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Food economy and settlement system during the Neolithic in the Egyptian Sahara

Abstract

The earliest known Early Neolithic sites in the Nabta/Kiseiba area were occupied by hunter-gatherer-cattle herders. These sites date as early as 9800 bp, and are small, thin settlements located in the lower parts of playa basins. They were probably used by small groups who came into the area to pasture their cattle after the seasonal rains, and remained there as long as surface water was still available in the lowest parts of the basins. There is no indication that they dug water wells. These small sites are the only known remnants of a settlement system that must have included other areas where permanent water was available during the dry season, but where that was is unknown. Around 8050 bp, following a sharp, abrupt interval of hyper-aridity when the desert was abandoned, there was an abrupt change in the settlement system. The new groups had large settlements and lived in the desert the year-round. For the first time, they dug large, deep water wells, intensively collected grass seeds and other plant foods, and stored them in large bell-shaped pits.

This paper offers an explanation of why these changes in the settlement system and food economy occurred.

Introduction

The last time the Southwestern Desert of Egypt was really wet, with permanent lakes and flowing streams, was during the final wet phase of the Last Interglacial, about 70,000 years ago, when there was around 500 mm of rain per year. Numerous Middle Palaeolithic sites are associated with those deposits. From then until around 12,000 or 13,000 years ago (uncalibrated), the Southwestern Desert was hyper-arid and unoccupied (Wendorf et al. 1984; Wendorf et

al. 1993). Then, around 13,000 years ago, as the tropical monsoons of central Africa expanded and began to move northward into what is now southernmost Egypt, the desert began to receive some rainfall, but not very much, probably around 100 mm per year or less, and mostly during the summer months. These rains were sufficient only to form seasonal lakes, or playas, that left fluvial sediments on the floors of the deflational basins formed during preceding intervals of aridity.

This paper will attempt to pose and answer the questions as to why, after nearly 2000 years of small, ephemeral settlements occupied only briefly after the summer rains, the Nabta/Al Jerar Early Neolithic people living in the Nabta-Kiseiba area in Southwestern Egypt around 8050 bp abruptly changed their seasonal pattern of movement, beginning to live in the desert year-round, to dig large, deep water wells, and to harvest intensively the local wild seeds and other plant foods and store them in large, deep underground pits. These changes occur at the onset of El Nabta/Al Jerar Humid Interphase that witnessed the highest rainfall in the Southwestern Desert since the Last Interglacial. It was the Holocene Maximum in this part of Egypt. Did the changes in the food economy and settlement system primarily occur because of the increased rainfall? Or did they occur because of other factors, and if so, what were they?

The ethnographic data

In an effort to answer these questions we examined the ethnographic literature relating to the food economies of several modern pastoralists and hunter-gatherer societies in various parts of the world. First, we examined the data from a series of pastoralist societies (Johnson 2001), and it was soon evident that pastoralist economies almost everywhere have been significantly altered by both later Neolithic and modern day developments, most importantly by the introduction of domestic plants.

While most pastoralists live in areas where growing crops is at best marginal, the cultivation of domestic plants in adjacent, more suitable, areas did occur. This was soon followed by the emergence of symbiotic relationships between the pastoralists and cultivators that resulted in profound changes in the economies of the pastoralists. Much later, other changes in pastoral economies occurred with the introduction of government control, taxation and a money economy.

Having failed to find among modern pastoralists a society that was similar to those that were indicated for the Nabta/Jerar entity, it was reasoned that a closer resemblance might be found among modern hunter/gatherers, particularly those who live in very marginal environments where symbiotic relationships with cultivators were not feasible, and that a comparison with their economies

with that of the Nabta/Al Jerar entity might be more informative. Ethnographic information on modern hunter/gatherer societies living in environments comparable to that of the Nabta/Kiseiba area during the Holocene Maximum is generally limited to desert areas of North America, Australia and southern Africa. The groups in the Great Basin in North America live in areas with comparable rainfall; however, it is not a similar environment to that of the Western Desert of Egypt. The floors of the Great Basin valleys where the people live are high, above 1800 m, with cold winters and short growing seasons. It is not surprising, therefore, that the hunter/gatherer groups living in these high altitude deserts intensively gather plant foods and store them for consumption during the winter (Steward 1938). A closer parallel to the environment in the Nabta-Kiseiba area during the period between 8050 and 7300 bp is the modern desert of western Australia. The groups living in this desert all share a very similar food economy. Good examples are the Pitjandjara (Tindale 1972) and the Ngatatjara (Gould 1968). Another comparable area is the desert of southern Africa, the home of the G/wi and !ko Bushmen in the Kalahari Desert (Heinz 1972; Silberbauer 1972). All four of these groups lead nomadic lives, moving through a seasonal round from one patch of resources, mostly plants, to another within an extensive territory. None of them store food; it is always eaten shortly after it is collected, and when one resource fails they simply move to another. The territories of these groups are large enough and sufficiently productive that with frequent movements they can accommodate the food needs of the people living there, and yet their areas have such limited resources that no other group contests their ownership. This could well have described the Western Desert of Egypt before the Holocene Maximum. They are not common, but some groups living in desert areas do collect plant foods intensively and store them for later use. The question is why.

In an analysis of ethnographic studies of the relationship between mobility, housing and environment among 49 hunter/gatherer societies living in unproductive areas of less than 100 mm of precipitation, Binford (1990: 140ff) noted that storage of food does not occur in areas where the effective temperature is greater than 15.8. Effective temperature is a measure of solar-radiation intensity, i.e. overall warmth, combined with the length of the growing season (Bailey 1960). It is a particularly useful guide to expected plant biomass or density. In his ethnographic sample of 49 societies, of the six groups with no dependence on aquatic resources, and who were living in areas with effective temperatures above 15.3, none store food. On the other hand, the eight societies in the Binford sample living in areas with effective temperatures at 15.3 and below all store food. This is because, like the people in the Great Basin, all of these groups live in areas with cold winters, and storage is a security tactic against food shortfalls during the winter (Binford 1990: 140ff).

In a subsequent analysis of a much larger data base consisting of over 300 hunter/gatherer societies, Binford (2001: 188f., 348) showed that intensification (he defines this as the tactic that increases the production of food per unit area) occurs when group size increases. Among hunter/gatherers there seems to be a threshold of population density that closely correlates with the onset of intensification and storage. That packing threshold is 9.1 people per 100 km^2 (Binford 2001:238f.). In some instances packing occurs because other groups have moved into part of the resource area, and in other instances it develops because of government interference that confines once widely scattered groups into a smaller area. When the population is unable to expand into other areas, regardless of the effective temperature, then it can either find a way to increase its subsistence diversity or initiate intensification. In most settings with limited resources, intensification and storage are the primary tactics for group survival.

The Nabta-Kiseiba Neolithic sequence

Now let us examine the Neolithic sequence in the Western Desert of Egypt, particularly that of the Nabta/Kiseiba area in far southwestern Egypt. The first known settlements in this area are associated with playa deposits of Final Pleistocene-Early Holocene age and are identified as El Adam Early Neolithic. Several radiocarbon dates on charcoal between 9800 and 8750 bp (uncalibrated) are associated with these sites (Connor 1984a; Close and Wendorf 2001). Two of these earliest sites, however, rest on from 4 to 6 m of playa sediments, indicating there were rains in the desert for some time before humans ventured into the area. These earliest Adam sites are very small, and probably were occupied by a few individuals for only short periods of time. Some localities show evidence of reuse, but even these are relatively small, with thin cultural debris confined to areas rarely exceeding 100 m^2 (Connor 1984a; Close 2001). In addition to a distinctive lithic assemblage dominated by straight backed pointed bladelets, almost all of the Adam sites also contain rare sherds of well-made pottery with granite temper, apparently from local outcrops, with closely packed, rocker stamped, comb-impressed designs in the generalized Early Khartoum style (Nelson 2001b).

These earliest known sites are located in the lower parts of deflational basins that were seasonally flooded during and immediately after the summer rains. Because none of these early sites show traces of water wells, it is presumed that they were not occupied during the driest time of the year, winter and spring, when there was no surface water. The most likely season for human occupation was late summer through fall, when water was probably available at pools in the deepest part of the basins. The occupants of these earliest settlements hunted small game and did some gathering of grass seeds in addition to being cattle pastoralists (Wendorf and Schild 1994; Gautier, 2001; 2002). Almost all of these

early camps have yielded rare bones of domestic cattle that are among the oldest domestic cattle known, dating between 700 to 1000 years prior to the earliest cattle in Southwest Asia. This suggests that there was an independent center for cattle domestication in northeast Africa, a conclusion that is also supported by mtDNA analyses of modern cattle (Bradley et al. 1996).

The absence of permanent water makes it highly unlikely that wild cattle were present in the desert, and since it is difficult to imagine these Adam groups taking wild or even semi-tamed cattle into the desert for grazing, it is presumed that prior to their presence in the Western Desert of Egypt, the early stages of this cattle domestication process occurred elsewhere, but where is unknown. It could have been either in the Nile Valley, possibly in southern Egypt or northern Sudan, or farther south in the Sahelian zone of northern Sudan. Wild cattle are known to have been present in both areas during the Final Pleistocene, but there is no evidence of domestic or semi-domestic cattle in the Nile Valley until much later (Gautier 2001). Unfortunately, there is almost no information available on the archaeology of the northern Sahel for this time period.

The fact that cattle remains are relatively rare in these Adam sites has led to the suggestion that the modern African pattern of cattle use, where cattle are exploited mostly for milk and blood, and are rarely killed for meat, evolved in this or a nearby desert area. Cattle by-products may have been an important source of food to the earliest groups using this area, a kind of "walking larder" (Close and Wendorf 1992). It seems probable that cattle also may have been useful for transportation, for carrying loads, such as water or hut frames for long distances.

Other fauna recovered from these early sites are all small, desert-adapted species that do not require surface water, but can obtain moisture from vegetation and dew. They are mostly gazelle, hare and a few small carnivores. The character and species paucity of the fauna clearly indicates an environment with very low carrying capacity. Although preservation in these open sites is poor, a few carbonized plant remains, mostly grass seeds, have been recovered from these earliest sites. The presence of grinding stones in almost all of these localities also indicates that plant foods may have been a relatively consistent food source.

There was a brief, but intense arid episode between 8750 and 8550 bp (uncalibrated) (the Post El Adam Arid Phase) that coincided with the disappearance of the Adam entity from the southwestern desert of Egypt. In the subsequent moist interval the area was re-occupied by small groups, identified as El Ghorab variety of Early Neolithic. These new Ghorab people apparently also lacked water-wells and used the area only seasonally, much as did the El Adam groups. New features in El Ghorab included small, shallow, basin-shaped hut floors that are found in a few sites. The motifs on the pottery were also different, most of

the designs were deeply impressed nested v-shaped elements covering the entire exterior of the vessel, and made with a stylus. Like the Adam entity, they were also hunter-gatherer-pastoralists, and had many other elements in common with El Adam.

The Adam and Ghorab entities shared closely similar lifeways and settlement system, of which we may be seeing only small, specialized herding fragments. Both groups had only very small settlements, usually located in the lower parts of basins that were flooded during and immediately after the summer rains. Both groups had cattle, at least incipiently domestic and probably limited to very small herds, which they brought with them to graze on the grasses that grew around the basins and on the adjacent plateaus after the summer rains. They could not move very far from the basins, however, as the cattle had to drink at least every other day. Pools of surface water would have been present in the lowest part of the basins for several months after the rains, but by late fall until the following summer rains, there would have been no surface water.

Where these hunter-gatherer-cattle pastoralists spent the dry season is unknown. It could have been in the Nile Valley. There are close similarities between the lithic assemblages from the later El Adam sites and those from the only excavated contemporary site along the Nile, Dibeira West 51, located on the west bank of the Nile, near Wadi Halfa (Schild et al. 1968: 695ff; Wendorf et al. 1979). There are also close similarities between the lithics of the Ghorab entity, and those from El Kab, near Edfu in Upper Egypt (Vermeersch 1978). Both of these localities were repeatedly occupied, as indicated by their stratigraphy, and also by the range of dates for El Kab. These similarities suggest that the seasonal ranges of some El Adam and El Ghorab groups included the Nile Valley, and that their seasonal round had an east-west alignment. There is, however, no evidence for pottery in these Nile sites, and all of the associated remains of cattle are identified as wild *Bos primigenius* (Gautier 2001, 2002).

A second possibility is that some of the Adam and Ghorab groups had a north-south seasonal round. The ranges for these Adam and Ghorab groups could have included the artesian spring areas of Dakhla and Kharga Oases, where permanent water was probably available. There is at least one El Ghorab locality at Kharga (E-76-6; Wendorf and Schild 1980: 188f), and a few typical El Adam artifacts have been found near Dakhla (McDonald 1991). Still a third possibility is that the Adam and Ghorab groups followed the summer rains northward, coming from and returning to winter base camps located to the south, in the northern part of the Sahel, in what is now northern or central Sudan. Unfortunately, almost nothing is known of the archaeology of that area during this period. Between around 8250-8050 bp, the Nabta-Kiseiba area in Southwestern Egypt was abandoned by the Ghorab Early Neolithic, who probably left at the

onset of an abrupt episode of aridity, named by us the Post El Ghorab Arid Phase (Schild and Wendorf 2001; Wendorf and Schild 2001). The area was not occupied again until the beginning of the Nabta/Al Jerar Humid Interphase, dated from 8050 to 7300 bp. This was the interval of the highest rainfall since the Last Interglacial, the Holocene Maximum in this part of Egypt. The annual rainfall is estimated to have been around 200 mm, or slightly more, hardly enough for a tropical rainforest but adequate to support a wide variety of grasses, herbs, legumes, tubers, shrubs and trees. The grasses must have formed a relatively dense cover over the entire huge catchment area of Nabta Playa, because sedimentation was sharply reduced, in spite of the considerable influx of water that flooded the lower part of the basin. Over 20,000 charred plant remains belonging to 130 taxa, including 10 varieties of trees and shrubs, were recovered from one El Nabta site, E-75-6. The most frequent were edible plants, including sorghum and two varieties of millets, all of which were wild (although there are suggestions that the sorghum may have been cultivated [Wasylikowa et al. 2001a; Barakat 2001; Królik and Schild 2001]). Several hundred other charred plant remains of many of the same taxa were recovered from the nearby Al Jerar site with relatively poor preservation (Site E-91-1; Wasylikowa et al. 2001b; Barakat 2001; Wendorf et al. 2001b). Many of these identified plants grow today in southwestern Egypt, but as scattered small patches and never in dense stands. To find dense stands one would have to look farther south in northern Sudan, in the northern section of the Sahelian belt.

The Nabta/Al Jerar Humid Interphase was followed by another sharp, brief period of hyper-aridity (7200-7100 bp) when the previously deposited playa deposits were extensively eroded, and the desert again abandoned. Moisture returned to the area just before 7100 bp, but the rainfall was never again as much as during the previous El Nabta/Al Jerar Humid Interphase, and probably less than it was during El Adam and El Ghorab Humid Interphases. Although playa-like deposits formed near the mouths of some tributary drainages where they were blocked by dunes, playa sediments did not accumulate in the center of the basin. With the return of moisture, however, Neolithic groups again occupied the area (Wendorf and Schild 2001). The first group is identified as Ru□at el-Ghanam Middle Neolithic (sheep and goat herders, 7100-6700 bp), followed by Ru at el-Baquar Late Neolithic, and then by Bunat el-Ansam Final Neolithic (builders of megaliths, 5400-4800 bp). All of these differ in the details of the associated ceramics, and some of the lithic tool types, but they shared closely similar lifeways. Sites of these later Neolithic groups are comparatively few, and the occupied areas are generally smaller, when compared with El Nabta/Al Jerar entity. They are usually located where water could be obtained from a local perched water table, and they were often repeatedly used. Based on the numerous grinding stones, and the few charred plant remains recovered, these later groups

continued to gather seeds for food. They also stored in sub-surface pits, hunted gazelle and hare, and were herders. In addition to the cattle, they now had domestic sheep/goat (Gautier 2001; Close 2001; Nelson 2001a). It seems likely, given the reduced rainfall, that the carrying capacity must have been sharply reduced. The area certainly had more rainfall than today, but there were several sharp periods of aridity accompanied by deflation and erosion.

El Nabta/Al Jerar lifeway

The groups who re-occupied the Nabta/Kiseiba area around 8050 bp were economically still hunter-gatherer-cattle pastoralists, but they came with or rapidly developed a different economy, a new settlement system, and several new technologies, all of which functioned as an integrated system. These new technologies made it possible to live in the desert throughout the year, including the driest period, and to exploit the available resources more efficiently and intensively. Among these new technologies was the ability to dig large, deep wells to provide water for themselves and for their cattle. There was also a change in the way plant foods were used, from immediate consumption to intensive harvesting and storage in pits for consumption when other food resources were not available.

With water wells they could stay in the area during the dry season, from late fall until the onset of the summer rains. The edible plants, mostly grass seeds, tubers and fruits, also matured during the early part of this period, in the fall and early winter. Storage facilities justified an intensification of effort on the abundant plants, and provided the resources that enabled them to stay in the area during the late winter and spring when other food was not available.

The intensification of the use of plants during the Nabta/Jerar Humid Interphase had a profound impact on their annual cycle of seasonal rounds. Because the nearby areas would have been quickly overgrazed, it would not have been possible to keep a sizable herd of cattle in or near the occupied basins. Thus, it is likely that either the cattle herds were very small, or there were two sub-groups present. The first sub-group would have consisted of those who stayed at the winter base from October until June, at which point the summer rains began and they were forced to move out of the basins. The other group would include those who were herding cattle, possibly at some distance from the winter camp, moving frequently to avoid over-grazing. Because the cattle need to drink every other day, they could not have been too far from water. Possible evidence of these herding groups may be the small localities with a few flaked stone artifacts, a hearth, and perhaps a grinding stone. These are very frequent on the plateaus and sand sheets in this area and farther to the west (Connor 1984b; Wendorf et al. 1987a; Close 1990).

All of the larger basins and some of the smaller ones in the Nabta-Kiseiba area have settlements that were used during the Nabta/Al Jerar humid Interphase. On this basis, there were more people in this area during this interval than anytime before or after. The sites are all in the lower parts of the playa basins, presumably to be near the water wells, and probably not far from where many of the edible plants were most abundant. They were obviously used only seasonally, most probably in the winter, and abandoned with the onset of the summer rains. Where the people went when they left the basins is unknown. It seems likely, since water at that time would have been plentiful, that they may not have moved very far, grazing their cattle on the new plant growth that quickly appeared.

Understanding the Nabta-Al Jerar settlement system and food economy

In a preceding section it was noted that since the Nabta/Al Jerar groups were seen as functioning primarily as hunter-gatherers, with a relatively minor pastoralist element, these Early Neolithic societies might share many features with modern hunter-gatherers. The ethnographic literature indicated that some modern hunter-gatherers store food, but that most of these live in areas with cold winters and short growing seasons, such as the high altitude valleys of the Great Basin in North America, a very different environment from that at Nabta. But what about those societies living in areas similar to Nabta, did they store? And if so, why?

From Binford's (1990) study of 49 hunter-gatherer societies it was learned that storage of food does not occur in areas where the plant biomass is adequate to supply their needs. They did not store where the effective temperature, a good proxy method for estimating the amount of plant biomass, is greater than 15.8. But a reconstruction of the paleoenvironments at Nabta, using the Bryson (1992) method to estimate past temperatures, resulted in a calculated effective temperature at Nabta between 8050 and 7300 bp of around 17.5, well above where one would expect storage to occur. Why, then, did the Nabta/Al Jerar people store?

A second study of over 300 hunter-gatherer societies by Binford (2001:238f.) noted that efforts to increase the production of food occurs only when population density is more than 9.1 people per 100 km^2. When this packing threshold is reached, hunter-gatherers either find a way to increase their subsistence diversity, or intensify their food production, with intensification and storage being the most effective tactic in areas of limited resources. If the relationship between environmental parameters and population density that is evident today among hunter-gathers also applies in the past, then it is highly likely that the Nabta/Al Jerar economic system developed in response to restriction on group mobility. They did not store plant food because there was more rainfall and more abundant plants. They did not intensify their collection of

plants and store them because they were there, but because they had to, if they were to survive in this area during the dry season. For some reason unknown to us, the Nabta/Al Jerar groups could not move to or expand into another area where food and water was available in the winter.

Clearly, the Nabta/Al Jerar people were not local. They came to the Nabta/Kiseiba area from elsewhere, but where is unknown. It is very unlikely that they came from the Nile Valley, because there are no known sites in the Valley that could represent a complex from which the Nabta variant could have been derived. A similar argument can be made in regard to areas both to the north and west of Kiseiba; by El Nabta times, Dakhla and Kharga Oases are very different in both lithics and ceramics.

The most likely source for El Nabta is to the south, in central or northern Sudan. Furthermore, because the earliest Nabta sites already had water wells and storage pits, it is reasonable to suggest that these predecessors of the Nabta/Al Jerar entities had been living in an area where they had to dig water wells and collect and store plant foods to survive through the winter and spring. This suggests that the population density in these winter base camps already exceeded the packing threshold, and that their neighbors may have circumscribed their resource area. It is possible that with the increased precipitation that occurred during the Holocene Maximum there was a general south to north shift in population into northern Sudan and the southern part of the Western Desert. In this scenario, it is likely that other groups who had occupied the areas beyond them on the south were also moving north, thus limiting their range back to the south. Because of a bleak and unproductive landscape immediately north of the Nabta/Kiseiba area, the Sinn El Kedab Scarp and the high Eocene Plateau, expansion in that direction offered limited resource opportunities. As a result, the new arrivals continued to dig large, deep wells for water during the dry season, they collected intensively the available plant foods, and they dug pits where they stored the plant foods that were to be used when other foods were no longer available.

Later Neolithic Economic and Settlement Strategies

The organizational strategy of digging water wells and storing plant foods continued to be employed throughout the remaining stages of the Neolithic in the Nabta area. The stratigraphic evidence indicates that during the Middle, Late and Final Neolithic intervals, a period of over 2000 years, broken by two major arid phases, there was no playa sedimentation in the center of the basin at Nabta. This is very different from the situation evident during all of the earlier humid interphases when huge lakes filled the larger basins and thick playa deposits were laid down in their center. It is good evidence that there was much less precipitation

during these later humid intervals than in any previous humid interphase in the Holocene. Although difficult to quantify, because of frequent reuse of the same localities, the size and number of sites indicate that there were fewer people, but also, the productivity of the area was greatly reduced. The ability of these later groups to move to more productive areas must have been restricted, because they continued the same survival tactics employed by the Nabta/Al Jerar entity, suggesting that the population still exceeded the packing threshold. To survive through the winter and spring they collected plant foods, stored them in pits, and dug water wells in those few localities where water could be obtained because of a perched water table. Later, shortly after 4800 bp, even these tactics were not enough, and the area was abandoned, except for occasional, temporary visitors like us.

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