highness Sheikh Mansour Bin Zayed Al Nahyan, UAE Deputy Prime Minister and Minister of Presidential Affairs** who, on behalf of the **Khalifa International Date Palm Award**, has graciously agreed to assist SIWA oasis in the field of date palm cultivation.

In recognition of the uniqueness of this product as part of the heritage and lives of its people, the contribution of the **Khalifa International Date Palm Award** has been outstanding to revive focus and attention on this blessed product for the people of Siwa and for Egypt in general.

The Organization of the First Egyptian Date Palm Festival in SIWA, one of the many initiatives promoted and supported by the **Khalifa International Date Palm Award** in Siwa, has no doubt created the momentum to protect and enhance the sustainable date palm production in Siwa, and the date palm industry in Egypt.

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Summary information

Name of the Agricultural Heritage System: Siwa Oasis, Egypt

Requesting Agency: Government of Egypt, through Ministry of Agriculture, represented by the Desert Research Center

Country/Location/Site:

Accessibility of the site to capital city of major cities: Approximately 800 km on paved roads (10 hours), from Cairo, via Alexandria and Marsa Matrouh.

Abstract

This document proposes to recognize and designate Siwa oasis in the northwestern Desert of Egypt as a Globally Important Agricultural Heritage Site (GIAHS) under the respective FAO program. Siwa is a globally significant *in situ* repository of plant genetic resources, especially of uniquely adapted varieties of date palm, olive and secondary crops that are highly esteemed for their quality and continue to play a significant role in rural livelihoods, both for nutrition and income. Situated in a remote region of the Sahara, and surrounded by breathtaking desert landscapes, Siwa oasis is distinguished by a range of archaeological treasures that testify to the long history of the oasis at the crossroads of ancient trade routes, going back to Pharaonic and Ptolemaic epochs. Its long isolation from outside influences, a population tracing its origin to Berber civilization and speaking an indigenous language, and environmental constraints have given Siwa a unique local culture embodied by its mud-salt brick architecture, peculiar social institutions and a rich heritage of handicrafts. Challenges to oasis agriculture, biodiversity and cultural identity are currently effectively addressed by a number of national and local initiatives, including sustainable agricultural practices, improved irrigation management, the protection of wildlife in and around the oasis as well as sustainable tourism.

1 Geographic and socio-economic context of Siwa Oasis

1.1 Location, topography and geology

Siwa Oasis is situated in a depression at the northern edge of Egypt's Western Desert, 80 km from the Egyptian border with Libya and 300 km south of the Mediterranean port town of Marsa Matrouh, the nearest town of any size within 500 km (Fig. 1). At approximately 29° North and 25.5° East, the 800 square km Siwan Depression stretches 80 km in east-west direction It is from 2 to 20 km wide, and lies as much as 18 m below

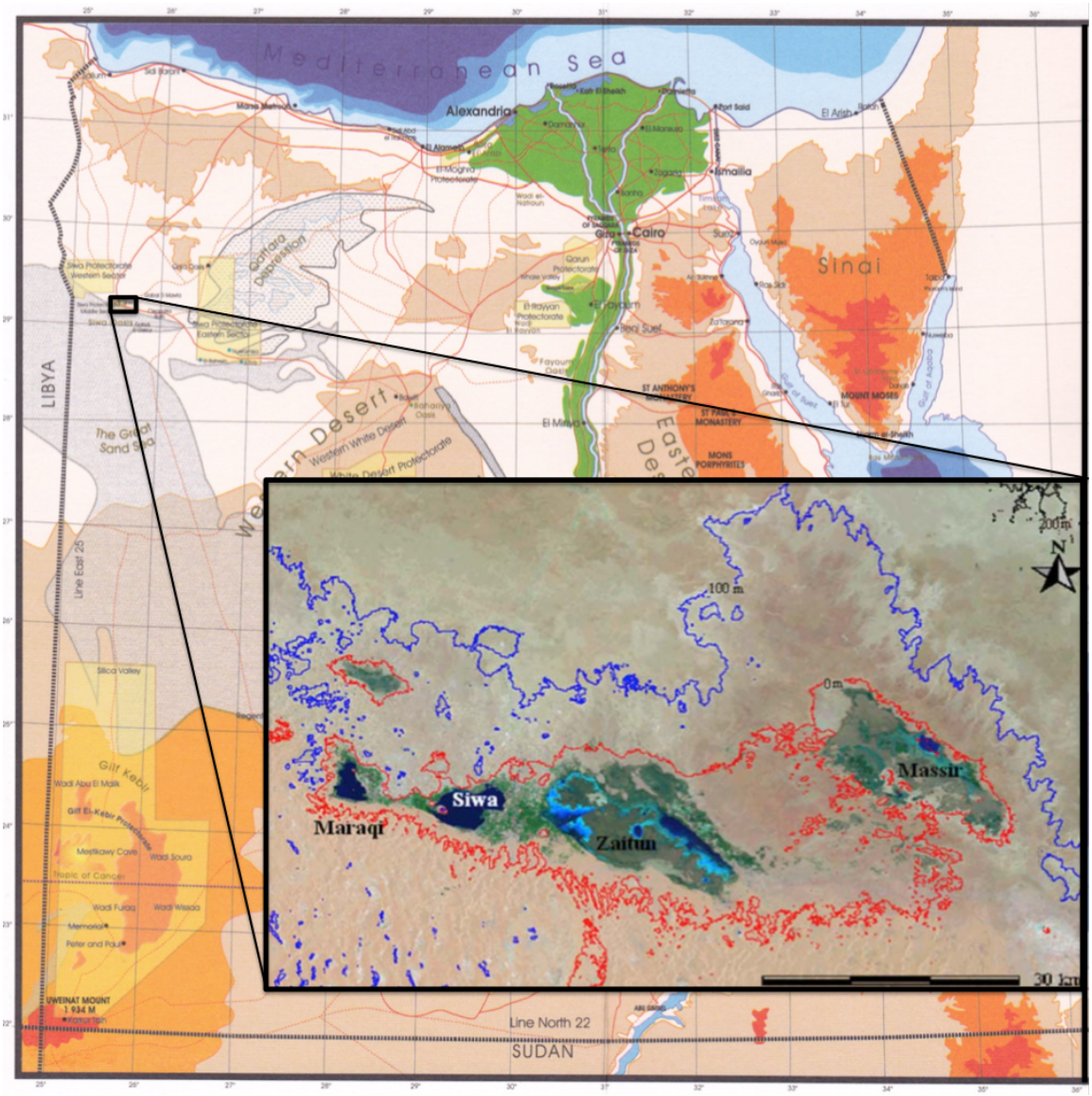

Figure 1: Location of Siwa oasis within Egypt. Blue and red lines in inlet denote 100 and 0 m altitude above sea level, respectively. (Source: Masoud & Koike 2006)

sea level. It is bounded in the north by an escarpment that rises to over 100 m above the depression floor and on the south by a subdued scarp of about 20-50 m covered with sand dunes (Fig. 2). The depression floor rises gradually from east to west and then merges with the general desert level. The deeper portion of the oasis is occupied by salt marshes and sabkhas[1]. These are salt-crust deposits so hard that this material is being traditionally to build houses (mud-bricks locally known as *karshif*) (Fig. 3). Imposing inselbergs rising from the depression belong to the Middle Miocene, while the sand deposits belong to the recent and Pleistocene periods.

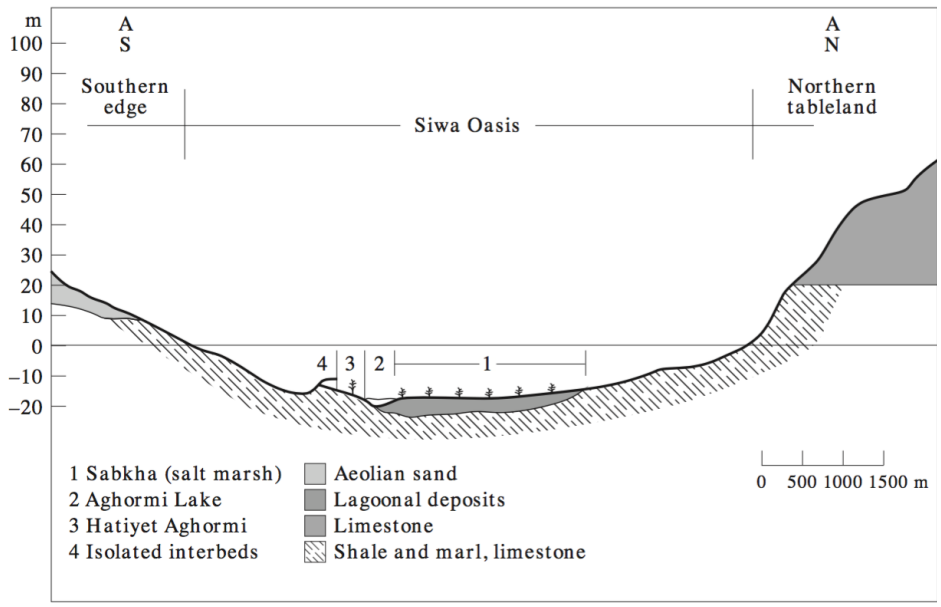

Figure 2: North–south section of Siwa Oasis. (Source: Misak *et al.* 1997)

The soil of Siwa consists chiefly of sandstone and limestone particles derived from the floor and the walls of the depression. It contains large proportions of sand (60%), small amounts of clay (7%) and large amounts of soluble matter, particularly sodium chloride. Soils do not exceed two to three meters in thickness over much of the depression area and are thinner in many places. Water tables are shallow over most of the area, often with a capillary connection between the water table and the ground surface.

The soils have a texture of light to medium with good vertical permeability. The calcium content of the soil is generally high ranging from 5% to 40%. There is no problem of minor elements like zink, copper and manganese, and there is no need to add potassium. Nitrogen and phosphorus have to be added. Some 88 km^2 (20,940 feddan; ca. 10% of the total depression area) are currently cultivated, mainly to date palm and olive orchards that are irrigated by several hundred wells, described in detail further below.

[1] Now increasingly turning into salt lakes because of the excess of drainage water from irrigation

Figure 3: Sabkha at Siwa lake, Maraqi area. The hardened salt-mud crust is used as building material in traditional Siwan Karshif architecture (see section 3.3; Photo: M. Hermann 2016)

Siwa Oasis is surrounded by scenic and uninhabited desert landscape, with large sand dunes and limestone outcrops, and other unique geomorphologic features that make the area attractive to tourism. Owing to its unique desert flora and fauna, 7800 km^2 of this landscape has been declared the Siwa Protected Area, described in detail under 5.1.2.

1.2 Climate and hydrology

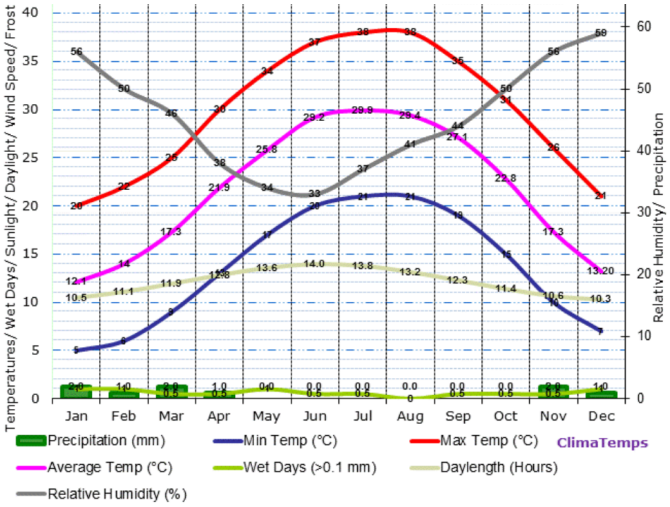

Figure 4: Climate diagram of Siwa

The climate of Siwa (Fig. 4) exhibits extreme aridity from April to November with very low rainfall occurring from December to March (average of 10 mm/year). The maximum precipitation recorded in one day was 28 mm, but such rainfall is extremely rare. One such rainfall reportedly destroyed Shali, the ancient mud-brick village of Siwa.

The monthly mean maximum temperatures range from 20°C in January to 38°C in July, with a yearly average of approximately 30°C. Monthly mean minimum temperatures range from 4°C in January 21°C in July. Absolute maximum temperatures can reach 50°C while the absolute minimum

temperatures measured was 4.5°C. The climate is somewhat warmer and more humid in the summer than most other desert areas off similar latitude, and is slightly colder in the winter. Frost has been recorded from December to February.

Mean monthly relative humidity ranges from 30% to 58%. Humidity highs occur during December and January and lows during May and June. Evaporation ranges from 17 mm in June to 5.2 mm in December.

The location, topography, climatic conditions and isolation from external pest and disease pressures in Siwa are all favorable for agricultural production, but it depends completely on ground-water resources for irrigation. Siwa is located above two huge reservoirs of groundwater, the only substantial fresh water supply in the region. The upper reservoir is composed of interstitial water confined in the cavities of Miocene limestone. This reservoir extends down to a depth of about 550 m below ground surface. The deep aquifer consists of thick layers of Nubian Sandstone, which belongs to the cretaceous and carboniferous ages. These layers go down to a depth of about 2000 m below ground surface. The origin of the groundwater is the rain, which fell during the more humid ages 30,000-40,000 years ago on the Green Mountains in Libya and the Tbiety Mountains between Libya and Chad and slowly percolated downwards.

The salinity of water from the aquifers is high in the upper reservoir (1800-7500 ppm) but low (170-325 ppm) in the deep Nubian sandstone reservoir[2]. It is at high artesian pressure and appears as natural springs. Because of its availability, local people have always been encouraged to dig wells and thus establish agriculture. These wells have created a network of oases, which surround several lakes. These oases are named, from the west eastwardly, Maraqi, Siwa, Zaitun, and Massir, of which Siwa is the largest and most urbanized. Due to the saline nature of soil and water and soil, mostly salt tolerant crops were cultivated in Siwa, which explains the predominance of oil palm and olives in the cropping system.

The annual discharge of irrigation water from the aquifers is ca. 255 million cubic meters. From this, about 222 million cubic meters are lost as evapotranspiration, while the remainder goes to the natural lakes of Siwa oasis. Paradoxically, the very abundance of irrigation water is also a serious threat to agriculture. Intensive cultivation in Siwa has long been intertwined with the overuse of irrigation water in a closed system. These practices, combined with the inferior qualities of the prevailing soil, the physiography, and human-induced mis-management practices, have resulted in deleterious impacts on the resource base as well as on the environment. For example, lacking proper drainage, a shallow water table has been formed and salt has accumulated in the topsoil. Severe water logging was then initiated and consequently extensive patches have now been salinized.

[2] Abo El-Fadl 2013

1.3 Population, ethnicity and language

In 2016, the human population of Siwa was reported to be around 28,300 persons[3], a considerable increase over the 8085 persons reported for 1980[4] and 12,500 in the 1990s. Population growth is higher than in Egypt in general. Literacy is 89%

Having been at the crossroads of trade routes, the people of Siwa are of mixed genetic origin, but culturally –and to a considerable extent demographically– Siwans are of Berber origin, and have closer ties to nearby Libya, which has a large Berber population, than to Egypt, which has a negligible Berber population. Thus, the traditional culture of Siwa shows many features unusual in Egypt, some reflecting its longstanding links with the Maghreb and the fact that many of its inhabitants are of Berber origin. Until a tarmac road was built to the Mediterranean coast in the 1980s Siwa's only links with the outside world were by arduous camel tracks through the desert. These were used to export dates and olives, bring trade goods, or carry pilgrims on the route which linked the Maghreb to Cairo and hence to Mecca.

Primarily orchard-keepers, farmers, and craftsmen, Siwans do not traditionally keep camels for transport of their produce. Instead, they relied on their relations with Bedouins to ship their dates and other products to distant markets[5]. Today, some Bedouins have permanently settled around Siwa, mostly raising only livestock. Historically, they also have played a key role in harvesting, processing, and transporting dates and olives, tasks that now involve migrant workers from the Upper Nile, some of which have become residents of the oasis as well.

As a result of their isolation, the Berber inhabitants of the Oasis developed a unique culture manifested in its crafts of basketry, pottery, silverwork and embroidery and in its style of dress. The most visible and celebrated examples of Siwa's material culture were the bridal silver and the ensemble of silver ornaments and beads that women wore in abundance to weddings and other ceremonies. These pieces were decorated with symbols, which related to Siwa's history and beliefs and attitudes.

The indigenous language of Siwa is *Siwi*, also known as Oasis Berber. Spoken exclusively in Siwa Oasis by an estimated 15,000 people[6], Siwi is the easternmost Berber language, one of the few surviving representatives of the languages spoken in the eastern Sahara before the arrival of Bedouin Arab groups in the 11th century. Siwi has been heavily influenced by Egyptian Arabic attesting to the effect of migration on the language. Siwi includes loanwords with no surviving counterpart in modern regional Arabic dialects, indicating a significant time depth and the involvement of at least three distinct varieties of Arabic at different periods[7]. Although Arabic has gained local importance as the language that dominates education, commerce and administration,

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[3] DRC 2016
[4] Arar 1981
[5] Fakhry 1974
[6] Naumann 2012
[7] Souag 2013

the status of Siwi as a spoken language is rather strong in Siwa as compared to the situation of some other Berber languages. The majority of the native population views the language in a positive light and nearly all learn to speak Arabic as a second language from an early age. Siwi is not an un-described but under-studied language. Most of the relevant literature consists of limited word lists, grammar sketches, or articles dedicated to specific topics.

1.4 Distinctiveness of Siwa among Egyptian oases

Siwa shares some features with other Egyptian oases such as the aridity of the climate, the origin of hydrological resources, and the geological substrate, however a number of characteristics distinguish it considerably and makes it unique. Siwa is a repository of distinctive date palm varieties and other crops (e.g. Siwan spearmint) the history of which goes back to the distant past (for details see section 2.2.1). Moreover Siwa oasis is dotted with archaeological remains from Pharaonic and later epochs, which have given historical fame to the place (see sections 3.1 and 3.2) and add to the oasis' remarkable touristic appeal. Most importantly, Siwa is unique insofar as Siwans have Berber ancestry and have managed to preserve much of their linguistic and cultural heritage (see 1.3 and 2.4). A visible manifestation of that heritage, among others, is the Karshif architecture, a tradition not encountered elsewhere (see section 3.1).

1.5 Administration and local governance

Siwa belongs to Matrouh governorate, one of the 27 governorates of Egypt. With a total area of 1372 km^2 Siwa acconts for 1.45% of the governorate's total area. Administratively, Siwa is divided in Siwa City, where 74% of the population is

Table 1: Non-governmental and civil society organizations in Siwa (year refers to establishment date)
Society of Social Unity, 1966
Society of Al-Shoban El-Moslimin, 1966
Society of Local Development – Ogurmy, 1984
Society of Local Development – Mshandt, 1984
Abo-Shroof society for Development the Local Community, 1997
Siwa Society for Community Development and Environ-mental Protection, 2001
Oasis Lovers Society for Community Development, 2005
Siwa Sons Society for Tourism Services, 2008
Society of Environmental Protection - Om El-Sagher, 2009
Islamic Society of Quran and Sunna People, 2010
Al-Bakr Society for Community Development in Siwa, 2011
Al-Fath Society for Community Development in Siwa, 2011
Society of Dar the Qur'an and Sunnah, 2013
Society of Science and Faith for Community Development, 2013
Society of Organic Crops Producers in Siwa, 2013
Society of Charity for Local Community Development, 2014

concentrated and 5 villages, namely Elmaraky, Aghormi, Abo Shroof, Om Elsaghir and Bahy Eldin.

There are 21 primary, 14 preparatory and 6 secondary schools, overseen by the local educational administration. There is a Central Hospital, four health units and five private clinics. Two police stations and two fire units provide security.

Although they are not part of the government in Siwa, non-governmental and civil society organizations play an important role in providing education, health and business development services to address development needs of the Siwan people. There are a total of 16 organizations established between 1966 and 2014. Their communication and capacity development capabilities are widely recognized in the governorate as complementing the functions of official government institutions.

2 Characteristics of the proposed Siwa GIAHS

2.1 Food and livelihood security

2.1.1 Importance of agriculture in the economy and livelihood of Siwa

Agriculture has been, and continues to be, the most important economic activity in Siwa and is the foundation for the Siwan livelihoods. There are currently some 280,000 date palms generating some 25,000 t of dates per year[8], which correspond to approximately 2% of Egypt's total date production. Similarly, Siwa is a significant national olive producer with a total yearly output of 27,500 t. Apart from the income generated through primary agricultural production, there are considerable employment and additional income effects from the drying and packaging (six companies in Siwa) as well as from the value-added processing of olives into pickles, much of which is still done at the household level, and into high-value olive oil (there are eight modern olive presses in Siwa). Domestically produced dates are a local staple in the oasis and provide a pillar of local food security.

As shown in section 2.3.1, Siwa date and olive orchards still harbour a diversity of vegetables, fruits and medicinals, some of which are planted predominantly for sale. As seen in Table 3, grapes, tomatoes, cucumbers, molukia (*Corchorus olitorius*), Siwa spearmint (*Mentha spicata*) and karkade (*Abelmoschus sabdariffa*) are all significant horticultural operations in the oasis generating local income, but their importance is orders of magnitude smaller that that of dates and olives. Alfalfa is an important feed as in other parts of Egypt. Various vegetables and especially fruits are grown interspersed in date and olive orchards for family consumption. Yet, the demand for most foodstuffs in the oasis is overwhelmingly (>90%) met by imports from Egypt's Nile valley and the Delta. The absence of significant horticultural production in Siwa is explained by the predominance of saline soils, the lack of horticultural competitiveness and Siwa's comparative advantage for the production of dried and storable food products.

[8] DRC 2016

Table 2 provides further detail on Siwa's crop areas. It should be noted that agricultural census data are notoriously difficult to generate in a mixed cropping system. The areas occupied by specific crops cannot easily be determined. Tree counts are mainly used to derive area estimates for dates and olives assuming standard planting densities. In the case of minor crops, a precise area determination is hampered by the fragmented and dispersed nature of plots. Thus the numbers in the table are to be interpreted with caution. They certainly do not add up precisely to the 21,000 feddan estimated to be the total physical area currently under cultivation in the oasis.

Table 2: Crop areas[1] in Siwa (feddan[2])

Olives	17000
Date palms	7000
Alfalfa	2700
Wheat	107
Barley	15
Molukia	32
Tomatoes	23
Pumpkin	16
Water melon	14
Onion	12
Pepper	2
Cucumber	10
Egg plant	3
Siwa spearmint	35
Karkade	45
Grapes	>30
Guava	>30
Other fruits	>30
Liquorice	22

[1] Source: Siwa Agricultural Administration 2015

[2] One feddan = 4200 m^2

2.1.2 Nutritional, culinary and medicinal value of dates

As described in section 2.1, dates represent an important element in the livelihoods of the Siwan people. Moreover, at an average annual per capita consumption of 8 kg, dates contribute significantly to the nutritional quality of the local diet. Depending on their maturation and dehydration state, dates contain a high percentage of carbohydrate (total sugars, 44-88%), protein (2.3-5.6%), fat (0.2-9.3%), essential salts and minerals, vitamins and an elevated proportion of dietary fiber (6.4-11.5%).

Sugars, especially fructose, glucose, mannose, maltose, and other non-reducing sugars such as sucrose, represent over 80% of the dry matter. The glucose-to-fructose ratio varies between 1 and 2 depending on the cultivar and ripening stage. A small amount of the carbohydrates in dates is accounted for by polysaccharides such as cellulose and starch. Fully mature dried dates contain such high average dietary fiber content (three quarters consisting of insoluble fibers) so that six to seven dates (approximately 100 g) consumed daily by an adult would provide 50-100% of the recommended daily intake.

Dates are also rich in vitamins, especially β-carotene (vitamin A), thiamine (B), riboflavin (B), niacin, ascorbic acid (C) and folic acid. The contents of carotenoids vary with the cultivar and stage of ripeness, with the total content of carotenoids decreasing towards the final ripening stages and in storage.

Dates also contain significant amounts of at least 15 essential minerals, including phosphorus, potassium, sodium, zinc, manganese, magnesium, copper, iron, fluorine and selenium, with individual minerals varying in content from 0.1 to 1000 mg per 100 g dry matter.

In conclusion, a diet including dates, when complemented with protein-rich food items such as milk products and fish, is uniquely simple but perfectly sustaining. Apart from being a good substitute for refined sugar, and a rich source of natural fibers, dates have been identified as having antioxidant and anti-mutagenic properties, and were also found to reduce heart disease (see below).[9]

A number of medicinal effects are directly or indirectly ascribed to the consumption of dates. The fruit is rich in tannins, making it a good astringent remedy for intestinal troubles. Formulations based on dates such as infusions, decoctions, syrups and pastes are often administered against colds, sore throat and cough.

Phenolic compounds in dates are known to have *anti-viral, -bacterial and -fungal properties*, potentially explaining their reputed use as remedy for certain diseases and prevention of chronic inflammations. The fruit and its by-products are rich in dietary fibers, selenium, carotenoids, ascorbate and other antioxidants, which may prevent oxidative damages.

Dates have been a staple food in Siwa and are commonly offered to welcome visitors. A number of processing companies sell dates filled with almonds or other nuts, or covered in chocolate. Dates may be included in some kinds of bread baked in Siwa. *Tagellan inteni* is a unique Siwan dish made from ground dates, which are cooked with wheat flour into a smoothly textured brownish paste, which is served with olive oil, and commonly eaten at breakfast (Fig. 5).

Figure 5: *Tagellan inteni* is a unique Siwan dish made from ground dates and wheat flour.

[9] Section based on El-Hadramy & Al-Khayri 2012

2.2 Biodiversity

2.2.1 Agricultural biodiversity

Siwa is eco-geographically and culturally isolated by more than 300 km from other agrarian communities and, perhaps because of this, detailed observations were made there by a number of agricultural scientists and geographers in a way that provides time-series data lacking from many other agrarian landscapes. The perennial crop inventory of Siwan Berbers has remained relatively stable through time and few traditionally cultivated annual species or landraces have been lost. However, additional crop species from other parts of Egypt have been adopted since a paved road was completed to Siwa in 1986. The reasons for the relative stability of Siwan agrobiodiversity may relate to both the need for crop ecotypes to be adapted to the alkaline edaphic conditions in Siwa and Siwan cultural adherence to its traditional cuisine.

Date palm

Genetic diversity studies on date palm have demonstrated that there is a clear association between population characteristics and the environments (i.e. oases) in which they grow. However, plasticity has apparently been sufficient to allow genetically similar date palm cultivars to grow and produce in widely differing oasis environments. Local date palm cultivars with outstanding adaptation to climatic, edaphic, and management factors, are the products of centuries of interaction between farmers, the genetic and breeding systems of the date palm, and the environment.

Date palm cultivars are differentiated principally by two criteria. For consumers, fruit characters are relevant, in particular the degree of sweetness and dryness (soft, semi-dry, and dry) in accordance with fruit water content, sugar and dry matter content as well as textural properties (depending on their composition at harvest when fully ripe). Producers, on the other hand classify date palms by their period of maturation. The selection and maintenance of date palms ready for harvest at different times allows producers and markets to extend the supply over longer periods.[10]

Siwa's native date varieties can be broadly classified in four categories[11]:

1) First and foremost is the famous *saidi* variety (clone) considered among the finest in the world. In a diversity assessment of date palms from Egypt, *saidi* and two related accessions (from Assiut and Faiyum), shared a distinctive genetic profile compared to some 27 other accessions included in the genetic analysis[12]. Accounting for some 80% of all date palms in Siwa (5660 feddan[13]), *saidi* is a semi-dry type of date. The large *Saidi* dates have very sweet flesh, few fibers,

[10] Kader & Hussein 2009
[11] El-Wakil & Harhash 1998
[12] El-Assar *et al.* 2005
[13] One feddan = 4200 m^2

and a favorable flesh weight percentage of 85%. They need to be picked before the fully mature stage, as these drop form the trees. They are dark yellow after drying. Siwa Oasis produces 65% of all Saidi dates in Egypt.

2) *Freihi* is the second most important clonal variety accounting for 20% of Siwa's date production (580 feddan). With an average fruit weight of 6.5 g it is a small-fruited "dry date" meaning that its fruits can reach full maturity on the tree. *Freihi* ripens early in October.

3) A third category consists of a diverse set of clonally propagated cultivars with very high fruit quality but these are difficult and slow to propagate, and therefore represented by a limited number of trees in the oasis. *Ghazali*, a dry date variety ripening in November with dark-red fruits, is highly esteemed for its large fruit size (12 g), thick pulp and delicious taste, but there are probably no more than a dozen trees in the entire oasis. *Tagtagt* has small fruits with yellow color, and delicious taste. This variety is a poor yielder (<70 kg per tree) and matures relative late in the season, from December to January. It is now down to perhaps no more than 30 palms in Siwa. There are other clonal varieties of little current economic importance, including *oshikakbil* (highest flesh weight percentage), *kakwengeb* (very large fruits) and others, such as the legendary *abu tawil*, reported in 1979 as an extraordinarily long date of up to 10 cm in length, which was reserved for consumption at special occasions.

4) Some 770 feddan are planted to *Azzewi* dates, a collective term to denote a highly diverse set of palms emerging from seedling volunteer trees (growing spontaneously from seeds). According to local estimates, some 300 "types" of azzewi are recognized ranging from dates with high eating quality to very poor quality dates used as animal feed.

Figure 6: Morphology of fruit, flesh and seed of date varieties in Siwa. 1 Freihi; 2 Ghazali; 3 Ghorm Ghazal; 4 Kakwengeb; 5 Said; 6 Oshikagbil; 7 Tagtagt. (Source El-Wakil & Harhash 1998.)

Non-date agricultural biodiversity

The Siwan crop inventory comprises 46 crop species (apart from date palm), which are shown in Table 3. Of these, 34 species had already been mentioned in reports over the last 100 years, while 12 crops cultivated in Siwa now were not recorded by earlier observers and must be recent introductions after paved roads connecting Siwa with the outside world were completed two decades ago[14]. These species include apples, guavas, prickly pear, zucchini squash, sorghum, basil, cucumbers, chard, taro root, and luffa sponges, bananas and sugar cane. Some of these have been in the Mediterranean Basin for centuries, but because Siwa was relatively inaccessible for a long time, the introduction of these crops may have been delayed. Crops such as apples and guavas may have been limited until recently by the availability of nursery stock physiologically suited to the peculiar environmental conditions of Siwa. Rice was introduced early in the

[14] Nabhan 2007

20th century, but was abandoned for fear of mosquitoes and malarial parasites associated with its cultivation in standing water[15].

Tree crops and vegetables dominate the Siwan crop inventory. Tree crops are particularly well suited to be associated with date palms and are commonly found in plantations. Vegetables are less common. The demand for most fruits and vegetables nowadays is mostly met by produce brought into Siwa from the Nile delta, except for a number of species discussed in section 2.5.2.

In any case, the 34 crop species recorded over the last century persist as components of Siwan agrobiodiversity. Particular landraces recorded earlier still persist at Siwa today, except for two cases of crop substitution. First, European-bred cucumber cultivars that are more frequently today and are certainly more prevalent in markets than the older snake melon, a gherkin-like landrace related to Armenian cucumbers. Second, the use of an older "honey" melon called *shammam* has been replaced by modern cultivars of cantaloupes that are easier to store and ship.

Market vendors in Siwa's souks label a number of folk varieties as bi-Siwi. These are locally adapted landraces that Siwans believe (1) occur nowhere else, (2) tolerate saline soils and alkaline spring waters more than introduced varieties have, and (3) provide essential ingredients for the distinctive flavors and textures of Siwan cuisine. Crops with locally adapted landraces are marked with "LR" under comments in Table 4.

The cultivation of olives in Siwa is believed to date back to antiquity[16] and so do probably some of the heirloom varieties still grown in the oasis. The following is an account of both traditional and modern varieties, which are grown presently for use in pickling and oil extraction:

The famous *Hamud* variety is considered the finest among native table olives. Its medium- to large-sized fruits with high flesh-to-stone ratio can be pickled either green or black, but they are highly sensitive to bruising during handling. *Hamud* is self-compatible and has good rooting ability. It is also fairly resistant to drought and salinity.

Wategen has smaller fruits with a medium flesh-to-stone ratio. Although dual purpose, it is mainly used for the extraction of oil that which is high in oleic acid and has low bitterness. Its rooting ability and productivity are intermediate. *Wategen* ripens from September to November.

Named after its origin in the al-Maraqi village, the small-fruited *Maraqi* variety excels with its high productivity and elevated oil content of up to 25%. So far *Maraqi* accounts for only 2% of the olive crop area, but it is being propagated on a commercial scale and is expected to become Egypt's main oil cultivar. It ripens from November to December.

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[15] Fakhry 1974
[16] Bliss 1998

Table 3: Crop inventory of Siwa Oasis (after Nabhan 2007)

Scientific name	English	Siwi	Comments
	Tree crops & fruits		
Malus x domestica	Apple	Tuffaah	
Prunus armeniaca L.	Apricot	Mishmish	
Musa paradisiacal L.	Banana	Al-Mawz	
Ceratonia siliqua L.	Carob	Ti-jarobiin	
Phoenix dactylifera L.	Date	Tiini	LR
Ficus carica L.	Fig	Imuuchan	LR
Vitis vinifera L.	Grape	Tizren	LR
Psidium guajava L.	Guava	Juuwaffa	
Ziziphus lotus Lam.	Lote fruit	Nabakt bi-Siwi	LR
Mangifera indica L.	Mango	Manga	
Morus alba L.	Mulberry	Tuut	
Olea europea L.	Olive	Azumur bi-Siwi	LR
Prunus persica (L.) Batsch	Peach	Xoox	
Pyrus communis L.	Pear	Kummitra	
Prunus domestica L.	Plum	Burquq	
Punica granatum L.	Pomegranate	Al-Monen	
Citrus reticulata Blanco	Tangerine	Burtgan bi-Siwi	LR
	Vegetables		
Beta vulgaris L.	Chard	Selk	
Capsicum annuum L.	Chile pepper	Al-Filifil bi-Siwi	LR
Phaseolus vulgaris L.	Common bean	Fasulya	
Coriandrum sativum L.	Coriander	Kuzbara	
Cucumis sativus L.	Cucumber	Al-Xiyaar	
Solanum melongena L.	Eggplant	Lubginga	
Corchorus olitorius L.	Jew's mallow	Al-Muyixiyaad	LR
Luffa cylindrica Roem.	Luffa	n.a.	
Abelmoschus esculentus L.	Okra	Bamya	
Allium cepa L.	Onion	Al-Filau	
Portulaca oleracea L.	Purslane	Makhmakh	
Hibiscus sabdariffa L.	Roselle	Karkade	LR
Cucumis melo L. *var. flexuosus*	Snake melon	Tefossayn	
Cucurbita pepo DC.	Summer squash	Kuusa	
Lycopersicon esculentum Mill.	Tomato	Al-Taamatim	LR
Citrullus lanatus (Thunb.) Mansf.	Water melon	DaHmiksa	
Cucurbita moschata Duch.	Winter pumpkin	Likdiwa	
	Grains		
Zea mays L.	Maize	Yarldin	
Eleusine indica Gaert.	Millet	n.a.	
Sorghum vulgare L.	Sorghum	n.a.	
Triticum aestivum L.	Wheat	n.a.	
	Fodder & herbs & specialty crops		
Medicago sativa L.	Alfalfa	Gazaar	
Melilotus officinalis L.	Sweet clover	n.a.	
Ocimum basilicum L.	Basil	RiHaan	
Ricinus communis L.	Castor bean	n.a.	
Lawsonia inermis L.	Henna	Al-Henni	
Mentha spicata L.	Spearmint	Neana'a bi-Siwi	LR
Saccharum officinale L.	Sugar cane	Laksab	
Glycyrrhiza glabra L.	Liquorice	n.a.	

LR denotes crops with landraces believed to be unique or specially associated with Siwa

Moluqi has small fruits and is not suited for pickling but it has high oil content of about 27-30%.

Agizishamy and *Agiziaksy,* two very similar varieties, have large-sized fruits and are preferred for pickling. They are harvested from September to December.

Kalamata, a world-famous Greek table variety with large-sized fruits has been introduced to Siwa. Average fruit weight varies from 3 to 7 g. The oil content ranges from 15 to 20%. Kalamata matures from September to October. It is difficult to propagate, and its shelf life is limited.

One minor tree crop in Siwan oasis gardens may be as ancient at the oasis as dates and olives, for it has long been associated with Berbers of the Libyan Desert. Its name in Siwi is suggestive of its antiquity: it is the lote tree (*Ziziphus lotus*), called locally Nabakt bi-Siwi (see Fig. 7).

Figure 7: *Ziziphus lotus,* a common fruit associated with date palm in Siwa (Photo: M.Hermann, March 2016)

Another -commercially relevant- specialty crop in the oasis is Siwan spearmint (Fig. 8), a distinct chemotype of *Mentha spicata*. It has much higher oil content than other types of spearmint, and moreover, is characterized by lower carvone and higher limonene contents. A multilocational trial across Egypt[17] suggests that the oil content and composition of this spearmint is subject to genotype x environment interaction. Cultivation of this vegetatively propagated crop in Siwa provides raw material for oil extraction of consistently high quality, probably owing to the prevailing climatic conditions (high temperatures, atmospheric dryness and solar irradiation).

[17] Edris *et al.* 2003

Figure 8: Siwa spearmint, a distinct chemotype of *Mentha spicata indigenous to Siwa* (Photo: M. Hermann)

Animal genetic resources

Table 4 presents the faunal component of agrobiodiversity in Siwa. The local abundance of manures from these livestock have provided a local and stable source of fertilizer to Siwan crops that agricultural nutrient management has changed little over the last

Table 4. Livestock as a component of the Siwan cropping system (Source Nabhan 2007, DRC 2016)

English	Cairene Arabic	Siwi (Berber)	No. animals
Cattle	Baqar Toor/Tiraan	Itfunast/Array	1300
Buffaloes			335
Sheep	Xaruuf	Itdaan	4930
Goat	Miaza	Tirreada	4725
Camel	Gamal	Al-rham	
Donkey	Humaar	Lizirt	
Dog	Kalb	Agurzni	
Rabbit	Arnab	Tiarzett	
Pigeon	Hamaam	Abdir	
Turkey	Diik ruumi	Maalot	
Chicken	Farxa	Tiazet	4000
Duck	Batt	Al-Batt	1150

century. Traditional manuring is practiced extensively in date and olive plantations. A few other customs peculiar to Siwa livestock management should be noted. Female donkeys are excluded from the Berber villages and kept only on the outskirts by the Bedu, who facilitate donkey breeding and sales of the male progeny to Berbers. Pigeons are kept in towers on the edges of dooryard gardens, date groves, and corrals and, as in much of Egypt, squab (young unfledged pigeon) is considered a delicacy.

2.2.2 Flora of Siwa Oasis

Irrigated farmland, irrigation canal banks, reclaimed and salinized waste lands as well as water bodies provide diverse habitats for the 79 species of wild plants that have been recorded in Siwa[18], making it the second most diverse of five oases surveyed in the Western Desert, presumably because of its long history of agriculture and land use. With Poaceae, Fabaceae, Compositae, Cyperaceae and Chenopodiaceae comprising more than 50% of the total number of species, plant diversity is un-evenly distributed among taxonomic groups.

Other families are conspicuously less diverse and the majority of recorded genera are represented by a single species. Genera comprising more than three species include *Euphorbia*, *Cyperus*, *Avena*, *Chenopodium*, *Cuscuta*, *Medicago*, *Juncus* and *Tamarix*.

Some species have become rare and may be considered endangered. These include *Gossypium arboretum*, *Rostraria rohlfsii*, *Stipagrostis vulnerans*. *Populus euphratica*, a threatened tree not known outside Siwa Oasis, grows on the sand dunes that surround certain wells in the western areas of Siwa Oasis. Two invasive species, nowadays common in Egypt, namely *Ambrosia maritima* and *Aster squamatus* form dense populations in Siwa and often dominate the orchard habitat characterized by shade and humid conditions.

2.2.3 Fauna of Siwa Oasis

The seemingly austere landscape of Siwa and the surrounding desert is alive. It is inhabited by a diverse, but secretive and mostly nocturnal wildlife, which is not easy to spot. Siwa supports a distinct and wide-ranging collection of animal species, including at least two species of amphibians, 28 mammals, 32 reptiles, 52 insects, 92 soil fauna and a variety of birds. Among these, several species appear to be unique to the Siwa region[19].

Particularly charismatic animals include the Dorcas gazelle (*Gazella dorcas*), which is still fairly common, several species of desert foxes (e.g. *Vulpes zerda*), the Lesser Egyptian Jerboa (*Jaculus jaculus*), the venomous Saharan sand snake (*Psammophis aegyptius*), and the sandfish lizard (*Scincus scincus*), to name just a few.

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[18] El-Ghani & Fawzy 1994, 2006

[19] Mikhail 2012

Of the 164 bird species that have been recorded in Siwa[20], only 26 breed locally. The other 138 species are visitors from Europe that spend the winter months in the oasis or pass through on migration, from and to wintering grounds further south, via one of the major migratory routes across Egypt. The species range in size from passerines weighing less than 10 g to storks, and birds of prey. The rich vegetation of the date palm orchards and water resources of the oases attract millions of birds that can be observed during the spring and autumn migration.

2.3 Knowledge systems and adapted technologies

2.3.1 Date palm cultivation and crop management

Dates can grow in very hot and dry climates, and are relatively tolerant of salty and alkaline soils. They thrive in deep soils, preferably sand 1-2 meters deep. Date palms require a long, intensely hot summer with low humidity during the period from pollination to harvest, but with abundant underground water near the surface or irrigation.

Date palm is a diploid perennial, and monocotyledonous plant belonging to the Arecaceae (palm family). A distinguishing feature of date palm, with important implications for the production of dates, is that it has separate female and male trees. It is of course only the female trees that bear fruit.

New date palm cultivars are the result of a continuous selection process carried out by farmers in their orchards following sexual reproduction. Seeds germinate easily and are available in large numbers. Occasionally, seeds germinate under their mother trees and this leads to large levels of genetic diversity within populations, especially with natural pollination. The long time span for a date palm to reach sexual maturity and reveal its sexual identity have led to the predominance of clonal propagation (offshoots) of females from elite date palm cultivars. This is today the most common method of propagation. It relies on the transplanting of offshoots exchanged or traded between growers and groves. A well-maintained palm can produce up to three offshoots per year with a maximum of up to 40 during its lifetime. However, transplanted offshoots develop slowly, and typically begin to bear fruit within 5-8 years.

Female plants start producing dates at 4 to 6 years of age and reach full production within 15 to 20 years. The average date palm produces 70 kg fruit annually, with yields of more than 100 kg possible with intensive management. When farmed with low levels of inputs and management, dates may produce 20 kg fruit or less annually.

Although date trees are wind- and insect-pollinated, farmers in Siwa practice artificial manual pollination in order to secure fruit set. Some male trees are grown in date gardens, and pollen is collected for the artificial pollination that is critical for the success of production. Cultivars differ greatly in their fruit set percentage. It is also part of traditional knowledge that different pollen sources can influence the size of fruits, known scientifically as the “metaxenia” effect.

[20] Goodman et al. 1986

Because of the biology of the date palm, its cultivation has a number of unusual features that are not common in other perennial crops. Several cultural practices, such as pollination, harvesting, and pruning require access to the crown of the tree, and in old trees reaching 15 m in height, this can be challenging. Each tree will be climbed at least three times per year, and typically more often since pollination may be practiced three consecutive times (Fig. 9).

After pollination, bunches are often tied to the leaf stalks to support the weight of the fruit. Fruit thinning is sometimes practiced, since it increases fruit size, improves fruit quality, advances fruit ripening, and facilitates bunch management. Fruit thinning can be carried out in three ways: removal of entire bunches, reduction in the number of strands per bunch, and reduction in the number of fruits per strand.

Although date palms can withstand long periods of drought under high temperatures, large amounts of water are required for vigorous growth and high-quality fruit. Date palms are usually fertilized, although responses to fertilization are inconsistent particularly when applying nitrogen. Manure has traditionally been used in date production, and nitrogen-fixing alfalfa is grown frequently in date orchards. Experiments in Siwa have shown that potassium fertilization increases vegetative growth of date palms of the *saidi* variety and improves fruit quality, especially if combined with fruit thinning[21].

[21] Harhash 2000

Figure 9: Manually pollinating date palm. Note that prior pollination the older leaves have been removed to facilitate access to the crown of the palm. (Photo: M. Hermann, 2016)

2.3.2 Date palm harvest and post-harvest knowledge

Unlike most other fruits, dates can be consumed at the four distinct ripening stages described below, with obvious implications regarding their utilization, marketability, nutritional value and processing. These four stages are usually referred to by the local Siwi terms *agingin*, *irgawin*, *isimimin*, and *infit* to represent the immature green, the mature full colored, the soft brown, and the hard raisin-like stages, respectively.

During the *agingin* stage, the fruit increase in size and weight rapidly until in the *irgawin* stage they reach full size and weight. The fruit color changes from green during *irgawin*

to a color characteristic of the cultivar during *isimimin*. They remain turgid and astringent and due to a substantial amount of water-soluble tannins have astringent taste. Fruits during the *infit* stage are characterized by a darkening of the skin to amber, brown, or nearly black, accompanied by softening, decreasing astringency[22].

During the *infit* stage, fruit lose much of their water and the sugar-to-water ratio is high enough to prevent fermentation, similar to raisins or dried prunes. Water content is 75% to 80% in young fruit, decreasing to 40% to 60% at the beginning of ripening, and decreasing rapidly later. The sugar content is accumulating until reaching 72% to 88% of dry matter at maturation.

Until the 1980s, harvested dates were dried on public drying places, where they were safe from theft. Dried dates were then pressed into blocks for sale (Fig. 10). It was also customary to store dried dates in lined earthen pits. However, today, dates are dried in forced-ventilation ovens installed at various processing companies.

Figure 10: Traditional drying and processing of harvested dates in Siwa. (Painting by Yussef Ibrahim.)

2.3.3 Secondary products from date palm

Dates are the economically salient product derived from the date palm, but virtually every other part of the palm is used. Thus the date palm in Siwa is a genuine multi-purpose tree still today.

Secondary edible products include palm cabbage and palm juice. Palm cabbage (called *gummar* in Siwi) is the tender meristematic apex of the palm and can only be obtained

[22] Bliss 1998

by destroying the palm. Traditionally, consumption of *gummar* has been reserved for religious festivities. Palm juice, called locally *lagbi,* on the other hand does not require to kill the palm, but can be tapped from careful incisions of the apex, which yield several liters per day. The juice is sweet and ferments rapidly. Consumption of palm juice was significant in the past during feasts of farm workers.

There is also a multitude of non-food uses of different parts of the palm (Fig. 11). Some of these result from the annual pruning of leaves, fruit stalks and spathes. Leaves are very often used to construct fences providing wind protection for horticultural crops, or to make mats, baskets and crates. They also represent a source of fuel for baking bread and for implements such as brooms.

The fiber surrounding the petiole base (*asan*) is used to make ropes (*tasmat*). The trunks of date palms are providing construction material for doors, furniture and notably construction beams and ceilings in *karshif* architecture (see section 3.3).

Finally, highly nutritious animal feed can be produced from date seeds and low quality dates.

2.4 Cultures, value systems and social organizations

The traditional society of Siwa is based on so-called *qabilas*, groups of people with a common ancestry, but also open to outsiders with no kinship links. Each *qabila* is presided over by a sheikh, who is elected by the elders of the family lineages. The sheikhs of the 12 existing qabilas constitute the *maglis*, an executive council, which oversees community issues, arbitrates conflicts between cabilas, and generally provides local governance.

Siwa is still a very conservative society. Outside of the family nucleus, there is strict separation between men and women in the oasis, from an early age on. Men work in the plantations and soukhs, while women, especially married women are restricted to their homes, and rarely venture outside. Women in public are always veiled. Apart from household chores, it is common for women to engage in cottage industries, such as weaving, embroidering, etc. Although women may have their own income, inherit and exercise other civic rights, it is the men who participate in public life, to the point where they even assume shopping tasks.

As a result of their isolation, Siwans developed a unique culture manifested in its crafts, although some of it has been lost. There is a wide assortment of historic basketry and palm frond products that were finely woven and decorated. For daily clothing, the women dress in a variety of colors, which are often embroidered near the neckline. Interestingly, the predominant colors for ornaments on basketry and clothes are green, yellow, orange, red and black to symbolize the ripening stages of date fruits[23].

[23] Bilancetti *et al.* 2012

Figure 11: Traditional non-food products from date palm made in Siwa. Clockwise from upper left: 1) Chair made from leaf midribs; 2) Farm worker producing rope from fibrous sheaths of petiole base; 3) Ceiling made of palm wood; 4) Fence made of date palm fronds (Photos: M. Hermann, 2016)

Among collectors of silverwork, Siwa is known for its jewelry, bridal and other silver ornaments that women wore in abundance at weddings and other ceremonies[24]. These pieces were decorated with symbols common to Berber people across North Africa designed to promote good health, fertility and to protect the wearer from misfortune. The jewelry, which was made by local silversmiths, comprised silver necklaces, earrings, hair ornaments and many rings. For a wealthy woman, the full ensemble could weigh as much as five or six kilos.

Being overwhelmingly Muslims, Siwans celebrate Eid al-Fitr and Eid al-Adha. The Eid El Siyaha Festival, in honor of the town's traditional patron saint Sidi Sulayman, is unique to Siwa. It takes place at harvest time, at full moon in October. The name is often misunderstood as a reference to tourism, but in fact predates it. Indeed it is a 150-year-old tradition, celebrating the day when peace was made between Siwans after age-old disputes over land and water usage, by arranging meetings and prayers at the Dakrour mountain village. Since then, Siwan men have been travelling each year to the Dakrour mountain to eat together and sing chants thanking God, and reconcile with one another. The women stay behind in the village, and celebrate with dancing and singing. The food for the festival is bought collectively, with funds gathered by the oasis' mosques.

2.5 Remarkable landscapes, land and water resources management

2.5.1 The unique agricultural Siwa landscape

The Siwa landscape is an eminently anthropogenic one. Without the agricultural use and human hydrologic intervention, the oasis would look very much like the surrounding desert, including patches of land with sparse natural vegetation sustained by natural springs. From prehistoric times, humans have engineered wells through ingenious and autochthonous technologies, which provide abundant water for plant and animal production and have also brought domesticated plants into the oasis, notably date palms, which are the dominant Siwan landscape feature. Agricultural interventions have also provided niches for wildlife, as described in 2.2.3. Thus human activities have critically shaped landscape features and ecosystem functions.

2.5.2 Agriculture as the dominant Siwan landscape feature

The cropping system of Siwa oasis very much determines the landscape in Siwa within and around human settlements. It is dominated by intensively cultivated date palm gardens, which traditionally are inter-cropped with fruits, vegetables, fodder crops and occasionally cereals. This results in a three-storey canopy structure with date palms occupying the highest stratum, with fruits at intermediate height and all other crops up to one meter above ground level. In recent decades, owing to their good profitability and adaptation, olives have gained economic importance and are also intercropped with date palm, or planted in monoculture. Date palms are typically spaced at comparatively low planting densities in the oasis (80-100 palms per hectare) in order for sufficient light to penetrate the canopy underneath the palms. At the same time, the stress-resilient date

[24] Bliss & Weißenberger 1983

palms shield other crops and provide a micro-climate (lesser temperature amplitudes, higher air humidity) suited for less hardy species that would otherwise not thrive in the desert. Mixed cropping of perennial and annual species has the additional advantage of increasing area productivity, water use efficiency, especially when the date palms are still young. Moreover, this system provides a diversity of foodstuffs, an aspect of Siwa's oasis agriculture, which was more important in the past, when food supplies from outside the oasis were erratic.

Figure 12: Typical Siwa landscape with date palm gardens, unirrigated land, inselberg mountains and drainage lake (View from Mountain of the dead, Photo: M. Hermann, March 2016)

One particularly important component of this cropping system is alfalfa, a perennial and deep-rooted legume, which has the ability to re-grow after being cut for fodder. It can be harvested several times per year. Alfalfa's primary benefit is the combination of high yield per hectare and high nutritional quality as fodder for cattle, sheep, and goats in terms of elevated protein content and highly digestible fiber. Equally important is the ability of alfalfa to fix atmospheric nitrogen through its root nodules, and thus render the N-deficient soils in Siwa productive. Not only enriches alfalfa the soil with nitrogen that becomes available for date palms and other non-leguminous crops, but also part of the fixed nitrogen leaving the gardens as fodder will eventually return as manure.

Figure 13: Date palm garden in Maraqi, mix-cropped with alfalfa in foreground, olive and fruit trees in background (Photo: M. Hermann, March 2016)

Figure 14: Pigeon towers in Siwa. Note fence made of Date palm leaves (Photo M.Hermann, March 2016**)**

2.5.3 Water resources management

The common irrigation method in Siwa is traditional surface irrigation by gravity in small basins, which vary in size from 4 to 16 m^2. The advantages of this method include simplicity, low energy and capital needs, and the ease of the leaching process. On the other hand, irrigation losses with this method are high owing to seepage from wells, storage pools and irrigation canals, which are often very long and built of sandy and porous soil.

Irrigation with ground water from natural springs and artificially drilled wells is as old as agriculture itself in Siwa. Water is abundant from the aquifers underlying the oasis (as described in section 1.2), and the ease of drilling productive wells has led to a large number of them. There are 226 old "Roman" *aiun*, and 1600 *abar*, which were drilled starting in the 1960s and especially after 1980. *Aiun* (singular: *ain*) denotes natural springs or wells dug in the remote past, with some indeed going back to the Roman era. *Abar* (singular: *bir*) are artesian wells drilled by contemporary generations. *Abar* include also those nine deep wells drilled since the 1980s that produce water of low salinity from the Nubian sandstone aquifer at a depth of 1000-1200 m[25].

Water from the top shallow aquifer may have up to 7500 ppm dissolved solids[26]. Irrigation with this water will quickly lead to soil salinization unless there is proper drainage to leach out accumulated salts from the soil. Another reason for the need of drainage is that there are always periods during which part of the water of the continuously flowing wells is not fully utilized. These periods are mainly during nighttime when no irrigation is practiced and in winter when water requirements are far less than the available discharges. Drainage is, therefore, needed to remove this surplus water.

Almost all wells are private property, and some of the large old *aiun* may have dozens of owners, who share water rights, but also the responsibility for the maintenance of the wells and distribution ditches. Many new wells have been added in recent decades, as this is the only way to irrigate newly developed agricultural areas at higher elevations, and also because farmers desire to be less dependent on the communal well management. However, communal wells are still in operation, and increasingly so, because of the need to consolidate the proliferation of wells (see section 5.2.1).

Ancient regulations governing water rights in communal wells are laid down partially in the *Siwa Manuscript,* o collection of historiographic texts by Arabic-Islamic authors going back to the Middle Ages. They are also passed on as oral tradition between generations. Water rights are entitlements for the time during which the water of a well can be used entirely or partially. They are associated with specific plots of land and can be traded together with them. A group of farms fed from one well is traditionally called a *hattiyya*. It is normally surrounded by an interceptor open ditch, which collects surface (run-off) and subsurface drainage. The ditches of a number of *hattiyyas* flow to a secondary drain and

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[25] Section based on Bliss 1998

[26] Abo El-Fadl *et al.* 2013

then to a main drain, which discharges its water to the lowest point in the vicinity. Continuous flows to these low points formed the lakes now known as *birak*.

The *ahisab* is the supervisor overseeing the distribution of water to the plots of individual farmers. He determines the precisely timed schedules for opening and closing of irrigation canals. A respected individual called locally *rikab* maintains a registry of water rights, and arbitrates conflicts over water use. Both the *ahisab* and the *rikab* were traditionally remunerated in kind with a certain amount of dates.

3 Historic relevance

3.1 History of Siwa

Although humans have settled in Siwa at least since 4000 BP, as is evident from the large number of tombs and mummies found in the oasis, Siwa's existence was barely noticed in the Nile valley and remained unmentioned by Pharaonic sources. Since the pyramid age, Siwa lay far removed from Egyptian security concerns as well as interests relating to material resources and trade.

The ancient oasis of Siwa was crucial to the trade caravans, which crossed the desert from the Nile valley in the east to the Mediterranean harbors of Libya in the west. However, it is not before the Egyptian Late Period, i.e. before 2600 BP, that Siwa emerges from historical obscurity. Though known as Siwa today, prior to the fifteenth century it was called Ammonium by the Greeks and Romans, and the oasis' inhabitants as Ammonians. This name stems from the Latin *sal ammoniacus*, meaning "salt of Ammon" named so because it was found near the temple of Ammon and its ancient oracle.

Till Roman times the oasis remained a sovereign "sheikhdom" ruled by a Libyan tribal chief, or *basileus* in Greek (="king"). Officially he was also the high priest of the Oracle of Amun, whose sanctuary was built on the acropolis of Aghurmi, situated next to the king´s palace. During public oracular processions the god answered questions by means of "gestures", exacted by the priests, or by giving answers in writing letters miraculously sent from heaven. Aside of its attraction for traders from the southern oases and central Africa, Siwa prospered as a religious centre, with many kings sending delegates to consult the Oracle of Amun. It was particularly the visit of Alexander the Great visit, during his campaign to conquer the Persian Empire, that the Oracle of Amun derived much of its fame in antiquity. The oracle, Alexander's court historians alleged, confirmed him as both a divine personage and the legitimate paraoh of Egypt.

In the course of the first century AD, Siwa became part of Roman Egypt. In Byzantine times, Siwa figured amongst the bishops of the eparchy of Libya, as confirmed by the existence of a Byzantine cemetery in the far west of the oasis.

Siwa started to go into decline around the sixth century AD, when many of the pagan temples in Siwa fell out of use because of the spread of Christianity. This period coincided with the collapse of the Roman Empire. In 708 AD first attempts by the Arabs to conquer the ancient citadel Aghurmi failed and it was not before the middle of the 12th century that Islam gained a secure foothold in Siwa.

The contemporary name of Siwa is derived from Siwi, the language spoken by the Berber tribe from Libya that invaded the oasis during the 12th century, during which the old town of Shali and a mosque were established on a hill just over one kilometer west of Aghurmi, in all probability deliberately far from the late-antique center of paganism.

In 1819, Muhammad Ali, the founder of modern Egypt, conquered the oasis and officially made it part of Egypt.

3.2 Highlights of Siwa's archaeological heritage

The following is just a selection of archaeological sites testifying to the long history of Siwa:

Built in the 12th century AD on the highest hill of the oasis in order to better defend the population from nomad incursions from the desert, the ancient fortress of Shali is perhaps the most iconic site in the oasis. Originally accessible through only one gate, the fortress was used for nearly 800 years. It started to be gradually abandoned in the 19th century by its inhabitants, who moved outside to escape overcrowding and a crumbling infrastructure. Built in *karshif* (see next section), houses were critically damaged by three days of heavy rains in 1926. Today, Shali lies in ruins, except for the old mosque and some buildings at the entrance to the city. Still, Shali remains a prominent feature towering five stories above the modern town and is lit at night by floodlights.

Gebel el-Mawta, the Mountain of the Dead, one of Siwa's most visited attractions is a necropolis atop a hill outside the historical Siwa, where Siwans buried the dead from the 26th Dynasty through Ptolemeic (Greek) and Roman times. Excavated by the famed Egyptian archaeologist Fakhry, some tombs have painted walls, dating back to the Pharaonic era.

The Temple of the Oracle of Amun (see also frontispiece) stands magnificently amid the ruins of the abandoned village of Aghurmi, the oldest village in the oasis founded on another hilltop. Built about 2600 BP, it draws its fame from two historical events: the aforementioned visit by Alexander the Great, and the failed expedition of the Cambyses army. There are breathtaking views from Aghurmi hill on the sprawling palm plantations and lake Zeitun, against the desert backdrop (see Fig. 15).

The Temple of Umm Ubayda is situated amidst a date palm grove, a short distance from Aghurmi. Constructed about 2400 BP, in the 30th dynasty, the temple was dedicated to the ancient Egyptian god Amun, and –connected via a passage way- was presumably an integral part of the oracle. From drawings of the temple it is evident that the temple was still fairly intact in the 19th century, but an earthquake destroyed it leaving only one wall with Pharaonic reliefs and inscriptions.

The Cleopatra spring is an ancient spring, perhaps in use for millennia, also near Aghurmi. It is surrounded by date palm groves, and a good example for the more than 200 "Roman wells" still in operation in the oasis.

Figure 15: Siwa's archaeological heritage sites. Clockwise from upper left: 1) View from Gebel el-Mawta; 2) Temple of the Oracle of Amun; 3) Cleopatra's spring, 4) Temple of Umm Ubayda. (Photos: M. Hermann 2016)

3.3 Karshif architecture

The traditional architecture of Siwa is unique for its use of *karshif* in a peculiar and little-studied building technique employed in the construction of the old town Shali, and of buildings of the 19th century in the oasis after Shali was being abandoned.

Karshif is a hardened mix of sodium and potassium chloride (75-85%) as well as quartz and calcite particles that occur at the shore of salt lakes as firm deposits as water evaporates and solutes crystallize (see Fig. 3). Irregular-shaped *karshif* slabs and blocks are mined at lakeshores and taken to construction sites, where they are assembled into walls up to 2 m thick. A mud mortar made by hydrating *tafla*, a mix of clay (40-60%), gypsum (20-30%) and sodium chloride (10-30%) occurring underneath the salt crust is used to bind the *karshif* fragments. This mortar is quite different from usual mud mortars in that it hardens not only through drying, but also the crystallisation of sodium chloride into one rigid matrix that intimately binds *karshif* blocks together into a sort of "monolith".

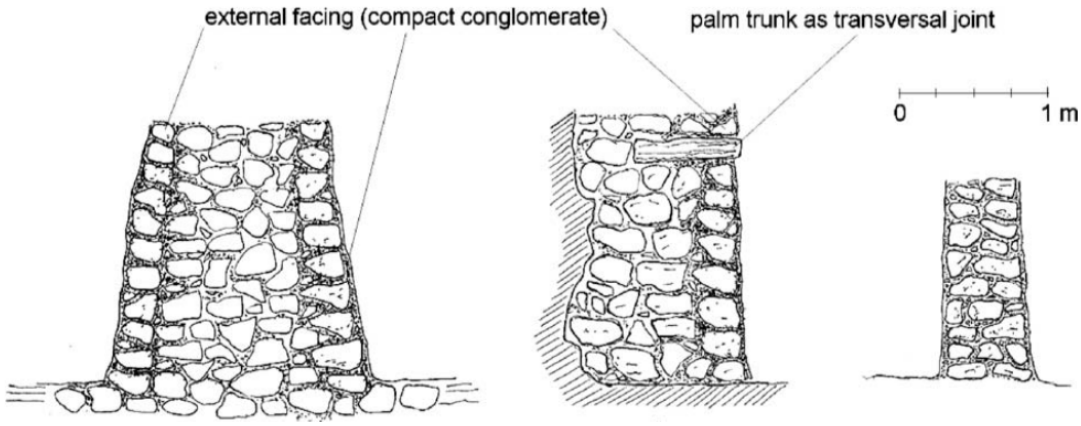

Figure 16: Ancient walls in Shali made of karshif blocks and clay mortar (Source: Rovero et al. 2009)

Karshif architecture would be unthinkable without the use of date palm trunks, which are ubiquitously used as beams in *karshif* buildings (see Fig. 17), in order to stabilize walls and, split longitudinally into half beams, to construct floors, realize architraves and projecting structures. Olive wood is the only other wood available in the oasis, albeit much less abundant, and wood from outside the oasis was unavailable in the past. In modern *karshif* buildings, use of palm wood seems to be supplanted by timber, or at least partially so, possibly because palm wood is a very deformable material and exhibits great vertical displacements under loads.

Karshif has been hailed as being superior over modern construction materials insofar as it insulates against heat. *Karshif* buildings are cooler in summer and warmer in winter, thus mitigating weather extremes. On the other hand, *karshif* walls are quite brittle and threatening fissures occur frequently, especially near corner edges, and under palm beams. If these remain open, occasional rains and humidity can further weaken the structural integrity of buildings. Thus, neglect of Shali's *karshif* architecture led quickly to

Figure 17: *Karshif* architecture in Siwa. Clockwise from upper left: 1) Ruins of the old Shali town center; 2) Use of date palm trunks as floor beams; 3) Renovation of *karshif* building in Shali, old Mosque in background; 4) Modern *karshif* building (Siwa Documentation Center of Cultural Heritage and Natural). (Photos: M. Hermann 2016)

the destruction of the old city after its final abandonment in the 1930s. Also, *karshif* building foundations have been said to become unstable because of hygroscopic action on ground with shallow water tables.

Figure 18: Brick building under construction, emulating the design and plaster of karshif architecture (Photo: Hermann 2016).

4 Threats and challenges

4.1 Agricultural expansion, drainage and soil salinity

In the distant past, when the number of wells in operation was just sufficient for the peak demand requirements of the cultivated lands, excessive winter supply was counterbalanced by summer evaporation from the free water services of the lakes. The lakes were almost dry late in spring, summer and early autumn. Water depths in winter were shallow. The difference between winter and summer water levels in the lakes was only 20 cm and was kept constant in the 40 years to 1977[27]. In 1981, the level of water in the lakes was still deep enough to drain most of the cultivate area by gravity[28].

[27] El Quosy 1990
[28] Arar 1981

With the increasing population in recent decades, the cultivated –and hence irrigated– area was much increased, as can be appreciated in Fig. 19, which shows the evolution of land use from 1990 to 2008. As a consequence of the expanding agricultural area and the improvement in drilling techniques, the number of wells increased considerably.

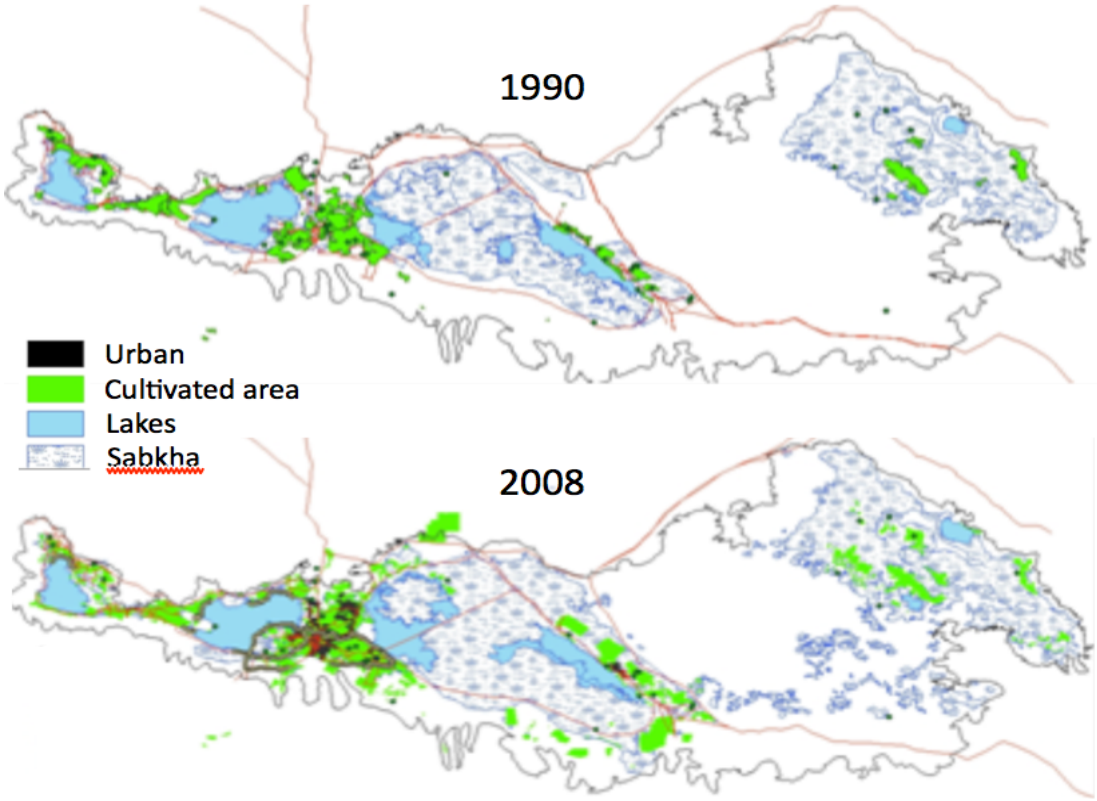

Figure 19: Evolution of land use in Siwa between 1990 and 2008 (Source: Samy 2010)

This increase was not accompanied by corresponding improvement of the drainage system. The wet periods of the lakes became longer and covered almost the whole spring and autumn. The water depth in the lakes in summer became larger. In winter this depth became too high for main drains to flow by gravity. This caused water levels in these main drains to remain high for longer periods of time. The consequence is that groundwater tables are getting closer to the ground surface and thus affecting the productivity of some areas and severely injuring the crops at higher elevations.

As illustrated in Fig. 19, of a total oasis area of 1050 km^2, the cultivated area increased from 1990 to 2008 from 53 to 88 km^2, lakes 60-76 km^2, sabkhas 335-470 km^2, urban area 6-10 km^2, respectively[29]. The increase in the surface area of lakes is more pronounced in the Western area of the Oasis. For example, Siwa lake grew nearly two-fold from 21 to 38 km^2 during the period from 1990 to 2008.

[29] Samy 2010

The problem of rising groundwater tables was further exacerbated by putting new areas at higher elevations under irrigation. This causes excessive water seepage from newly developed areas to the low-lying land and aggravates the already existing water logging and salinity in older orchards (Fig. 20).

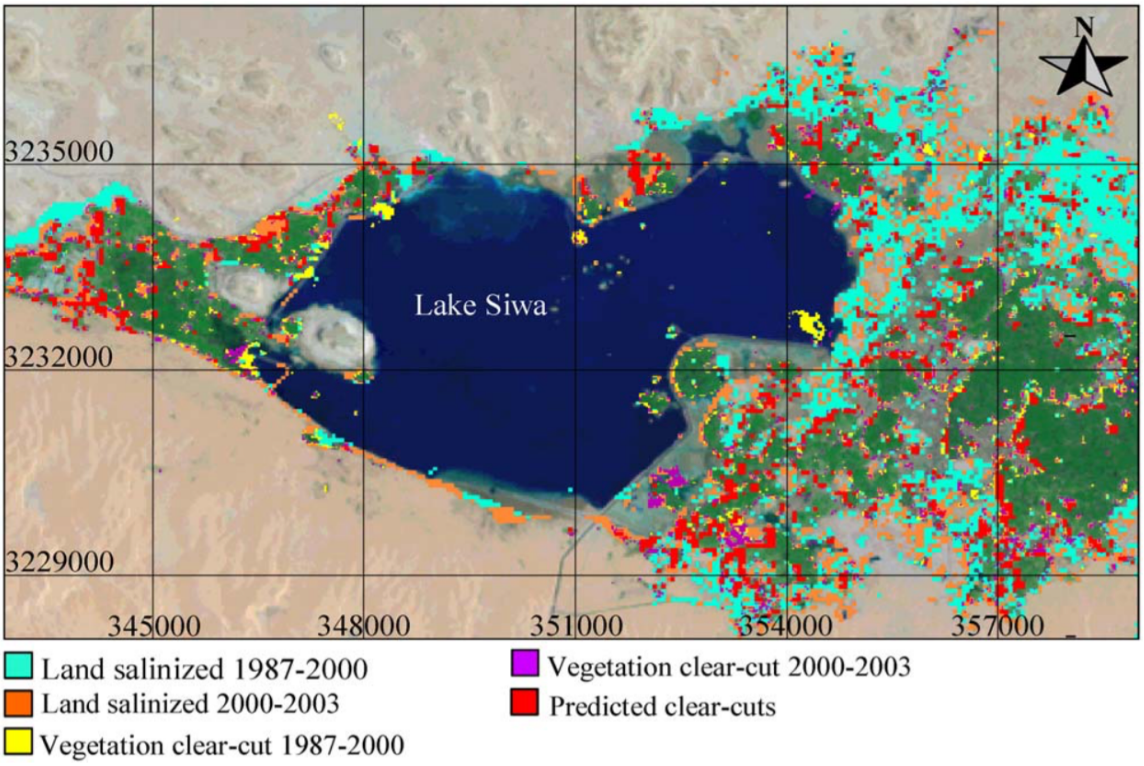

Figure 20: Salinized lands and vegetation clear-cuts as well as the areas predicted to be removed in the near future surrounding Lake Siwa. (Source: Masoud & Koike 2006)

During 1962–1977, the rate of the rise of the water table was 1.33 cm/year, while during 1977–1990 it was 4.6 cm/year. The water table has now reached the ground surface in some areas, causing an advanced stage of salinization. Consequently, extensive patches have been gradually converting into salt marshes, leading to an increased degradation of the relatively limited soil resource base. The evaluation of satellite images[30] suggests that 85 km^2 of land in the oasis became salinized during the period of 1987–2003, with vegetation directly affected and depleted on some 21 km^2 including natural vegetation, date palms and olives. These problems are also addressed and fully acknowledged in the SADS (see 5.1.1).

[30] Masoud & Koike 2006

Figure 21: Salinity damage in Siwa. Left: Dying olive trees amidst salinity-resistant date palms. Right: salinity-induced leaf necrosis of a guava tree (Photos: M. Hermann, March 2016).

4.2 Urban development

Information from the city council suggests that there are very few formal guidelines or architectural codes for the development of Siwa. Furthermore, these guidelines are rarely implemented or formally monitored and enforced. The aesthetic qualities of the traditional Siwan architectural style is one of the most important legacies and attractions of the oasis but it is being abandoned in favor of "modern" building styles which are jeopardizing Siwa's unique architectural identity[31]. The expanding population and its growing housing needs put further pressure on the traditional architectural style, which is now in danger of being overwhelmed by alien styles and replaced by unattractive structures.

The lack of a coherent master plan for the oasis, with proper zoning of building heights, and historic district planning including details of streetscapes, sidewalks, lighting and other related guidelines and tourist facility planning is also a major weak point. Regrettably, solid plastic waste and litter is a ubiquitous eyesore in Siwa's villages and fields, and should be a major concern for the community, since cleanliness is so important for tourism. There is a lack of sufficient and proper garbage bins, and many unsightly construction sites and debris. In this regard, the community's solid waste management is in need of a thorough overhaul.

[31] Sinibaldi *et al.* 2007

Strategic responses to the current problems of urban development of Siwa include:

- Sound urban and architectural development of the oasis using guidelines for urban development and building codes that are consistent with architectural tradition and sensitive of the landscape of the area.
- Initiatives promoting the maintenance and reviving of the architectural building tradition of the oasis through restoring abandoned or derelict houses and giving them new values as unique visitor accommodation facilities or for other uses.
- The adoption of improved waste disposal practices.

4.3 Agricultural biodiversity

As described in section 2.2.1, the more than 32 crop species recorded over the last century persist as components of Siwan agrobiodiversity, and there is currently no concern about the disappearance of unique genotypes except for date palm. Sustained commercial use of a number of unique Siwan crops such as Karkade, Siwa spearmint and roselle will continue to be preserved through use. The same is probably true for particular landraces of fruits, which persist in date palm and olive orchards and are locally used for subsistence. It has been conjectured that some introduced cucumber and cantaloupe cultivars may currently be displacing the older Siwan snake melon and a native "honey" melon called *shammam* but concrete evidence is currently not available, which may provide a pointer for future research needs.

A point of concern is, however, the threatened status of a number of clonally propagated date palm cultivars, which have high fruit quality but are difficult and slow to propagate, and hence are represented by only a few trees in the oasis (see also section 2.2.1). These include the varities *Ghazali*, *Tagtagt, oshikakbil, kakwengeb* and perhaps others with extraordinary fruit qualities. Also, date palms derived from spontaneously growing seedlings with unique characteristics should be catalogued and their need for preservation be assessed.

5 Dynamic conservation plan for Siwa as an agricultural heritage site

5.1 National policies and initiatives

5.1.1 Sustainable agricultural development strategy for Siwa

In response to the need to improve the livelihoods of the rural poor through efficient and sustainable use of natural resources, Egypt has in 2007 adopted a “Sustainable Agricultural Development Strategy towards 2030” (SADS). Its main goal is to increase agricultural productivity while at the same time making more efficient use of natural resources. Thus, the strategy emphasizes sustainable intensification, reducing over-encroachment and fragmentation of agricultural land, and in particular, increasing water use efficiency.

SADS provides the framework for the “Sub-project for the Development of Siwa Oasis”, which is being implemented by the Ministry of Agriculture and Land Reclamation, the Ministry for Irrigation and Water Resources, the Agricultural Research Center, the Desert Research Center, Egyptian Universities and the local community.

The salient activities of this project are as follows:

- Synthesis of research findings on the hydrological relationship between the groundwater aquifers and the water balance, drainage, and the prospects for agricultural expansion and its environmental impact;
- Achieving technical and administrative control over the wells, resulting in the collection and storage of water for raising water use efficiency;
- Raising water use efficiency by closure of wells, which contribute to the excess water discharge;
- Replacement of flood irrigation with modern irrigation techniques, and padding irrigation canals to reduce water leakage and ground water level rises;
- Improving field drainage to reduce the level of ground water and soil salinity, including the installation of pumps to remove agricultural drainage water;
- Rehabilitation of 1000 deteriorating date palm and olive farms, through the introduction of new varieties resistant to high temperatures and salinity, and the expansion of the use of biological pest control and windbreaks;
- Expansion in the cultivation of organically certified medicinal and aromatic plants, their processing and marketing;
- Cultivation of timber trees resistant to salinity and water-logging;
- Improvement of the processing, packaging and marketing of dates and olives, and feed production from processing residues;
- Local capacity development in land, water and crop management, especially targeted to women.

5.1.2 Designation of Siwa Protected Area

Not only has Siwa Oasis such attractions as scenic landscape, historical heritage and a distinctive local culture, but the oasis is also surrounded by an uninhabited region of high aesthetic value, which contains some of Egypt’s most spectacular desert landscapes and many unique geomorphologic features. In 2002, the Egyptian Government declared 7,800 square km in and around the Siwa Oasis a Protected Area (PA), in recognition of Siwa’s cultural, biological and environmental value. The new status prohibits all activities that damage or deplete its natural environment, including indigenous flora and fauna, and has bolstered the movement to preserve Siwa’s invaluable resources.

The Siwa PA is divided in three isolated sectors shown in Fig. 22: the Western and Eastern sectors and Bir Wahed south of Siwa. Of particular interest here are the Western sector and Bir Wahed because of their proximity to Siwa. The Western sector is

dominated by large sand dunes and low limestone outcrops. Characteristic of the sparse vegetation is feral date palms (Fig. 23), *Tamarix* sp. and *Nitraria refusa*. Beside its splendid scenery, the Western sector is also a refuge for the few remaining populations of gazelles in Egypt. Approximately 40 km from Siwa town lies Shiyata Oasis with a densely vegetated brakish lake that attracts migrating water birds. Situated on the ancient trading routes north of Siwa is Gerba. This small depression with plentiful vegetation is used for grazing by herders resident in the villages around Siwa. The Bir Wahed sector in the south of Siwa Oasis consists of the dunes of the Great Sand Sea that stretches endlessly in a landscape of great beauty. Bir Wahed attracts many tourists also because of its cold and hot springs.

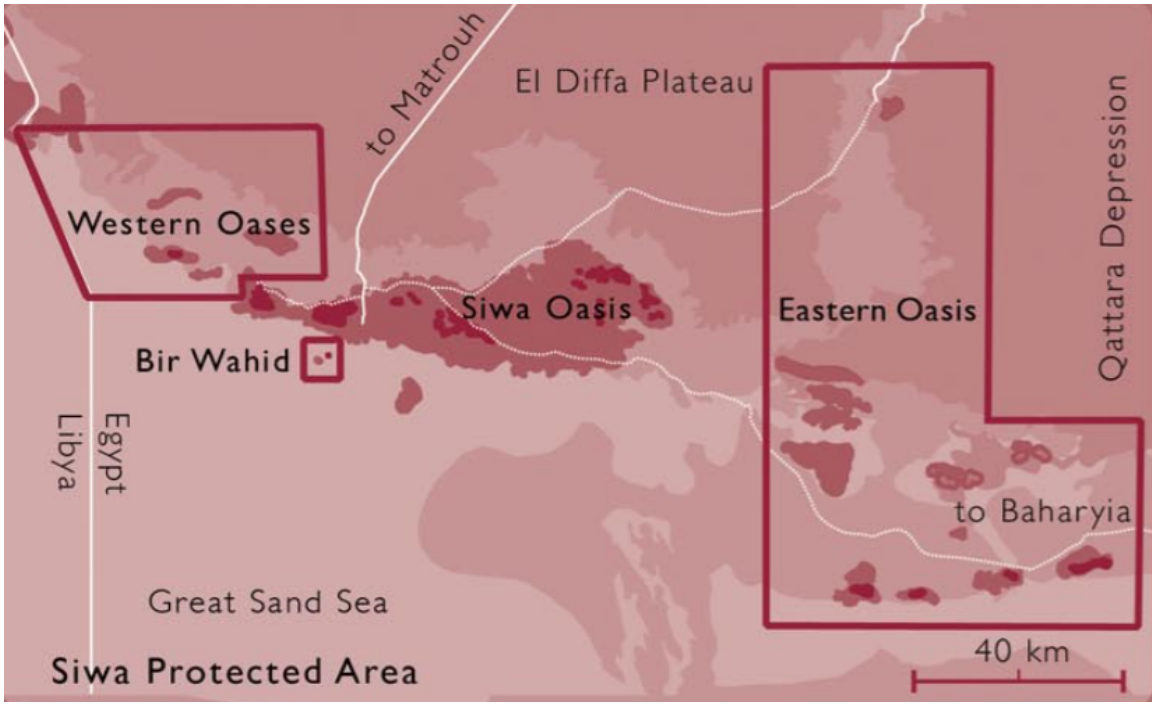

Figure 22: Map of Siwa Protected Area (Source: EEAA)

A visitor center (museum) with displays of Siwa's nature was established. It includes colorful satellite map of the Protected Area landscapes and geology, as well as exhibits of iconic plants and animals. Moreover, there is a management unit with appropriate office quarters for the Protected Area. Ranger Outposts have been identified, at which control and assistance to visitors in strategic locations of the park are provided. Drivers and guides organizing trips to the Protected Area are certified following a rigorous orientation program under the control of Egyptian Environmental Affairs Agency. Furthermore, promotional information material has been made available, such as a comprehensive pocket guidebook about Siwa, posters and maps with details on touristic attractions.

Figure 23: Large sand dunes and feral date palms in Bir Wahed, Siwa Protected Area (Photo M. Hermann**).**

5.2 Local policies and initiatives

5.2.1 Improved water management

The Sustainable Agricultural Development Strategy described under 5.1.1 addresses the need to resolve the problems related to rising water tables and the resulting salinization. The strategy is entirely dependent on reliable water management plans. To control the water balance in Siwa, the following measures have been suggested[32]: (i) full utilization of the naturally flowing water, particularly through winter cultivation; (ii) prevention of new ground-water drilling and control of the water flow from old wells; (iii) usage of drainage water for forestation projects; (iv) introduction of new plant species having high capability to consume water (biological drainage); and (v) improvement of the present drainage system.

Water of high salinity from the upper aquifer is now being increasingly blended with water of low salinity from deep wells to lower the salt load of irrigation water. A control system has been put in place, which requires permits for the drilling of new wells. Following consultations and surveys, farmers increasingly install tanks to collect water, which is released for irrigation as needed.

From 1996 to 2011, the General Administration for Groundwater (Ministry of Irrigation) embarked on a major project to consolidate the wells of Siwa in order to rationalize water

[32] Masoud & Koike 2006

use. Some 700-900 wells of a total of 1800, many of which drilled without permits, were closed, while 370 wells were designated as official “ministerial” wells. A number of wells were too dispersed to be included in this consolidation effort. Nine deep wells, which produce water of very high quality from 1000-1200 m depth (from the Nubian sandstone aquifer), have been drilled. Five of these wells are owned by the government, and four wells are owned by companies, which use the water for bottling.

Six high-capacity pumping stations have been installed, to move drainage water into the Siwa lake. This has led to a relative drainage improvement in some areas, but in the long run, there are limits to raising the lake’s water level. Therefore, a feasibility study is underway to assess the infrastructure needs and operating costs for pumping drainage water from Siwa into the Tbaghbagh depression, which is located at the edge of the Qattara depression, at a distance of 80 kilometers from Siwa oasis. Unfortunately, land separating Siwa from Tbaghbagh rises to an altitude of about 30-40 m above sea level, and thus drainage water would have to be raised over 50 meters altitude requiring a pressure of 5.55 bar.

Furthermore, the action plan of Siwa community aims at replacing the traditional flood irrigation system with more water-efficient modern methods such as gated irrigation pipes, syphon tubes, a localized irrigation system such as drip, mini-sprinkler and surge flow furrow irrigation systems. Under consideration is also the adoption of ultra-low flow techniques, pottery drippers, clay pitchers, and automatic hydraulic self-compensating gated irrigation pipes.

5.2.2 Reviving the cultural heritage

There are several initiatives in Siwa to create awareness amongst locals and visitors for the unique handicraft traditions of the oasis. These initiatives also seek to document and preserve those traditions.

Built amidst gardens, the House of Siwa is a museum of Siwan customs and traditions containing displays of Siwa’s ancient handicraft and household and agricultural tools. The exhibition includes traditional wedding dresses and shawls that are decorated with the unique Siwan embroidery. There are also collections of silver jewels, palm leaf baskets and old pottery. The museum was built in karshif architecture (see next section), to showcase ancient building techniques. A small gift shop is there as well where visitors can purchase handicraft produced by Siwan girls and women.

The Siwa administration has established a Center for Integrated Development of the Local Traditional Industries. It teaches girls and unmarried women handicraft techniques, and thus provides opportunities for self-employment in the household. There are workshops on weaving, embroidery, pottery and silverware. Many of the designs are inspired by date palms (see Fig. 24).

South of the old Shali fortress, there is an old manual olive oil press inside a private *karshif* courtyard. Built in 1920, the press is still working and is used in the harvesting season, from October to December. This type of traditional oil press is driven by a

donkey. The first step in the oil production is the grinding of the olives, then the pressing and filtering of the oil. The oil cake left after oil extraction is a nutritious animal feed.

Figure 24: Modern handicraft from Siwa with references to date palms. Clockwise from upper left: 1) Embroidery symbolizing the colors of dates; 2) embroidered shawl; 3) Silver jewelry with palm motives; 4) Baskets made from palm leaves.

5.2.3 Sustainable tourism

The rich natural and cultural landscape of Siwa with its archaeological attractions combined with the largely pristine and intact wilderness of the region has been drawing a growing number of tourists to the oasis (see Table 5). Agriculture, in particular date palm orchards provide a critical esthetic quality to Siwa, and dates, olives and to a minor extent other local agricultural produce such as Siwa spearmint and karkade are sold in great quantities to tourists in specialized retail outlets in the city center. These "ecosystem services" of Siwa's agriculture benefit tourism in a significant way.

Table 5: Main tourist attractions of Siwa oasis

Cultural heritage

- Berber and Bedouin communities and their traditions
- Local festivities, especially Eid El Siyaha (October)
- Local handicrafts (embroidery, silver jewelry, basketry)
- Traditional *karshif* architecture
- Heirloom agricultural produce, especially dates and olives

Main archaeological sites

- Temple of the Oracle of Amun
- Temple of Um Ubayda
- Mountain of the Dead with ancient tombs (Gebel El Mawta)
- Ancient mudbrick fortresses of Shali and Aghurmi

Other archaeological sites within the Oasis

(Eastern part)

- Khoraishet Site
- Abo Sherouf Site
- El Zeitun Site
- Sallam Site
- Abu Al Awaf Site

(Western part)

- Doric Temple
- Bilad el Roum
- Deheba Site
- Khamisa Site
- Timaserain Site
- Bahi El Din Site

Landscape and natural features

- Scenic salt lakes
- Geological formations along the El Diffa escarpment
- Dunes of the Great Sand Sea
- Springs
- Agricultural with date and olive groves

Tourism in Siwa started in the 1980s. The high season is during Ramadan and Easter holidays. In 2010, an estimated 1000-1400 foreign (mostly from Italy, France and the United Kingdom) and 800 Egyptian tourists visited the oasis in a given month. Since the Egyptian revolution in 2011 the numbers of tourists from foreign countries have declined, a development hoped to be temporary only. According to the official Information Tourist Authority, tourism is seen as very beneficial to the community, in terms of the income

and employment generated, particularly from the sale of food products, principally dates and olives, and souvenirs that are produced by women (carpets, dresses, palm leaf products and silverware). Currently there are 28 registered hotels in Siwa, with a total capacity of 600 double beds.

The conservation of natural habitats, wildlife and landscapes are of paramount importance for the sustainability of tourism. Therefore, the Egyptian Environmental Affairs Agency (EEAA), in collaboration with IUCN and with Italian development assistance undertook to propose an integrated strategy for sustainable tourism and ecotourism activities in the Siwa region, which has since been adopted[33]. This strategy is aligned with the principles of sustainable tourism as provided in the guidelines of IUCN, WCPA, UNEP and WTO, and in particular of the CBD regarding biodiversity and tourism development .

It identifies options, opportunities, priorities and needs for fostering the development of those forms of tourism that could help preserve the rich and unique heritage of Siwa , while at the same time supporting the socio-economic development of the oasis.

Noting the support of local tourism stakeholders of the government policy towards tourism development in the country and the consensus among local communities on the importance of “quality tourism” as opposed to “mass tourism” the strategy embraces the following strategic principles:

- Tourism development and visitors' use of the area must not cause excessive impact to the resources of the region.
- Sustainable tourism opportunities in Siwa need to be diversified and expanded while at the same time improving the quality of visitors' experience.
- The engagement of local communities in sustainable tourism must be ensured so that significant benefits accrue to them.
- Promotion of Siwa as a site destination *per se* rather than as part of a tour package.

5.3 Awareness creation

5.3.1 National date palm festival

As a center of date palm diversity and quality dates, Siwa oasis has been instrumental in organizing and providing the venue for the first Egyptian date palm festival, which took place in October 2015 for the first time, and will be celebrated in subsequent years. With financial and organizational support from Khalifa International Award for Date Palm and Agricultural Innovation of the United Arab Emirates, the first edition of the festival was under the auspices of Egypt’s Ministries of Agriculture and Trade and Industry, the United Nations Industrial Development Organization (UNIDO) and the Food and Agriculture Organization of the United Nations (FAO), the province of Marsa Matrouh,

[33] Sinibaldi *et al.* 2007

the Council of Siwa City, and the Siwa Community Development and Environmental Protection Association. Attended by 111 exhibitors from various parts of Egypt, the festival sought to celebrate the diversity of dates and to promote the awareness for quality dates as well as to find solutions to the problems experienced by the Egyptian date palm producer: the lack of planting material of high-quality varieties, better pest management, and the improvement in processing and packaging for improved value-adding and marketing. Winners of the various competitions were awarded ten prizes during a closing session.

5.3.2 National TV

The Egyptian Radio and Television Union produced and aired in 2009 on national Egyptian TV a series of documentaries, featuring Sowa oasis. Conceived to further national interest in the oasis and promote environmentally sound tourism, the documentaries featured the archeological attractions of Siwa, cultural customs, and the many manifestations of traditional handicrafts. They also covered *karshif* architecture and the linguistic and agricultural peculiarities of Siwa.

5.3.3 Slow Food

In November 2006, dates from Siwa were presented in Turin, Italy, as a sustainably harvested heritage food promoted by Slow Food International at the Salone del Gusto associated with its Terra Madre gathering of 5,000 farmers from around the world. On the occasion, a Slow Food "Presidium" was established to safeguard and promote the authenticity and flavor of Siwan dates. The Presidium's goal is to promote the oasis' quality dates on the national and international market, protect heritage date varieties at risk of extinction and assist growers to control the entire production chain – from planting to export - and to certify the product as fair-trade and organic.

Several of Siwa's folk varieties of dates have been added to Slow Food's Ark of Taste, an international catalog of 800 heritage foods from 50 countries that are part of the local memory and tradition. Slow Food works in partnership with local organizations and farmers to increase production, consumption and commercialization of the endangered foods through education and training programs.

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7 Acronyms

AD	Anno Domini
BP	Years before present
CBD	Convention on Biological Diversity
DRC	Desert Research Center
EEAA	Egyptian Environmental Affairs Agency
FAO	Food and Agriculture Organization of the United Nations
g	gram
GIAHS	Globally Important Agricultural Heritage System
IUCN	International Union for Conservation of Nature
kg	kilogram
km	kilometer
LR	Landrace
m	meter
mg	milligram
PA	Protected Area
ppm	parts per million
SADS	Sustainable Agricultural Development Strategy towards 2030
t	metric ton (1000 kg)
UAE	United Arab Emirates
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
WCPA	World Commission on Protected Areas
WTO	World Trade Organization