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Beyond collapse: the role of climatic desiccation in the emergence of complex societies in the middle Holocene

Nick Brooks

Saharan Studies Programme, Tyndall Centre for Climate Change Research and School of Environmental Sciences, University of East Anglia, Norwich NR4 7TJ, UK. Email: nick.brooks@uea.ac.uk.

Extended Abstract

Abrupt climate change is often invoked as a trigger for the collapse of civilisations. The fall of the Akkadian Empire and the end of the Egyptian Old Kingdom around 4200 years before present (BP) have both been attributed to climatic change resulting in regional desiccation (Cullen et al., 2000; Hassan, 1997; Weiss, 1997). However, there is widespread evidence that climatic and environmental stress played a major role in the emergence of early civilisations, and that aridification in particular acted as a trigger for increased social complexity associated with urbanisation and state formation. This paper argues that the highly urbanised, state-level societies of the sub-tropical arid belt that emerged in the middle Holocene did so as a result of a process of adaptation to water scarcity.

Evidence that the desert belt of the northern hemisphere experienced wetter conditions in the past is widespread, but is particularly rich in the Sahara (Jolly, 1998; Kutzback and Liu, 1997; Lezine, 1989; Lioubimsteva, 1995; Maley, 1977). Dating of archaeological sites, lake sediments and faunal remains indicates that wet conditions were established in the Sahara by around 10,000 BP after a long period of aridity associated with the last glacial period (Goudie, 1992, Ritchie, 1994; Roberts, 1998). This humid phase was associated with an intensification of the African Monsoon caused by increased northern hemisphere summer insolation, resulting in its penetration far north of its current northernmost position (Claussen et al., 1999, 2003; Ganopolski et al., 1998; Tuenter et al., 2003). The early Holocene humid phase was, however, punctuated by episodes of aridity that appear to have coincided with North Atlantic cooling events evident from ice-rafted debris and Greenland ice-core records (Alley et al. 1997; Bond et al., 1997; Cremaschi et al., 2001, 2002; Di Lernia and Palombini, 2002; Goodfriend, 1991; Smith, 1998; Guo et al., 2000). While summer insolation remained strong, the Saharan region recovered from these arid interruptions, and humid conditions were re-established. However, there is evidence that recovery was at best partial in the eastern Sahara after an arid event around 6000 BP (Di Lernia and Palombini, 2002; Goodfriend, 1991; Smith, 1998), and the entire Sahara had entered a period of desiccation by around 5000 BP (Cremaschi, 1998; Grandi et al. 1999; Jolly et al. 1998; Lioubimsteva 1995). The process of environmental desiccation that followed the southward retreat of the monsoon was mediated by geography; while water persisted at or near the surface in some locations long after the cessation of significant rainfall, hyper-arid surface conditions were established rapidly in other Saharan regions (Cremaschi and Di Lernia, 1998).

It has been noted that the rise of Dynastic civilisation in Egypt coincided with the onset of widespread Saharan desiccation, and a number of authors have suggested that increased social complexity in the Nile Valley may have been precipitated by desertification in the eastern Sahara. Adams and Cialowicz (1997, p 57) state that the formation of the pharaonic state was the result of the expansion of the Naqada culture of Upper Egypt and was “encouraged by the pressure of a greater population in the south, where climatic change in the late Predynastic had reduced winter rainfall and husbandry in the deserts and brought about a reliance of agriculture in natural basins.” This view is supported by Wilkinson (2003), who argues that populations that had previously practiced seasonal migration between the Nile Valley and the summer savannah in what is now Egypt’s Eastern Desert were forced to settle permanently in the Nile Valley as a result of the cessation of summer rainfall. Malville et al. (1998, p 448) suggest that “an exodus from the Nubian Desert at ~4,800 [uncalibrated radiocarbon] years BP may have stimulated social differentiation and cultural complexity in pre-dynastic Upper Egypt.”

It is plausible that the necessity to settle permanently in the Nile Valley, coupled with a likely increase in population due to immigration resulting from the desiccation of the surrounding Saharan regions, stimulated both technological innovation and further social stratification. Current models of Egyptian state formation suggest that the northward expansion that led to unification followed a period in which competing "proto-state entities" coalesced in Upper Egypt in the late sixth millennium BP (Maisels, 1999). It is tempting to interpret such a process within a context of both cooperation (between the constituent elements of such entities) and conflict (between entities) driven by the need for collective security in a time of instability and dwindling resources. Migrant groups arriving in the Nile Valley are likely either to have come into conflict with existing populations or to have formed disadvantaged groups, either of which would have increased social stratification. Groups of lower status would have provided a pool of labour which during the Early Dynastic period could have been exploited for the monumental building projects that were a prominent feature of Egyptian society.

The cultural and environmental trajectories of Mesopotamia are less well understood and arguably more complex than those of Egypt. The courses of the Tigris and Euphrates appear to have been more variable than that of the Nile, and shifts in river courses had dramatic impacts on local environments, meaning that caution must be exercised in palaeo-environmental interpretation (Maisels, 1999; Matthews, 2003). Nonetheless, a combination of palaeo-environmental evidence and modelling studies reviewed briefly by Algaze (1991) indicate that parts of southern Mesopotamia underwent a process of aridification in the middle and late sixth millennium BP, the formative period of Mesopotamian civilisation characterised by the Uruk culture. A combination of changes in river courses and increasing aridity has been postulated by Algaze (2001) as a driver of increasing social complexity, stimulating social instability, regional competition and conflict, and population agglomeration. While palaeoclimatic proxies are unavailable at present for the southern Mesopotamian alluvial lowlands, evidence from surrounding regions suggest a precipitation minimum from around 5200-4900 BP (Butzer, 1995, cited in Pollock, 1999), coinciding with the transitional Jemdet Nasr period. During this period the Uruk culture collapsed, giving way to "an extended period of regionalism" (Matthews, 2003, pp 118-119). The principal Uruk city of Uruk-Warka nonetheless grew dramatically, and "The region around Uruk-Warka played host to a sudden tenfold increase in settlement density at about 3200 BC, coupled with the development of a four-tiered hierarchy of settlement, all made possible by increased availability of dry and very fertile land newly freed from constant inundation by an ameliorating [sic] climate" (Matthews, 2003, p110, citing Nissen, 1988 pp 66-67). This period also appears to have been associated with increased conflict and the fortification of settlements, suggesting competition for resources as much as abundance resulting from the availability of new fertile land (Leick, 2001, p 55; Schwartz, 2001, p 262), and was followed by a period of competing and cooperating city states (Leick, 2001; Pollock, 1999).

While the factors driving demographic, social and political change in Mesopotamia in the sixth and fifth millennia BP were doubtless complex and numerous, there is evidence that the wider region was subject to significant environmental change during this period, characterised by increasing aridity (Wright, 2001. p 128). It is therefore a reasonable hypothesis that water scarcity and a consequent shift of population and food production to the vicinity of major rivers was a significant factor in the evolution of Mesopotamian society. The growth of urban centres and the emergence of competing city states that ultimately gave way to the Akkadian and Babylonian empires is reminiscent of the process postulated above for the Nile Valley, albeit unfolding over a much longer timescale. In Mesopotamia the emergence of city states is preceded by a degree of apparent cultural homogeneity during the Ubaid and Uruk periods. There is still much debate as to the nature of Ubaid society, and of the Uruk expansion throughout the sixth millennium BP; while some scholars view the latter in an imperial context, others question the view of Uruk as an imperial capital (Algaze, 2001; Matthews, 2003). What does seem unambiguous is that, while Mesopotamia is experiencing fragmentation at a time of unity in early Dynastic Egypt, in both cases cooperation and conflict are associated with the emergence of stratified state-level societies during a time of increasing aridity in the late sixth and early fifth millennia BP. It is also notable that complex urban societies emerge in other parts of the world in the early fifth millennium, for example in the Indus Valley region (Maisels, 1999, p 192; Chakrabarti, 1995, pp 111-114) and the Supe Valley of Peru (Solis et al., 2001). In both cases this form of increasing social complexity appears to follow regional climatic desiccation in the late sixth and fifth millennia BP (Enzel et al., 1999; Haug et al., 2001). While the interactions of human populations with the physical environment are even more obscure in the Americas and the Indus region than in Mesopotamia and Egypt, we can postulate (as a hypothesis to be tested) competition, cooperation and population agglomeration as responses to water scarcity that led to new social structures, as the surface environment underwent desiccation in response to a reduction in rainfall.

The purpose here is not to present a case for climatic determinism, rather to illustrate that climatic and environmental change of a kind usually associated (correctly or incorrectly) with the collapse of civilisations also appears to have played a significant role in the emergence of the very same civilisations. The environmental desiccation experienced in sub-tropical Africa and Asia in the sixth and fifth millennia BP appears to be associated with an abrupt cool episode occurring around 5900 BP that led to widespread aridity (Bond et al., 1997; Goodfriend, 1991; Smith, 1998). Research into land-atmosphere interaction suggests that this event may have acted as a trigger for long-term desiccation in some regions (such as the eastern Sahara) and that subsequent desiccation around 5000 BP was due to a collapse of vegetation feedbacks as orbital forcing of the summer monsoon weakened (Claussen et al., 1999, 2003; Haug et al., 2001). It should be noted that the cool/arid episode that has been linked to societal collapse around 4200 BP (Cullen et al., 2000; Weiss, 1997) was of a qualitatively similar nature to that of 5900 BP, while the outcomes of these events, according to the above hypothesis, were very different.

It is not only different outcomes from similar types of event that caution us against simple climatic determinism. The concentration of populations in expanding settlements where surface water is available, and the organisation of these populations into specialised urban and/or stratified state-level societies, is not the only response to increasing aridity evident in the archaeological record. In other words the nature of the response is not determined by the nature of the climatic stress to which people must adapt.

Differential adaptation is apparent in response to climatic desiccation in the Fezzan region of southern Libya, where Di Lernia and Palombini (2002) describe two contrasting responses to aridity in the middle Holocene. In higher elevation regions cattle herding, previously the dominant economic activity, almost completely disappeared after 5000 BP. The keeping of cattle was replaced by highly mobile pastoralism based on sheep and goats and involving large-scale year round movement in order to exploit remnant water and pasture, a nomadic lifestyle that persists to this day. In contrast, lower elevation regions were characterised by increasing settlement in relict oases, associated with sedentism and more intensive exploitation of local resources. Settlement in the relict oases ultimately led to the emergence of the Garamantian civilisation in the early third millennium BP, based on the exploitation of underground water resources via the construction of subterranean irrigation channels or *foggara* (Wilson and Mattingly, 2003). The Garamantes dominated the Fezzan between about 3000 BP and 700 AD, and their society appears to have arisen as the result of local innovation, the outcome of a process of increasing social complexity among the pastoral groups of the Fezzan (Di Lernia et al., 2002; Mattingly, 2003). As seems to have occurred in Egypt and Mesopotamia, the emergence of the Garamantian polity was associated with inward migration, increased population density, changes in religious beliefs and practices, social stratification and a more territorial approach to the landscape, catalysed by the final desiccation of most of the landscape soon after 3000 BP (Brooks et al., 2003; Cremaschi and Di Lernia, 2001; Di Lernia et al, 2002; Mattingly et al., 2003).

The evidence strongly suggests that climatic desiccation centred around 5000 BP played a major role in the emergence of early complex societies or “civilisations”, characterised by a high degree of some or all of the following: urbanisation, specialisation, social stratification, and state-level organisation. This event appears to have been connected with a combination of millennial-scale North Atlantic variability, orbitally-induced southwards monsoonal retreat, and a collapse of vegetation-atmosphere feedbacks. Nonetheless, the nature of early civilisations varied considerably, and there was no single trajectory followed by societies as they adapted to increasing aridity.

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