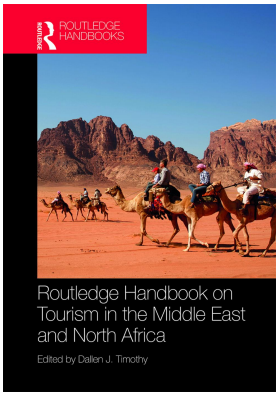

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DESERT LANDSCAPES AND TOURISM IN THE MIDDLE EAST AND NORTH AFRICA

Alan S. Weber

Introduction

Before the rise of ecotourism, arid deserts were relatively neglected as tourist destinations. Some of the reasons for this were the lack of infrastructure, poverty of local inhabitants, harsh and sometimes life-threatening environmental conditions and the negative misconceptions of deserts as wasteland, lifeless, and inhospitable. Before the 1940s and 1950s, when trucks capable of negotiating difficult terrain, including sand dunes, became widely available to local inhabitants, few people would venture into an arid desert without a highly experienced local guide knowledgeable about water sources, wayfinding and survival techniques. Wilfred Thesiger's *Arabian Sands* (1959) describes the first crossing of the hyper-arid Rub al 'Khali Desert between Oman and Abu Dhabi in 1946 during which his group suffered near disaster from shortages of water and food. Even some of his Bedouin guides from the local Rashid tribe were unwilling to proceed further into the desert.

However, with the advent of cell and satellite phones, GPS, reliable maps, and other modern technologies, remote desert areas can now be visited with much greater safety with proper planning and precautions. Consequently, deserts have become increasingly popular as tourist destinations owing to their natural beauty, serenity, remoteness ('off the beaten track'), and the hint of danger still attached to these extreme environments. Due to their fragility and limited ability to regenerate from human impacts, however, these ecosystems must above all be managed sustainably. This chapter examines the potential of desert landscapes in the Middle East for tourism, and the challenges that must be overcome, including long-term environmental and water resource management, equitable distribution of tourist revenues amongst local stakeholders, and preventing undesirable cultural disruption.

Desert biomes, tourism and cultural experiences

Deserts are areas of low precipitation (aridity) and account for almost 30–50 per cent of the earth's surface when including the polar regions. There is no agreed upon and strict definition of deserts, however. It is therefore best to consider deserts as a continuum of environments ranging from almost lifeless regions to areas capable of supporting various forms of agriculture.

Deserts and drylands can be defined by using various aridity indices, such as the ratio between annual precipitation and potential evapotranspiration (evaporation + transpiration) or AI = P/PET. Desert environments include hyperarid (AI < 0.05) and arid (AI = 0.05–0.20) lands, while semi-arid lands (typified by the Sub-Saharan Sahel) which support permanent grasslands, trees and shrubs are referred to as steppes, dry grasslands or dry savannahs (Middleton & Thomas 1997; Rakhecha & Singh 2009: 327). Semi-arid lands comprise approximately 20 per cent of the earth's land mass. Rainfall in desert regions usually amounts to less than 200 mm per annum (Weber 2013, 2014: 150). A large portion of the Middle East and North Africa consists of hyperarid and arid lands primarily due to the enormous Sahara Desert, which stretches across North Africa into the Arabian Peninsula, and extensive deserts are located in Iran, Pakistan and Afghanistan.

Deserts form as the result of constant warm tradewinds (Sahara Desert in North Africa), distance from large water bodies and rain-bearing clouds (Sonoran Desert in the US), offshore cold ocean currents (Atacama Desert of Chile), and rain shadow deserts when clouds drop their moisture as they rise over mountain ranges (Tibetan Plateau). Desert landscapes can consist of loose gravel, hard-packed pavements, rocky mountains and hills, canyons, sand dunes, rocky outcrops, dry lake beds and salt pans (deposits), with occasional areas of lush vegetation (oases) from underground water, springs or depressions. These varied geological features can often be found within the same desert region, providing a variety of landscapes for aesthetic enjoyment. Deserts exist in both hot and cold climates. Due to the sparse rainfall and vegetation that can only support a limited number of agricultural activities, such as date farming and nomadic animal herding, deserts generally have a low population density, although the major urban areas of Dubai (UAE), Doha (Qatar) and Riyadh (Saudi Arabia) flourish in arid deserts due to groundwater resources and seawater desalination. Without soil, plant cover, cloud cover or large bodies of tempering water, rocky deserts depending on their latitude can experience extreme temperatures ranging from -50°C to +55°C.

Desert areas, especially hyperarid regions, are underutilised and untapped as tourist destinations specifically, since they are often not suitable for mass tourism, but rather for niche activities such as adventure tourism, ecotourism and extreme tourism. Barriers to mass tourism include the fact that deserts are generally in remote or inaccessible areas with minimal infrastructure, which results in a lack of amenities such as electricity, Internet and cell phone services and creates discomforts like dust, extreme heat or cold, and unpaved roads requiring special vehicles. As evidenced by studies carried out in the Wadi Rum and Petra areas in Jordan, mass tourism places unique stress on desert biomes, which are fragile and delicately balanced (Reid & Schwab 2006). Litter, damage to the natural environment through human activity, and buildings that do not harmonise with the landscape can quickly destroy the original visual value of the destination. Desert tourist practice must therefore be governed by sustainable tourism principles.

The desert regions of MENA, with the exception of internationally renowned archaeological sites, including Petra in Jordan, the Pyramids of Egypt, Palmyra in Syria, Carthage in Tunisia and Persepolis in Iran, and coastal resorts on the Mediterranean, Red Sea and Persian Gulf, have been neglected in tourist development strategies both at the national and local policy level (Krakover 1985). Resorts along the Red Sea, Dead Sea and Mediterranean often simply provide a standard mass tourism beach holiday experience, and although located within desert regions, deserts are not necessarily part of the tourism product. The neglect of truly desert destinations is related to the current and historical challenges detailed in the section below on sustainable desert tourism. Thus, ecotourism (the sustainable appreciation of natural environments) is the main draw of deserts along with cultural tourism (appreciating archaeology, history and the traditional cultures of modern desert dwellers).

Although sometimes difficult to access by land vehicles, the lack of vegetation in some desert regions creates natural flat landing strips for small aircraft (salt pans and gravel deserts) so that regional airports do not need to be constructed. In addition, salt flats are suitable for such recreational activities as high-speed car racing (the Bonneville Speedway in Utah) and land yachting (sail-equipped wheeled vehicles), although motorised vehicles can have negative environmental impacts if not regulated. Modern off-road vehicles, helicopters, four-wheel drive trucks, and boats can also provide access in addition to well-adapted traditional means of transport such as camels, the 'Ships of the Deserts', which are particularly suited to Slow Travel and cultural immersion experiences (camping, desert safaris and homestays with camel herders).

The unique geomorphology (landscapes, geology and topography) of deserts is a major draw for visitors, and desert regions are often described as 'other-worldy' by newcomers (Eshraghi, Ahmad, & Toriman 2012). Certain desert features such as barchan sand dunes, salt flats and ventifacts only exist in drylands. Ventifacts or yardangs are statue-like rocks that have been sculpted into aesthetically pleasing forms by wind erosion. A striking example is 'Lot's Wife', a pillar of almost pure salt on Mount Sodom, Israel. Flash flooding in addition creates patterns of erosion resulting in canyons, wadis (arroyos), mesas and buttes not found in temperate climates or obscured by soil and vegetation. The lack of vegetation in deserts reveals the colours and patterns of underlying rocks. Differently coloured bands of granite, sandstones, siltstones, limestones, and volcanic ash form dramatic patterns, especially when folded by tectonic forces or uplifting. Along the Dead Sea area of Jordan and Israel, the completely exposed rock, salt and mineral deposits display pure whites from phosphates and salts, blacks, greys and browns from bitumen, pure yellow from sulphur, and a range of reddish hues from iron-bearing minerals. Thus 'geological tourism', based on topographical features such as shapes, colours, vistas and views, is gaining more attention in tourist strategies and represents a unique aspect of desert destinations (Allan 2016; Dowling & Newsome 2006).

Another unique experience related to the physics of sand dune movement are the 'singing sands' in some deserts. Through wind action or by walking on the surface, sand dunes under certain dry conditions produce a range of wailing, thumping, screeching and singing noises that Bedouins attributed to djinn (genies). The experience of hearing a singing sand dune is highly unique and unforgettable, a key tourist asset where they occur. Xerophytic and halophytic plants uniquely adapted to the desert, such as Saguaro cacti, and ephemeral grasses and flowers, which must rapidly bloom and produce seed after sporadic rainfalls, can transform deserts into dense, colourful landscapes. Through conservation efforts, large animals such as oryx, jackals, Thomson's gazelle, ibex, hyenas and sand cats are returning to areas that are off limits to human hunting.

Sand-skiing and sandboarding are other low-impact desert activities that complement hiking and other nature-related activities such as bird and animal watching, since these sports take place on moving sand which quickly erases human traces. Dune bashing, driving up and down dunes at high speeds and executing turns and vehicular acrobatics, is popular throughout the Arabian Peninsula, but this is a very high-risk sport with frequent injuries and fatalities from overturned cars. Also, destruction of natural dune-anchoring vegetation can cause dunes to advance rapidly, potentially aiding in desertification and the invasion of populated areas by sand. Thus, all sand dune-related recreational activities should be monitored and regulated and preferably restricted to specific areas away from protected natural parks.

As some deserts border areas of salt or fresh water, water sports and water activities including swimming, boating, jet skiing, bird watching, water animal safaris, and fishing can be combined with desert recreation. Large endorheic lakes and basins (water bodies with no outlet) surrounded by desert include the Caspian Sea, Chad Lake Basin in North Africa, whose

northern region borders on the Djurab and Ténéré deserts, and the Aral Sea of Uzbekistan (once the world's fourth largest lake and a popular tourist attraction, which has now shrunk to 10 per cent of its former size since the 1960s). The green delta and snaking green ribbon of the Nile River valley of Egypt are striking when seen from space, surrounded completely by the brown, hyper-arid Sahara Desert and Qattara Depression to the west. Nile River cruises generate substantial tourism-based income, and the Red Sea, also completely bordered by desert, remains relatively unpolluted, with healthy coral reefs and marine animal abundance for snorkelling, fishing and diving. The Red Sea can be contrasted with the Persian Gulf, which is suffering severe environmental damage from tourist infrastructure projects, such as removal of protective mangrove trees and mass mortality of coral from dredging to build artificial tourist islands and resorts (Gladstone, Curley, & Shokri 2013). The entire coast of North Africa borders the Mediterranean Sea, with the western portion bordering on the Atlantic; the areas closest to the sea are generally more temperate, mild and humid, offering a more hospital climate for northern tourists than the extremely hot and dry interiors of Algeria, Tunisia, Morocco and Libya, which are sparsely populated.

Due to low moisture in deserts, archaeological ruins suffer much less erosion than in temperate climates, especially when they have been covered by windblown sand and later excavated or are protected by caves. Prehistoric rock art from the Neolithic period has survived in Figuig, Oran, Djelfa, Ennedi and Tassili n'Ajjer across the Sahara, rivalling the Lascaux paintings in France. The Nabataean, Roman, Achaemenid, Sassanian, Egyptian and Babylonian empires have left behind significant desert ruins preserved by the dry climate. In addition, many tens of thousands of less flashy ruins, built heritage sites, geological oddities and aesthetically pleasing environments exist throughout the MENA deserts, but they must compete with iconic offerings such as the Pyramids. Tarawneh and Wray (2017) discuss the difficulties in developing tourist strategies for lesser-known Jordanian desert attractions such as Neolithic village sites, which have significant scientific, historical, cultural and archaeological value, but which also must compete with the visually stunning and well-marketed Nabataean rock sculptures.

Although most of North Africa, the Arabian Peninsula, Iran, Pakistan and Afghanistan consists of Muslim-majority nations, the Middle East boasts a surprising diversity of peoples for visitors interested in experiencing different cultures: followers of Abrahamic religions (Jews, Christians and Muslims), Indo-Iranians, Pashtun, Balochis and indigenous nomadic peoples such as Bedouin, Tuareg and Berbers. Dialect, language, foods, music and customs differ greatly amongst the major Middle Eastern desert regions—Maghreb (western Sahara), Egypt and Libya, Levant, Persian Gulf, Iranian plateau, Balochistan, and the Thar and Cholistan regions. Even within Islamic cultures, Shias, Sunnis, Ibadis, Sufis, Ismailis and Alawites follow different practices. Desert cultures tend to be highly hospitable (reciprocal altruism), even offering aid to enemies and potential enemies, since they expect similar treatment if a life-threatening situation arises such as being lost without water. Thus, native norms of guest-welcoming are valuable assets for tourism industries that respect and integrate local customs, a cornerstone of sustainable tourism practices.

A significant number of MENA countries are major oil and gas producers, and the Gulf countries (Kuwait, Qatar, UAE, Saudi Arabia, Iran, Iraq) in particular derive the majority of their GDP from oil export revenues. Thus, these countries suffer boom and bust economic cycles as their growth is governed by the rising and falling of oil prices. Many Middle Eastern countries have therefore embarked on economic diversification strategies, with national governments targeting tourism (including meetings, incentives, conferences and exhibitions (MICE)) as a major sector for state support and development (Stephenson 2017). Coastal resort and international residential development has therefore accelerated in desert regions such as Egypt (Red

Sea coast resorts), Qatar (The Pearl), UAE (Palm Jumeira, The World, Palm Deira), and Jordan and Israel (Dead Sea resorts). Developments such as the indoor ski slope Ski Dubai in the Mall of the Emirates have specifically been designed with an international clientele in mind, whose interests may lie in the warm climate, shopping and entertainment and liberal tax environment, and not necessarily in the desert location. These tourism strategies linked to economic diversification not only directly attract tourist dollars but also foreign direct investment in tourism infrastructure, such as hotels and residential compounds.

Challenges in sustainable desert tourism

A growing number of international organisations, most notably the World Tourism Organization (UNWTO), have embraced sustainable tourism principles for all sectors and markets of the tourism industry. Desert environments are fragile and do not recover from human impacts as rapidly as humid and tropical environments do, which can erase human impacts through new plant growth, erosion and bacterial and fungicidal decomposition of organic wastes, which desiccate in deserts instead of rotting. For example, tyre tracks in the desert can remain visible for decades. According to the UNWTO (2006: 11–12), sustainable tourism in deserts should:

1. **Make optimal use of environmental resources** that constitute a key element in tourism development, maintaining essential ecological processes and helping to conserve natural heritage and biodiversity.
2. **Respect the socio-cultural authenticity of host communities**, conserve their built and living cultural heritage and traditional values, and contribute to inter-cultural understanding and tolerance.
3. **Ensure viable, long-term economic operations**, providing socio-economic benefits to all stakeholders that are fairly distributed, including stable employment and income-earning opportunities and social services to host communities, and contributing to poverty alleviation.

The origin of the word desert from Latin 'desertum' or 'abandoned place' reminds us how stereotypes of these regions still persist in Western thought. Non-Middle Eastern tourists often hold two stereotypical views of these destinations: hostile and forbidding places suitable only for professional adventurers; or exotic and erotic orientalist locales, an image fostered by nineteenth- and twentieth-century colonial tourism to Algeria, Morocco and Tunisia (Al-Mahadin & Burns 2007: 138). Both of these preconceived notions can be the basis of marketing campaigns for these regions, but tourism officials should also consider the other dimensions of these locales discussed earlier, particularly since orientalist attitudes—most importantly, the stereotype that oriental peoples are governed by passion and not reason—are viewed as offensive throughout the Middle East.

Deserts can be subject to extreme and uncomfortable conditions during the hot season. The deserts of Libya, Iran and the Arabian Gulf can reach temperatures of 50–52°C (122–125.6°F) in the summer, which are at the outer limits of human survivability. Emergency services must therefore form part of tourist services—can guides treat heat exhaustion and the potentially deadly heatstroke? Both are serious medical emergencies. These temperatures can limit tourist activities to indoor attractions or to wintertime (when temperatures are comfortable) in the hot climate deserts, reducing the length of the tourist season. Dubai, a top tourist destination in the Middle East, has adapted to these potentially off-putting conditions by developing extensive indoor malls for shopping, an indoor ski slope, international dining options and entertainment,

such as concerts, shows and bars serving alcohol, which are illegal or tightly regulated in the more conservative Muslim-majority countries.

Several desert regions are suffering from internal political turmoils exacerbated by international superpowers. Major armed conflicts are ongoing in Syria, Iraq, Libya, Afghanistan and Yemen. All of these countries with substantial desert regions are unsafe for Western tourists and the origin of these conflicts may be indirectly or partially related to interference by foreign powers, water conflicts, overpopulation, wealth disparity and the divide between conservative and traditional ways of life in the desert and the more cosmopolitan lifestyles of city dwellers. An insurgency in Egypt's Sinai Peninsula desert is rooted in the marginalisation of Bedouin tribes. Tourism is therefore intertwined with conflict, as violence can drive away tourists, but resolving conflicts on the other hand can establish equity with desert peoples by providing them with small business opportunities if governments assist them in providing infrastructure such as roads, airports, dams, wells and business loans. Also, since tourism is one of the world's largest industries, unresolved nation-wide and regional conflicts can severely reduce the national GDP (Avraham & Ketter 2016; Timothy & Daher 2009: 151–152).

Water is essential for understanding Middle Eastern politics, social and economic structure, and the migrations of peoples. Desert regions are not devoid of water: the large Nubian Sandstone Aquifer System lies beneath Libya, Chad, Sudan and Egypt and has been exploited by The Great Man-Made River (GMM, which supplies Sirte, Tripoli and Benghazi) developed by former Libyan leader Muammar Gaddafi. The GMM is the world's largest water delivery system. Access to water has been a source of conflict both on a local (tribal skirmishes over oases) and national scale, both historically and in modern times. The collapse of the Ma'rib Dam, which supported the irrigation of 25,000 acres of farmland, between 570–575 AD in Yemen caused a mass migration of upwards of 50,000 people into the northern Arabian Peninsula. An earlier dam breach and migration may have included the powerful and influential Ghassanids, Christian Arabs who entered Syria and allied themselves with the Roman Empire. Thus, water issues have played a central role in Middle Eastern demographic shifts and will continue to do so in the future, especially in areas of increasing population density such as the Jordan–Israel region and large North African cities (Al-Alawi 2008; Dłuzewska 2008).

Tourism development in deserts not only requires extra water for tourist arrivals, but also water for the construction of buildings, roads and attractions and water for imported construction workers. For example, arid desert regions of low population density have manual labour shortages, and therefore tourist development increases the local population (Weber 2018). Historically, water withdrawals were limited by technology and although they lack surface and running water, some deserts in Namibia and Saudi Arabia have significant underground reserves. However, these are fossil water reservoirs, the remnants of glaciation or earlier wetter periods. Many are not replaceable when withdrawals exceed recharge rates from infrequent rains. With continuous mechanised pumping of underground water, water tables drop, causing land subsidence; aquifers become contaminated with salt water layers, and continued use of groundwater for agriculture can cause salination of soils which become increasingly toxic to plants (Hussain 2005). Saudi Arabia's aquifer system, once estimated to hold about the same amount of water as Lake Erie, has been depleted in a matter of decades by an estimated two-thirds to four-fifths of its former volume (Elhadj 2004: 27) due to unrestrained withdrawals for wheat production encouraged by government subsidies. Tens of thousands of years must pass before this water can regenerate. One solution for water shortages—the desalination of salt water carried out in many Middle Eastern countries that border oceans—is extremely costly.

Another negative environmental impact associated with increased use of deserts for tourist activity includes anthropogenic desertification, in which land through human activity becomes

more arid and vegetation and wildlife disappear. Although deserts pre-date the arrival of humankind, people's ability to manipulate their own environment since the invention of the steam and internal combustion engines has been unprecedented and humans may represent a major cause of desertification, primarily in the destruction of ground cover and the permanent removal of fossil fresh water with motorised pumps. This extracted water evaporates rapidly in dry regions without returning to the water table and cannot be replenished (Imeson 2012). Processes such as desertification and man's potential role in the creation of deserts, including climate change, is still not well understood due to the lack of scientific research and data gathering in remote regions. Many environmentalists, given the potential catastrophic consequences of desertification, take a cautionary 'better safe than sorry' approach and argue for limiting the worst and well-established human causes of desertification, such as slash-and-burn agriculture in drylands.

Although desert Bedouins developed ecologically sound practices such as *hima* (grassland management), their cultures have been disrupted by forced government sedentarisation policies and modernity. Living in harmony with their environment is becoming increasingly difficult, for example, when former nomadic people accustomed to searching for ephemeral grasslands after desert rains were forced to settle in one area where their domestic animal density caused severe land degradation from soil impaction and the denuding of plant cover. Thus, a rational strategy would be to combine the scientific evidence base for desertification mitigation with traditional local knowledge on how to preserve water, soil and food supplies (Davies & Holcombe 2009).

Indigenous peoples in arid deserts are sometimes poor and marginalised, existing on subsistence agriculture or nomadic pastoralism. The removal of the B'dul tribe from the Petra, Jordan, Nabataean monuments demonstrates the difficulties that can arise when competing commercial, indigenous and government forces clash over valuable tourist resources. The B'dul have lived in the Petra Park monuments for centuries and sold artefacts and provided guide and donkey transport services. They were forcibly removed by the Jordanian government in the 1980s to the government-built town of Umm Sayhoun near the park, and although many left willingly for the new amenities of electricity and running water, the eviction led to some minor armed skirmishes with officials (Al-Haija 2011; Chaouni 2014: 30–31; Comer 2012: 1–28). Using the monuments as living spaces was causing rapid deterioration of the buildings, and the continued touching of walls and the humidity from the breath of tourists has caused additional serious damage (Mustafa 2011). With very large fees charged for entrance—90 Jordanian dinars (US$127) for non-accommodated visitors—the obvious question is how much of this wealth is returned back to the local communities such as the B'dul and Layathnah? Also, international tourism experts, UNESCO, and Jordanian officials became concerned about how employment of Bedouins in the tourism industry was creating a 'neo-Bedouinism', a distorted version of traditional cultural practices which evolved to please non-Arab visitors, fulfilling their romantic preconceived notions of desert life. The UNESCO Proclamation of Masterpieces of the Oral and Intangible Heritage of Humanity placed the Bedouin culture of the Petra region and another popular tourist area, Wadi Rum, on their protected list. According to UNESCO (2005), 'the increase of desert tourism and its demand for "authentic Bedu culture" may lead to its distortion'. Bedouin culture is rapidly being subsumed by modern, urbanised culture throughout the Middle East, and cultural heritage tourism aims to preserve traditional ways of life not only to attract tourists interested in experiencing other customs, foods, language and music, but also to aid local inhabitants themselves to derive employment by simultaneously pursuing age-old patterns of living. However, some Bedouin leaders do not support this form of livelihood, fearing 'loss of traditional cultures, inflated prices, behaviour among youth that mimics

tourists' behaviour, water and air pollution, and declining moral values' (Al-Oun & Al-Hamoud 2008: 37). This issue is particularly complex since a major cultural attribute of Bedouins historically has been their adaptability to changes in environmental, social and political conditions (Hobbs & Tsunemi 2007).

Conclusion

All potential uses of deserts, including tourism, mining, grazing and wildlife management should be accompanied by environmental impact assessments as well as studies on the possible economic and cultural impacts to local inhabitants. Key issues that should be resolved in desert tourism planning and management include such questions as: Are local water withdrawals from fossil (non-renewable) water supplies sustainable for future generations? What other water capture or production strategies are viable? Will pollution including human sewage compromise potable water sources? Will extinctions of key species in vulnerable desert food chains (only a small number of species are adapted to hyperarid conditions) cause the collapse of other species, degrading the environment further? Will potentially valuable medicinal plants perish permanently from unregulated collection, off-road vehicle traffic, and walking and animal riding in the desert? Do permanent or temporary exclusion zones need to be established during migration or breeding periods of birds and animals? Will increased human activity harm current aesthetics or built heritage making them less attractive to visitors? Will local inhabitants be included in tourism policy planning and management and will they share in profits? Will indigenous cultural practices be protected from exposure to tourists? Without a solid evidence base to answer these fundamental questions, all human activities in deserts have the potential to render these regions eventually unsuitable for tourism. Table 15.1 summarises these varied challenges and suggests strategies for mitigation.

Table 15.1 Desert tourism challenges and recommended mitigation strategies

Desert Tourism Problem	*Recommended Mitigation Strategies*
Flora and fauna fragility	Off-limits and protected zones; restrict travel to marked trails and roads only; rotate fallow regions; temporary off-limits zones during breeding; patrols and fines for hunting or damaging wildlife; artificial breeding and reintroduction of indigenous plants and animals
Slow biome regeneration	Fallow areas; limited entrance; permits; environmental education; required video viewing on responsible tourist behaviours before entering parks
Landscape destruction	Initial environmental impact assessment, including natural aesthetics; ban or limit activities such as camping, open fires, collection of natural objects
Water scarcity	Desalination, pumped ground water, rain water collection, dams; limit entrance to day trips or water carried in by tourists; building codes requiring water-saving technologies; research into renewable energy desalination
Water competition	Engage farmers, ranchers, government agencies, and tourist developers in discussions on equitable water distribution
Local culture change	Engage local leaders; education on tourist impacts on culture; government subsidy of traditional local cultural activities

Source: Compiled from information in Weber (2014).

Sustainable tourism management avoids what is alien and non-natural. For example, non-indigenous ornamental plants at hotels and parks often require more water than native plants and can compete for habitat. Artificial water instalments in deserts like ponds and swimming pools evaporate and reduce fresh water supplies. Due to its sometimes non-renewable nature, water access, use and distribution must be negotiated with local stakeholders during tourism development so that the benefits of the industry can continue for future generations. Simple and effective sustainable practices for desert use include building practices using local materials and traditional knowledge for heating and cooling, such as adobe and mud-brick construction and the wind towers and underground canals developed for cooling in Iran and the Arabian Peninsula (*barjeel* and *qanat*). These practices are often less costly, more effective than modern technologies, and they validate indigenous knowledge systems that have evolved for maximum efficiency through millennia of human trial and error.

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