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The Decline of Desert Agriculture: A View from the Classical Period Negev.

Steven A. Rosen
Ben-Gurion University of the Negev

Abstract

The decline of the sophisticated and elaborate run-off agricultural systems of the Roman-Byzantine-Early Islamic Negev desert was a result of economic and political decline in the Levantine Mediterranean zone. Traditional explanations invoking either climatic deterioration or the "Arab Conquests" do not conform to recent survey and excavation data. These data demonstrate continued agricultural exploitation beyond the collapse of the Byzantine Empire and well into the Ummayyad and even the early Abassid Caliphates. The final abandonment of the desert agricultural systems seems to occur around the 9th or 10th centuries A.D. This abandonment is accompanied by a complementary collapse of the associated pastoral nomadic systems. Thus, neither the conquests, nor climatic changes dated to ca. the middle of the first millennium A.D. can explain the agricultural decline evident in the Middle Ages in the Negev.

Introduction

The presence of sophisticated large scale agricultural systems dating to classical times in the arid regions of the central Negev, southern Jordan, and Sinai has long served both to illustrate the ingenuity of the ancient peoples of the region, and as an inspiration to modern peoples as to the potentials of wise exploitation of the desert. Archaeological survey has demonstrated that agriculture was practiced throughout the Irano-Turanian desert steppe zone, in areas which today receive as little as 75 mm average annual rainfall (compare Kedar 1967 to Evenari et al 1982:32, fig. 13). Virtually every wadi worthy of the name shows terrace systems for the damming of flash floods and their exploitation for farming.

The amazing efficacy of these systems has been repeatedly demonstrated. Both texts (Bruins 1986:87; Mayerson 1962: 224-69; Kramer 1958, Document 82)

and experimental archaeology (Evenari et al 1982:191-219) have indicated that yields from the desert zone using run-off water catchment systems could in fact approximate those of the Mediterranean zone (Evenari et al 1982:191-219; Bruins 1986:87). Excavations and surveys have revealed the existence of large and numerous wine presses (e.g., Shersehfski 1991:198-200; Rubin 1996:54; also Mazor 1981; Orion 1982), suggesting industrial level production of grapes and wine. The reconstruction and operation of some of these systems over several decades have demonstrated that in some ways they constitute an agricultural regime more resistant to drought than their counterparts in the better watered areas farther north. Finally, in the central Negev, six towns with their village and homestead hinterland, comprise an urban system proper with a population over 20,000 people (Shershefski 1991:200-214; Broshi 1979; Elliot 1982: 103-114), whose subsistence was based on this agricultural regime.

In light of the impressive nature of these systems, their decline is all the more marked. By the 10th or 11th centuries AD, the entire settlement system of the central Negev has been abandoned. All previously occupied sites, including towns, villages, farmsteads, and even nomadic encampments, have been deserted, and there is no evidence for any alternative settlements, either permanent or nomadic (e.g., Rosen and Avni 1993; Rosen 1987a; Avni 1996; Nachlieli 1992. The desert has reverted to desert.

The stark contrast between the rich archaeological remains and contemporary desolation has struck every traveler through the region, and there has been no dearth of attempts to explain the apparent this apparent 'triumph of the desert.' Two general factors have been suggested as primary causes for Negev desertification:

1. the Moslem or Arab conquests, and the destruction of Byzantine civilization (e.g., Negev 1988:15; Sharon 1969; Reifenberg 1955:98; Palmer 1872:243; Loweermilk 1945:136).
2. a climatic deterioration which rendered habitation impossible due to shifting sands, increased erosion, and reduced water for agriculture (e.g., Issar 1995; Huntington 1911; Issar and Govrin 1991).

Additional subfactors have included the negative impact of overgrazing by Bedouin (e.g., Reifenberg 1955:98), the destructive effects of earthquakes (e.g., Fabian 1994), and increased marauding by nomads (e.g., Sharon 1976; cf. also Lowdermilk 1945:129).

Critical examination of these factors in light of recent intensive research carried out in the Negev indicates that each of these explanations is fundamentally flawed as a prime mover in the desertification of the Negev, although each plays a role within a larger perspective. The key issue, rarely discussed in reviews of the decline of classical civilization in the Negev, is that periods of cultural florescence can usually be tied to increased economic and social input from or integration with the Mediterranean core area. The collapse of the economic core will inevitably result in the collapse of its dependents, unless alternative economic paths are available.

Archaeological Overview

The Central Negev in the 6th century AD, the Byzantine period in local terms, was the well integrated frontier province of *Palestina Tertia*, of the Late Roman Empire (Rubin 1997; Shershefski 1991; Mayerson 1994). Although the lucrative trade route of the Nabatean period had long since been eclipsed by alternative trade systems (Negev 1983), the province functioned both as a strategic southern buffer zone protecting the Levantine heartland (Gihon 1980; Mayerson 1986, 1990), and as a

gateway to both the holy pilgrimage destinations of the Sinai and to the mineral rich desert regions farther east and south (Mayerson 1982, 1983).

Archaeologically, the region is marked by two complementary settlement systems (e.g., Shersehfski 1991; Negev 1983; Elliott 1982; Rubin 1990; Mayerson 1989; Rosen 1987b, Rosen and Avni 1993; Avni 1996; Haiman 1995a). First, in the north and in the higher mountains, both better watered than areas farther south, large towns supported by intensive run-off agricultural systems evolved out of the *Limes Palestina* and the preceding Nabatean caravanserai over the course of several centuries. By the 6th century AD the six towns (Elusa, Ruheiba, Subeita, Nessana, Avdat, and Mampsis) represent the expansion of Byzantine society and economy deep into the desert. The design and construction of these towns is dominated by an architecture whose roots are undeniably in the Mediterranean zone, with little adjustment for local conditions (Shershefski 1991:228), excepting the use of local raw materials (Negev 1980). Christianity is the only religion represented at these sites in this pre-Islamic period, and classic basilica style churches are present, in the plural, at each town. The wealth of the towns is especially evident in these churches, which showed such features as wall facings and furniture of marble imported from Anatolia, elaborate mosaics, and vaults of large wooden beams imported from the Mediterranean zone (Negev 1974).

Although defensively postured, defense does not seem to have been a primary consideration in the settlements. Aside from the isolated nature of many of the villages and farmsteads, only Mampsis shows a circumference wall, although Avdat shows a fortification wall on one side of the settlement. Neither is especially massive. Both Avdat and Nessana show internal forts, indicating military presence. Subeita (Shivta) presents a limited number of access gates to the town, but these gates are in fact breaks in the continuum of attached structures, and not the gates of a city wall (Shershefski 1991:184-188).

The agricultural systems surrounding these towns, both those in direct association with the towns, and those part of the village-farmstead hinterland, are perhaps the most impressive evidence of the wealth and long term the stability of the Byzantine regime (e.g., Evenari et al 1982; Mayerson 1960; Kedar 1967; Bruins 1986). Vast areas of both wadi floodplain and upper alluvial terraces show elaborate systems of terraced dams, drainage channels, sluice gates, and support walls. Hill slopes are covered with *tuleiliot el anab*, rows of stone mounds and stone lines, presumably connected to either ground clearance for runoff enhancement, or some other form of agricultural activity (Evenari et al 1982:127-147). Calculations based on aerial photography, pedestrian survey, and farm reconstruction demonstrate that the average ratio of drainage catchment to farmed area was approximately 21:1, so that with run-off estimated at 15% of actual rainfall, an average annual rainfall of 100 mm could be transformed to an effective annual rainfall for the farmed fields for more than 400 mm (Evenari et al 1982:95-119). Not only is this more than sufficient for growing barley and wheat, the basic cereal staples of the period, but sufficed for growing grapes and olives as well. The presence of olive and wine presses at each town, sometimes of an industrial scale, demonstrates clearly the practice of arboriculture and viticulture, and dates, figs, and even pomegranates were also grown (Mazor 1981; Rubin 1996; Mayerson 1960). Rubin (1996) characterizes this system as the adoption of the Mediterranean agricultural system into the Negev.

The second system, less well documented than *Palestina Tertia*, is that of the pastoral hinterland, located in the deserts beyond the village farming hinterland (Rosen 1987b; Rosen 1994; Avni 1996; Rosen and Avni 1993; Haiman 1995a). Aside

from the significantly lesser rainfall associated with these southern areas, the region is marked by the general scarcity of agricultural remains, and the presence of the larger scale pastoral encampments. The remains of pastoral encampments are found throughout the desert and steppe zones, but the larger aggregate camps are located only south of the agricultural areas. These camps are, obviously, smaller than the Byzantine towns and villages, but also differ in their basic architecture and organization. In essence, the structures revealed at such encampments are to be interpreted as ephemeral tent bases, or, in some cases, hut foundations which carried brush or tent superstructures. The settlements align along secondary and tertiary drainages, in patterns dictated by topography. Material culture analyses also support the interpretation of these settlements are basically pastoral nomadic (Rosen and Avni 1997:62-81), and textual references (e.g., Mayerson 1989) accord well with this. A key point in analyses of these pastoral systems is their essential dependence on the settled system to the north both for their subsistence and their material culture. The markets of the settled zone are a *sine qua non* for pastoral existence in the desert (cf. Khazanov 1984). Relations between the desert and the sown, while perhaps occasionally tense, must have been essentially stable for the nomadic system to have thrived.

In summary, at the peak of classical period agricultural exploitation of the desert, the region had been well integrated into the Roman-Byzantine (and later Ummayad) empire (Rubin 1996, 1997). That integration in essence established the economic and social stability which enabled the desert to bloom.

The Islamic Conquests as Cause for Desertification

The battle of Gaza, in 633-4 AD, marks the beginning of the political end of the Byzantine empire in the Negev. Although the events leading up to that battle, and the causes behind the Byzantine collapse, have been much discussed, and are beyond the scope of this paper, in terms of desertification, several important points require attention.

Archaeologically, there is no evidence for the destruction or violent conquest of any of the Negev towns (*per contra* Negev 1982:15). In fact, the processes of urban decline seem to have been initiated well before the Islamic period. Mampsis (Negev 1982:15) does not appear to show an occupation in the 7th century at all. Avdat shows evidence for a major earthquake at the beginning of the 7th century, after which the city seems to have been abandoned for two centuries, and eventually reoccupied during the Islamic period (Fabian 1994). Significantly, an earlier 5th(?) century earthquake resulted in repairs and 'retrofitting' of various structures against further earthquake damage. Nessana shows continued occupation at least into the late 7th century and probably well into the 8th, both in the archaeology (Shershefski 1991:5, 50), and in the archives recovered from the site (Kraemer 1958:213), with little obvious disruption, although a clear decline can be traced. At Subeita, the presence of a mosque wedged into an open space next to a church (Baly 1935; Segal 1983; Shershefski 1991:74) indicates 1. clear continuity of occupation well into the 8th century, and 2. its contemporaneity with at least one church on the site, indicating the peaceful coexistence of the two religions during the Ummayad period. Ruheiba (Shershefski 1991:95) also seems to show continued occupation into the early Islamic period . Recent excavations at Elusa have not revealed any evidence for Islamic occupation, but nor is there any evidence for destruction. The excavator (Goldfus pers. comm.) suggests an abandonment prior to the Islamic period. The city of Beer-

Sheba (Figueras 1979), in the northern Negev, seems to show archaeological decline as well, although again, with no evidence for either abandonment nor destruction.

In this context, it is important to recognize that the first decades of the 7th century were catastrophic for the Byzantine empire, as a result of its long wars with the Sassanids. Although it is unlikely that the Persian armies which devastated the Levant actually came as far south as the central Negev, the havoc wreaked on the Mediterranean heartland could not but have been felt on the periphery as well.

On the other hand, in spite of the decline marked in the cities, the Ummayad and early Abassid periods seem to show a rural florescence. The central village and satellite farms at Sede Boqer (Nevo 1985; 1991) are the best example of this phenomenon. Another example is the farmstead at Nahal Mitan (Haiman 1995b). Avni (1994) has indicated the presence of at least 13 mosques in the Negev Highlands in this period, some of which are clearly associated with farming settlements and others with pastoral encampments. Finally, a series of large homesteads have been excavated recently around the outskirts of Beer-Sheba, colonized during the Ummayad and early Abassid periods (e.g., Katz and May 1996-7; Negev 1996-7; Bar-Ziv and Katz 1993; Nachshoni et al. 1993; Negev 1993; Katz 1993; Gilead et al 1993).

Evidence from the nomadic periphery also shows continuity, with little evidence for destruction or invasion. Pastoral settlements dating to the 8th and perhaps 9th centuries have been excavated in the southern central Negev (Rosen and Avni 1997). Some of these, in the higher areas, seem to show the adoption of floodwater farming into the pastoral subsistence system (Rosen and Avni 1993). The continued import and use of typologically Byzantine ceramics (and other elements of material culture) from the settled regions into the pastoral sites demonstrates underlying economic continuities. There was no break in relations between the nomads and the farmers in the transition to the Ummayad administration. Importantly, there is no incursion of nomadic settlement types into the agricultural zones in this period. Although erosion is a dominant feature in the desert landscapes today, it cannot be linked to the overgrazing which is often tied to such pastoral incursions since there is no evidence of such incursions.

In short, the Islamic Conquests, a problematic rubric for the Negev, did not bring any desertification. While the late Byzantine period saw an urban decline in the Negev, the early Islamic period seems to have seen a rural renaissance.

Climatic Deterioration as Cause for Desertification

Establishing climatic change as a prime factor in cultural transformation requires three distinct steps. First one must establish the reality of the climatic change itself. Second, the suggested climatic change must be correlated chronologically with the cultural transformation, and third, a reasonable scenario or mechanism for causality must be established, beyond the mere fact of correlation. It is not enough to establish a climatic change, indicate a contemporaneity with a cultural change, and claim a causal link.

There are several lines of evidence suggesting a change in climate sometime following the classical period settlements. The most obvious of these are the deposition of extensive terraces sometime during the classical period (e.g., Goldberg 1994; Bruins 1986:189), following by their erosion and the downcutting of wadis (e.g., Reifenberg 1955; Bruins 1986:189; Ben-David 1997). It is clear that there has been landscape degradation, but it is not clear either when this degradation occurred, nor whether it was the result of climatic changes, or other factors such as

microtectonics, or human intervention. Certainly accelerated erosion can be expected if terrace systems are not maintained (cf. Butzer 1974), and some of the gullying that can be seen in the Negev today is the undoubted result of breached dam systems and not climatic change.

One possible indication of a climatic component is the existence of post-classical downcutting in areas where agriculture, or its abandonment, can be discounted as a factor. The pastoral encampment of Nahal Oded, south of the Ramon Crater, shows two post-classical wadi channels, one a modern one, and an earlier and somewhat higher one, which cuts several 8th century structures located on higher alluvial terraces. In the absence of any agriculture in the area, Ben-David (1997) suggests that these downcutting events reflect episodes of extreme aridity, both of which post-date the Ummayad period occupation of the site.

The infiltration and movement of sand dunes, blocking drainages and burying settlements has also been suggested as reflective of climatic deterioration. Issar (1995) claims that the burial of the Byzantine towns of Elusa and Ruheiba, beginning ca. 800 AD, is the result of an increased supply of Nile sands on the Levantine littoral, to be correlated with increased monsoon rains in East Africa.

Dead Sea water levels, as established from salt cave evolution and sediment analysis from cores have also been used to reconstruct climatic sequences (e.g., Frumkin et al 1991, 1994; Geyh 1994; Issar 1995; Neev and Emery 1995:62). Summarized briefly, higher Dead Sea levels are evident during the first two centuries AD, the Early Roman period, indicating greater humidity. This period was followed by a warmer, more arid period in the middle of the first millennium BC, not ameliorated until the beginning of the second millennium AD.

Analysis of oxygen isotope ratios from cave speleothems and marine molluscs (Gat and Magaritz 1980; Geyh 1994) show high ^{18}O ratio peaks ca. 2300 b.p. and ca. 1500 b.p. indicating cooler temperatures (and presumably higher humidity), with cooler (and moister) periods between and following. These analyses accord well with the Dead Sea water level studies. Of further interest is the apparently significantly warmer (and dryer) period prior to 2300 b.p., such that although not especially cool or moist on any absolute scale, the 2300 b.p. episode is a relatively significant amelioration. Later episodes do not approach this first in scale of change.

Given the above data, from different sets of evidence, it is hard to argue that climate remained stable during the first millennium AD (*per contra* Rubin 1989). The next issues are whether the climatic fluctuations outlined above do indeed correspond to and can explain the cultural and physical desertification of the Negev.

The weakest link in the argument is that of dating, since shifts of a few hundred years, quite within the range of radiocarbon errors given problems of fractionation, intrusion, etc. significantly affect historical interpretation (Gat and Magaritz 1980). However, given current dating of the climatic events, it is hard to reconcile them with the desertification of the Negev. Thus, the Nabatean and early Roman periods, in the final centuries BC and first two centuries AD, when agriculture was incipient at best (e.g., Mayerson 1963; Bruins 1986:189), seem to have been at a climatic optimum. The cultural peak in the succeeding Byzantine period seems to have been climatically dry! The Byzantine collapse and rise of the early Islamic Empire seems to have been either stable climatically, or marked by only minor fluctuations. Although sand dunes did indeed bury those cities built in the dune areas, Goldfuss (pers. comm.) suggests that Elusa was in fact abandoned relatively early, prior to the 8th century dune invasions claimed by Issar (1995). Notably, Avdat, Subeita, and Mampsis were not affected by dunes at all. It is important to stress here

that the gradual abandonment of the Byzantine cities is not equivalent to either the abandonment of the Negev, nor desertification. As indicated earlier, there is a significant Early Islamic **agricultural** presence in the Negev at least until the 9th or 10th centuries AD. The final abandonment of the central Negev, probably in the 10th or perhaps 11th centuries AD, in fact, may even be associated with the beginning of climatic amelioration. In short, climatic change does not adequately explain the decline of classical civilization in the desert, nor the reversion of the desert to desert..

The Rise of the Desert

In order to understand the rise of the desert, we must understand first its domestication. The essence of the classical period 'Green Revolution' in the Negev was the transplantation of a Mediterranean zone agricultural complex into the arid zone. This complex, in the Mediterranean zone, consists of cereal farming (wheat and barley), fruit crops including grapes, olives, figs, and dates, and animal husbandry, based especially on sheep, goat, and cattle, with significantly less emphasis on pig. Landscape management in the form of hill slope terracing and various forms of irrigation are integral to the complex as well (e.g., Stager 1985). *Per contre* claims concerning the inappropriateness and instability of Mediterranean zone farming systems in the New World and other non-Mediterranean environments (see Butzer 1996 for discussion) the expansion of the Mediterranean zone into the desert, in terms of culture, society, and subsistence, proved a remarkably stable phenomenon, enduring at least half a millennium. The stability of this system is even more marked given the political perturbations which occurred during this period, perturbations which included the rise and decline of urban centers, the rise of Christianity, the collapse of Byzantine administration, and the rise of Islam.

There are two points important for comprehension of the success of this Mediterranean system. First, the integration of the desert economy, both in terms of trade and subsistence, into the larger state, is to be stressed. Even beyond the fact of active imperial subsidy, the desert settlement system was well embedded in the classical world. This is reflected is virtually all aspects of material culture, economy, and society. Second, the Mediterranean economy itself should be seen as a flexible strategy, fluctuating between emphasis on cash crops and subsistence staples, depending on the historical and economic contexts. Within the Mediterranean zone, during periods of social collapse, the Mediterranean complex shifts toward subsistence mode, whereas during times of economic prosperity, cash crops play a larger role (cf. Stager 1985).

In the desert zone, the subsistence mode may be insufficient of itself, especially given large urban populations which were at least partially supported by trade. Even without reference to climatic change, the desert environment exerts pressures on settlement systems not felt in better watered areas. Thus, regardless of the effectiveness of runoff irrigation systems, agriculture in the Negev must have required significantly more labor input than farther north, for example, in the construction and constant maintenance of terrace dam systems. Subsistence is more difficult in a desert, and therefore the *raison d'être* of permanent settlement in the Negev has always been its integration with some other core region. The decline of the core region economy results in a reversion toward the subsistence end of the Mediterranean complex spectrum, one which may not be sustainable in the desert at the high population levels of village and urban society.

The Mediterranean complex continues well into the early Islamic period. In this context, it is important to understand that the early Islamic horizon in the Negev,

in spite of its rural character, still shows a high degree of social and economic integration with the Mediterranean core area. This is most obvious in the material culture continuities between the core and the periphery. However, it is especially impressive in the ideological integration, such that Negev rock inscriptions from this period follow very standardized Islamic formulae (Sharon 1990), burials are typically Moslem (Rosen and Avni 1997:13), and mosques follow standard definitions (Avni 1994). It is in the later Abbassid period, following the political and economic shift of the Caliphate to Baghdad, that the Levant itself declines. With that decline, the means for the integration of desert and sown are no longer available, and the entire desert system, both settled and nomadic, is abandoned..

Glantz (1994) defines desertification as the creation of unproductive desert-like landscape in a place where none had existed in the recent past. In the sense that the Central Negev reverted from being a productive and integrated component of a Mediterranean state system to its original desert state, the processes reviewed here are indeed those of desertification.

Final Note

The history of research on the rise of Near Eastern deserts is one inextricably tied to the political and ideological struggles of the region. Thus the 19th century British Orientalist Edward Palmer (1872:241-243), for example, viewed the decline of civilization and the rise of the desert as the result of invasion and indigence on the part of the local inhabitants. Ellsworth Huntington's (1911) environmental determinism, in which he claimed that settlement and the rise and decline of civilization was dictated by the carrying capacity of a region, in turn determined by climate and environment, was an antithesis to attitudes like Palmer's. It was adopted as state policy by the British Foreign Office in its administration of Palestine, and used as a rationale for limiting Jewish immigration. In response, Zionist ideologues (e.g., Ben-Gurion and Ben-Zvi 1979 [1918]) claimed that the decline of Palestine and the rise of the desert was the result of negligent administration, discounting the role of climatic change (Troen 1989). Indeed, Ben-Gurion (1961) idealized the rebirth of the desert. As a part of the scientific background to the Zionist vision of the blooming desert, the role of the black goat as a factor in the reduction of vegetation, and the consequent rise in erosion has often been stressed (e.g., Reifenberg 1955:98; also see Kohler-Rollefson 1992 for claim for destructive overgrazing in the Neolithic), thus legitimizing expropriation of Bedouin grazing lands. In response, some scholars have denied traditional pastoral nomadism and grazing as a significant factor in landscape degradation (e.g., Thomas and Middleton 1994:13, 67-73).

Desertification is the result of a complex chain of causality. On its most simple level, it is clear that land degradation is the result of physical processes. However, these physical processes are often set in motion by human activities (Glantz 1994), such that the issues are social and historical (Blaikie and Brookfield 1987). The historical causalities are also complex. It is easy to demonstrate that overgrazing by pastoralists causes erosion, but as shown above, land degradation as a consequence of overgrazing may be only the latest stage in desertification. In the circum-Mediterranean region, the steppe zones inhabited by Bedouin in the 19th and early 20th centuries were almost all agriculturally exploited during the classical period, and subsequently abandoned, to be exploited by pastoralists only later.

It is these historical complexities which need to be addressed before we can understand desertification as a social phenomenon.

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