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Savanna on the Nile: Long-term Agricultural Diversification and Intensification in Nubia

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Abstract

This paper provides an overview of changing agricultural systems from the Neolithic to the Post-Meroitic Period in the greater Nubian region. There remain major gaps in the archaeobotanical evidence, and larger samples collected by systematic sieving and flotation are few and far between. Gaps in our knowledge include the initial establishment of the summer, sub-Saharan cereal cultivation system, but other important trends are much clearer, such as the arrival of the classic Egyptian winter cereal cultivation system of Near Eastern origin in the Late Neolithic at least in Lower Nubia; the latter of which complemented established pastoral traditions providing for the emergent political economy. The northward spread of the summer savannah crop system during the first few centuries ce formed the basis for subsequent intensification through the adoption of the cattle-powered saqia. Diversification and intensification through an integration of the summer and winter crop systems along with the development of a cash crop industry facilitated the development of Meroitic state. These processes also may have played an important role in economic changes in the Late Meroitic to Post-Meroitic transition, including the devolution of the Meroitic state. In addition to representing a long-term frontier of overlapping agricultural systems, Nubia was a frontier in cooking traditions, a crossroads between a world of bread in the North and one of liquid preparations, porridges, and beers in the South.

Introduction

Nubia, that is the Middle Nile between Khartoum and Aswan, has significance as a link between sub-Saharan Africa and Egypt and the Mediterranean world. It has therefore potentially acted as a "corridor to Africa" (Adams 1977) for the spread of agricultural technologies and winter crops of Middle Eastern origin southwards, and as a corridor from Africa for summer crops of tropical origin to reach Egypt, Southwest Asia, and Europe. In recent years the northward movement of African crops through the Nubian corridor has received considerable attention in discussions of African archaeobotany and agricultural origins, in particular with the use of evidence from Qasr Ibrim to hypothesize a late domestication of sorghum (e.g., Rowley-Conwy 1989, 1991; Wetterstrom 1998; Rowley-Conwy et al. 1999). Due to its proximity to Egypt, with its long history of archaeological research, and the incentive of three dam-building projects at Aswan in the 20th century, Nubia has received much archaeological attention. In general, however, archaeologists have been much more interested in the role of Nubia as a corridor for conquest, a migration pathway of people (such as Nubian speakers), and as a center for trade in elite manufactured goods or precious raw materials.

Traditionally, excavations have focused on cemetery sites, and those with the monumental architecture of temples and palaces, while the excavations of domestic habitation sites have been rare, and the systematic pursuit of evidence for past subsistence even rarer (see Trigger 1965; Adams 1977; Török 1997; Morkot 2000). There has nevertheless been a (p. 928) considerable amount of haphazard collection and reporting of archaeobotanical evidence, and a smaller amount of systematic sampling via sieving or flotation. However, one of the aims of the present paper is to attempt a synthesis of the available archaeobotanical evidence for Nubian agriculture, with particular emphasis on those sites where more systematic archaeobotanical data is available. This review will demonstrate the fundamental importance of archaeobotanical contributions in order to understand the progression of agricultural developments in the greater Nubian region and their impact on the rise and fall of the Meroitic state.

The Archaeobotanical Record: Preservation, Recovery, and the State of the Evidence

Quality archaeobotanical material from Nubia is currently sparse. The imbalance of evidence from settlement and cemetery sites and archaeobotanical assemblages is a result of many factors including the late introduction of flotation to the area and excavation biases in favor of cemetery contexts. When considered in terms of syntheses of Nubian cultural history, archaeobotany was largely absent from treatments of the 1960s and 1970s, which relied largely on assumptions of subsistence production derived from modern historical parallels and a limited amount of Egyptological data (e.g., Trigger 1965; Adams 1977, 1981).

Although efforts at systematic recovery of plant remains are becoming more common in Nubian archaeology, most data comes from haphazard samples. A great many samples come from ceramic impressions and finds from graves. Unlike the sieved and floated samples from habitation sites, which can be related to routine domestic waste from behaviors such as crop-processing and dung-burning (Hillman 1984; Charles 1996; Reddy 1998; Murray 2000a, 2000b, 2000c; Fuller and Edwards 2001; Fuller 2004b), these other sources of evidence are biased in less well-understood ways. Impressions in ceramics, which make up most of the evidence from the Khartoum Mesolithic and Neolithic, represent the use of vegetable matter for tempering clay (Fuller 2013; McClatchie and Fuller 2014). As such we would expect them to be biased towards the types of materials most appropriate for tempering, such as grass straw and chaff, with the occasional incidental inclusion of grains, whole spikelets, or other seeds. The absence of taxa in ceramics may be more about preferences of potters than about presence/absence in subsistence, although when present, impressions are still significant lines of evidence (Fuller et al. 2007; Manning et al. 2011; McClatchie and Fuller 2014). The botanical inclusions are likely to be drawn from what is readily available in sufficient quantity in the season when and where the pottery was produced, and may not be a reflection of the full dietary range of plants or their relative importance. Nevertheless, ceramic impressions provide the best evidence to date for early use of wild sorghum and probable domestication processes between the 4th and 2nd millennium bce (Winchell et al. 2017; Beldados et al. 2018; Fuller and Stevens 2018; see also Stemler 1990; Beldados and Costantini 2011), discussed below. Finds from graves may also be biased for reasons of symbolism, although it is likely that staple grains have almost always taken on important symbolic qualities as “daily bread” (Toussaint-Samat 2009).

This lack of systematic settlement archaeobotany makes it difficult to assess the significance of apparent absences in the evidence. While the presence of a taxon is clear, assuming a secure context and valid identification, the absence of a taxon is not (Jones 1991). It could indicate three things: (1)

the absence of the species from the site in prehistory; (2) the masking of the evidence for the presence of the species by processes of taphonomy; or (3) the failure to recover the evidence through excavation and/or sampling methods. Given the limited and uneven sampling for some regions of Nubia and certain periods, many of our current conclusions must be regarded as tentative, with patterns in the data becoming clearer as the African archaeobotanical database expands. A particular problem is the limited evidence available for crop production during the Kerma period, and whether or not sub-Saharan crops, especially domesticated sorghum, featured in agriculture, or whether the crops were largely the winter staples cereals (wheat and barley) that dominated Egypt. In addition, the scarcity of investigations by archaeobotanical specialists with particular experience in this region mean that some identifications may not be as taxonomically resolved nor as reliable as in other world areas. Potential issues surround the identification of particular millet species, for example, and the cultivated races of sorghum, and specific identity of the grasses Setaria and Brachiaria spp. Although the flora of much of the Nubian Nile and surrounding deserts is similar to that in Egypt; the Sahel and sub-Saharan zone include many other species and it is unlikely that these are well-represented in available archaeobotanical seed reference collections. While these reservations mean that there is much work ahead, we nevertheless think that there is a sufficient quantity of data at present to justify interpretations of the history of agricultural developments in the region as a whole.

The current review updates previous assessments. For example, Fuller (2015) compiled fifty-seven sites or site phases from greater Nubia with some sort of archaeobotanical data (mostly studied through 2008), but there has been subsequent progress on several sites and assemblages. There are very few sites that have produced sufficiently robust archaeobotanical assemblages, with such examples including Qasr Ibrim (Rowley-Conwy 1989, 1991; Clapham and Rowley-Conwy 2007), medieval Soba (van der Veen and Lawrence 1991; Cartwright 1998), Napatan Kawa (Fuller 2004b), Meroitic Hamadab (under study by the authors and colleagues), and New Kingdom Amara West (Ryan et al. 2012, 2016). The majority of sites, however, have only presence/absence data from impressions in pottery and cemetery contexts. Sites with evidence are summarized in a series of maps in broad time horizons, including Early Holocene to Early Nubian (Fig. 46.1), Middle Nubian/Bronze Age (Fig. 46.2), and Late Nubian (Fig. 46.3), which correspond broadly to our chronological treatment of agricultural developments. This expands upon and updates those Egyptian sites included in the Trans-Saharan (p. 930) archaeobotanical database of Pelling (2014), and Nubian archaeobotanical record compiled in Fuller (2015). The broad contours of crop diversity in ancient Egypt remain those reviewed by Murray (2000a, 2000b), and while much larger numbers of plant finds are compiled by De Vartavan and Asensi Amoros (1997) many of those require critical re-assessment in terms of specific identifications and chronology.

Figure 46.1 Map of sites with archaeobotanical evidence, up to 3000 bce. Egyptian sites are selected and represent high-quality data. (1) Minshat Abu Omar; (2) Tell Ibrahim Awad; (3) Maadi; (4) El-Omari; (5) Farafra Oasis; (6) El-Abadiya 2; (7) Nagada South; (8) Dakhla Oasis sites; (9) Adaima; (10) Hierakonpolis; (11) Abu Ballas; (12) Afyeh; (13) Nabta (E-75-6); (14) NDRS: R12; (15) El-Kadada; (16) Ghaba; (17) Shaheinab; (18) El-Zakiab; (19) Kadero; (20) Um Direiwa; (21) El-Mahalab; (22) Sheikh el-Amin; (23) Sheikh Mustafa; (24) Khashm el-Girba (KG23); (25) Rabak.

Figure 46.2 Map of sites with archaeobotanical evidence, 3000–1000 bce. Egyptian sites are selected and represent high-quality data. (1) Kom el-Hisn 3; (2) Saqqara AKT01; (3) Saqqara AKT02; (4) Lahun;

(5) Amarna; (6) Abydos; (7) Gebel Roma/Wadi el-Hol A; (8) Tutankhamun's tomb; (9) Armant: MA 21; (10) Elephantine; (11) Toshka West; (12) Buhen; (13) Semna temples; (14) Ukma; (15) Amara West; (16) Sai: 8-B-25A; (17) Doukki Gel; (18) NDRS: P1; (19) NDRS: P37; (20) Shaqadud cave; (21) Mahal Teglinos (K1); (22) Kassala: JAG 9/SEG 1.

Figure 46.3 Map of sites with archaeobotanical evidence, 1000 bce–1000 ce. (1) Karanis; (2) Saqqara; (3) Hawara; (4) El-Hibeh; (5) Antinopolis; (6) Kom el-Nana; (7) Abu Sha'ar; (8) Mons Claudianus; (9) Quseir el-Qadim; (10) Quseir el-Qadim; (11) Phoebammon; (12) Epiphanius; (13) Kellis; (14) Karga Oasis; (15) Douch; (16) Elephantine; (17) Berenike; (18) Shenshef; (19) Wadi Qitna; (20) Qasr Ibrim; (21) Faras East; (22) Nauri; (23) El-Hamra (EH-4-008); (24) Kawa; (25) Umm Muri; (26) Dangeil; (27) Meroe; (28) Hamadab; (29) Soba; (30) Jebel Qeili; (31) Mai Hutsa; (32) Weki Duba; (33) Mai Chiot; (34) Sembel; (35) Mezber; (36) Ona Nagast; (37) Axum; (38) Jebel Tomat; (39) Abu Geili; (40) Lalibela Cave; (41) Natchabiet.

Challenges of the Nubian Environment: Water and Seasonality

The Nubian environment is on the one hand harsh, with high temperatures and little reliable rainfall, but on the other hand dependable due to the annual flooding of the Nile, which brought soil-replenishing silts as well as water. Of course Nile floods varied (p. 931) year to year, which made attention to this variation such a cornerstone of Early Egyptian state observations (see Butzer 1976). The baseline flow of the Nile comes mainly from the White Nile which only fluctuates slightly with increases in September-October, while in contrast the Atbara and Blue Nile swell massively due to summer rains over the Ethiopian highlands between July and October. Traditional agriculture in Egypt and the northern parts of Nubia had involved planting winter crops (wheat, barley, and other taxa deriving from the Middle East) on the fresh, wet silts of receding floods after October (Butzer 1976); this allows these crops to follow their natural flowering cycles that are tied to lengthening days of late winter and spring (Willcox 1992). By contrast most cereals and other annuals originating in the northern tropics are adapted to growth during summer rainy seasons, and therefore flower as day length shortens from later summer. This means that the natural flowering cycle of sorghum, millets, and other summer crops coincides with the period of Nile floods. Growing them on the floodplain would therefore expose such crops to destruction by Nile floods. While winter varieties (p. 932) of these crops are grown today, it remains unclear how long ago these varieties evolved, requiring either new mutations of flowering time genes or introgression from wild relatives in equatorial regions (e.g., southern African sorghums). Given that agriculture was not established in Africa near the Equator until perhaps around 2,000 years ago (Crowther et al. 2017), it is unlikely that such varieties would have been available to the early sorghum cultivators of Sudan or Nubia. The contrasting seasonality of cultivation, harvesting, and management of selected crops and when this is evident in Egypt and Nubia is summarized in Fig. 46.4, based on the evidence explored in this paper.

Figure 46.4 Seasonality of cultivation in Nubia, with an indication of the diversity of agricultural techniques in key periods of the cultural histories of northern (Egyptian), to left, and southern (Nubian) region, to right.

An Early Nubian Frontier: The Establishment of Levantine Agriculture on the Nile

Early farming in the Nile basin can be divided into two regimes, that of winter crops grown on receding flood water of the Nile and that of summer rainfall cultivation, with its origins in the savanna zones south of the Sahara (Fig. 46.1). While in traditional agriculture these regimes overlap, especially in Nubia and parts of Egypt as double cropping—two crops on the same land in alternating seasons—the archaeobotanical evidence indicates that double cropping was a relatively late development, becoming very important only from the Meroitic period onwards. We can therefore ask how and when these two different seasonal systems of food production came into existence and spread through the region. Nubia acted for millennia as a frontier between a winter-cropping regime of the North and the savannah regime of the South.

The establishment of agricultural production in early Egypt based on Middle Eastern domesticates is well known. The key crops of early Egyptian winter cultivation all originated as part of the Neolithic agricultural origins in western Asia, including various forms of wheat, barley, and a suite of pulses (including lentil, pea, vetches, broad bean, chickpea, and grasspea), as well as flax. Alongside these crops was the domestication of the main barnyard and pastoral livestock species—sheep, goat, taurine cattle, and pig (Fuller et al. 2011; Zeder 2017). The spread of wheat and barley agriculture as reviewed by Wetterstrom (1998) remains largely correct. Despite the widespread establishment of mixed agriculture, based on wheat, barley, pulses, flax, and livestock throughout the Fertile Crescent before 6000 bce, the evidence for cereal agriculture in Egypt does not pre-date ca. 4500 bce, represented by the finds of stored cereals from the Fayum Neolithic (Wengrow 2006; Phillips et al. 2012; Holdaway et al. 2016).

Once crop agriculture was established in Lower Egypt and the Fayum in the 5th millennium bce, this economy spread up the Nile and into Lower and Middle Nubia. In Egypt, finds of desiccated cereals in storage pits from the Fayum have been long known (Caton-Thompson and Gardner 1934) and date to ca. 4550–4350 bce based on charcoal from associated hearths (Wendrich et al. 2010), while similar-age sites of Merimde and El-Omari in the Nile delta have also produced cereals, assemblages dominated by emmer wheat and hulled barley forms, but also some einkorn, a small-grained free-threshing wheat from El-Omari (Helbaek 1956), the latter similar to the early "parvicoccum" tetraploid wheat of the southern Levant (Kislev 1979). As reviewed by Barich (2016), the Fayum Neolithic drew culturally on the established eastern Saharan Pastoral Neolithic technologies and traditions associated with early forager-pastoralists, who had been widely gathering wild savannah grasses as cereals, including wild sorghum (e.g., Wasylikowa and Dahlberg 1999, 2001; Fahmy 2014; Thanheiser et al. 2016), but in the Fayum Neolithic seasonal cultivation of newly introduced cereals substituted for collecting traditions. Barich (2016) identifies the arrival of wheat and barley with a second wave of immigrants from the Southern Levant in the 5th millennium bce, who provided training to local communities in cultivation (Barich 2016). Phillipps et al. (2012) have argued that the establishment of cereal cultivation in the Fayum, and presumably the Delta, was facilitated by a climatic shift that brought winter rainfall south from the Mediterranean around this time, inferring that flood recession agriculture, which was to characterize the Egyptian and Nubian practices for winter cropping, was a subsequent revolution connected to economic changes in the Predynastic (Naqada) period, from ca. 3800 bce. The directly dated emmer wheat and barley from Mostagedda indicates that flood recession cultivation was practiced in at least parts of middle Egypt by ca. 4200 bce, although it may not have been a strongly agricultural economy yet (Wengrow et al. 2014).

Calling into question some of these hypotheses and orthodoxies is the recent claim that wheat and barley were already present in Middle Nubia, in the Dongola Reach, by ca. 5000 bce. Recent phytolith sampling of dental calculus and samples recovered from below skeletons from Cemetery R12, in the Northern Dongola reach, produced phytoliths apparently from the husk of Triticum and/or Hordeum (Madella et al. 2014; (p. 935) Out et al. 2016). Morphometric analyses suggest the presence of both wheat and barley types (Out et al. 2016). Given the absence of wild members of the genera or closely related taxa in the native savannah flora of the region, these finds are interpreted as evidence for the presence of domesticated wheat and barley. A 14C date processed from phytoliths fell at 5300–5000 bce (Madella et al. 2014). Other nearby graves were dated to 4900–4600 bce (Out et al. 2016). These data suggest that wheat and barley might have already dispersed up the Nile valley by 5000 bce, half a millennium or more earlier than the normally accepted evidence from the Fayum and the Delta, but like the evidence from the Fayum, this need only indicate small-scale cultivation among seasonal mobile communities with a more pastoral-hunter-fisher focus.

Regardless, the Middle Eastern cereals were important from the Neolithic onwards, and were cultivated increasingly in Egypt and the northern Nubian Nile valley over the 5th and 4th millennia bce. There is clear evidence of barley and emmer wheat cultivation in the Nubian Nile valley. Subsequent to the ca. 5000 bce phytolith evidence, charred or desiccated cereal remains from Afyeh, Toshka West, Buhen, Ukma cemetery, Sai Island, imprints from Kerma, and finds in Northern Dongola Reach survey sites attest to wheat and barley from the 4th millennium through the early 2nd millennium bce (Fuller 2015). Although systematically collected evidence is so far limited, evidence for native savannah domesticates, such as sorghum, are absent. Also absent from Nubia, but present in Egypt since the Predynastic, are additional crops including flax and pulses that exhibit the diversity of the West Asian assemblages. Pulse finds are rarer than cereals, but lentil, pea, bitter vetch, and common vetch have been reported from various Egyptian sites, starting from pulse finds at El-Omari before the end of the 5th millennium bce (Wetterstrom 1993). This indicates that the introductions from the Levant went beyond just the cereals, but it is not clear whether or not the initial adoption in Egypt and in Nubia focused only on the cereals, with the pulses being adopted later. Indeed the first evidence for pulses in Nubia comes from New Kingdom Egyptian town at Amara West (Ryan et al. 2012, 2016), although this absence may be due to limited systematic sampling.

The Origins of Sorghum and the Savannah Package

In the early Holocene communities of the Sudan, which can be identified with Khartoum Mesolithic as defined by Arkell (1949), it is likely that gathered savannah grasses, including wild sorghum, were important alongside fishing and hunted game. Nevertheless, hard archaeobotanical evidence is limited, consisting primarily of just a few seed impressions in ceramics. Far more common in the Khartoum Mesolithic period are ceramics tempered with grass culm and leaf, which are unidentifiable to species, and rare impressions of husk and grain (Fuller 2013; McClatchie and Fuller 2014). (p. 936) Nevertheless wild sorghum impressions have been reported from Sheikh el-Amin and El-Mahalab on the Blue Nile (Anwar A. Magid 2003).

There is considerably more evidence of impressions of sorghum and millet grasses (Panicum, Echinochloa, Setaria, Brachiaria) in ceramics dated to the Neolithic in Central Sudan (5000–3000 bce), after the adoption of livestock. These data are suggestive of the use of gathered wild savannah grasses, as there are a range of taxa, and most sorghum impressions with preserved spikelet bases are of the wild type (Anwar A. Magid 1989, 2003; Stemler 1990; Beldados et al. 2015). Overall, the limited data from plant impressions in ceramics of the Neolithic in central Sudan shows a pattern similar to that of the charred plant remains from Nabta Playa site E-75-6: it shows a spectrum of savannah grasses of which wild sorghum is prominent and the largest grain present. The absence of domesticated sorghum has led to debate over whether cultivation without domestication might have been possible, or even whether wild sorghum might have been translocated to India in prehistory and then returned as a domesticated form by the Meroitic period (Haaland 1995, 1999). However, comparative studies of cereal domestication (e.g., Fuller et al. 2014) make this appear quite implausible.

The data now indicate that sorghum cultivation was established away from the Nile in the northern savannah zones in the 4th and 3rd millennia bce, and was probably very well entrenched by the 2nd millennium bce. A recent study of impressions on ceramics from Khashm el-Girba 23, a site of the Butana Group dating from ca. 3500–3000 bce located on a wadi tributary of the Atbara, found a mixed assemblage of morphologically domesticated and wild-type sorghum (Winchell et al. 2017). This indicates that sorghum was under cultivation and evolving to be a domesticated cereal, and cultivation must have begun by ca. 4000 bce. Another study of impressions from large fired clay fragments from Mahal Taglinos K1, a site near Kassala, dating to 1960–1760 bce, also indicates sorghum domestication was still ongoing, but further along than at Khashm el-Girba (Beldados et al. 2018; see also Manzo 2014). Site K1 also had a small amount of pearl millet (Pennisetum glaucum), a crop originating in the West African Sahel, which must have spread east by this period. The absence of evidence for sorghum from sites in the Nile valley, such as those of the Kerma tradition or the C-Group, while it could still be due to the quite limited archaeobotanical data, is likely to indicate a segregation between the subsistence traditions of the Nile valley (based on post-flood planting) and those of the savannah (based on summer rainfall).

Diversification, Fruit Crops, and Specialization

One of the recurrent hallmarks of complex societies and urbanization is evidence for agricultural diversification, including the cultivation of long-lived perennials and commodity crops. In the context of greater Mesopotamia, Sherratt (1999) outlined how this (p. 937) “secondary products revolution” for plants involved the establishment of grape vine cultivation and olive groves from which processed fruits or their products (wine, oil) could be turned into commodities for long-distance trade. In terms of agricultural landscapes this has two key implications. The first is temporality of investment, as newly planted grapes or olives are unlikely to produce much fruit for a few years and only reach maximal yields after a decade, and this represents a much longer-term investment in land management than a four- to six-month cereal crop (see also Abbo et al. 2015). The second is that the land and the labor invested in cultivating these species does not directly translate into staples for the household to consume or store, the way staple grain production does, but actually takes land and labor away from caloric production. Labor must also be invested in processing facilities (like olive presses or wine presses). Nevertheless, the aspect of diversification of land use, including tree fruits, a potentially wider range of garden crops (such as melons and vegetables), and diversification of staple grains (including into more cropping seasons), is evident. The investment in many of these new crops may also lead to specialization in the production of commodity crops, especially on the most suitable land, as their trade values will normally compensate for reduced staple crop production.

In dynastic Egypt it is well known that fruit and vegetable gardens, as well as long-lived perennials, were grown. Murray (2000b) provides a broad overview of the taxa known from archaeology, while several works from Loret (1892) to Brewer et al. (1994) explore species through the textual and art historical evidence. The exceptional preservation at the workmen's village at Amarna provides an impressive snapshot of the array of fruits, vegetables, and garden herbs and spices grown routinely during the 18th Dynasty (Stevens and Clapham 2014). Current evidence from Nubia fails to find much of that diversity, and future sampling work is necessary to establish whether that is absence of evidence due to preservation on Nubian sites or reflects a true lower diversity of cultivars in Nubia as opposed to Egypt. Nevertheless in Late Meroitic times and later (from ca. 1st century ce) a wide range of vegetables and herbs/spices have been found at Qasr Ibrim (Clapham and Rowley-Conwy 2007), although this still falls short of the diversity from Amarna. In part the diversity in New Kingdom Egyptian gardens was facilitated by expanded gardening techniques, chief among them being the water-lifting device the shaduf (Eyre 1994), which had its earliest use in the Sargonic period of Mesopotamia (ca. 2300 ce; Mays 2008).

Diversification in the crop package of Nubia during the Bronze Age may not have been possible without the introduction of shaduf irrigation, adopted perhaps through New Kingdom Egyptian influence. Although labor-intensive, the shaduf provided an improvement to manual watering (Eyre 1994) and enabled the cultivation of water-thirsty and labor-intensive fruit crops such as date (Phoenix dactylifera), melon (Cucumis melo), and watermelon (Citrullus lanatus). Evidence of these fruits comes from the temples of Middle Kingdom Semna (van Zeist 1983). Melon (Cucumis melo) is likely a local Predynastic garden domesticate (e.g., Van Zeist and De Roller 1993), quite distinct from inferred domestication processes in China (see Fuller 2012). Watermelon was adopted by the Middle Kingdom from possible Saharan origins. Fig also came to be (p. 938) cultivated, and recent studies at New Kingdom Amara West have demonstrated the presence of sycamore fig (Ficus sycamorus), which was widely grown in ancient Egypt (Ryan et al. 2012, 2016).

The occurrence of date palm is of interest and raises the question of whether this species was native to Nubia, and when it came to be heavily managed or cultivated for its fruit. In addition to fruits at Semna, date palm presence is further indicated by wood charcoal finds from Kerma period graves (NDRS:P1 and NDRS:P37) (Cartwright 2001). It has long been inferred that the date was brought into cultivation in eastern Arabia by ca. 4000 bce (Tengberg 2012; Weiss 2015). Recent genetic studies, however, suggest deep divergence in the genomes of date palms from the central to western Sahara and North Africa from those of the Middle East, making the date palms of Nubia and Egypt a zone of hybridization between two divergent ancient date palm gene pools (Hazzouri et al. 2015). This could suggest that some wild Saharan dates were already in the wadi systems and oases when cultivated forms were introduced from Arabia. Older assessments suggest introduction into Egypt during the Middle Kingdom (Murray 2000b). It was certainly a major consumed fruit in the New Kingdom (Clapham and Stevens 2009). In Nubia, it may be that date palm remained only a minor fruit until the New Kingdom, when plantations for fruit production were well-established under Egyptian control and facilitated by new irrigation technology. Artistic evidence suggests that date palms were managed on Nubian plantations together with doum palms (Hyphaene thebaica) and other trees (Fig. 46.5); the doum palm, like the date, was a potential source of sugar/sweetener. Dates may have also been processed for sugar via boiling, which can be inferred directly from lipid analysis of Post-Meroitic cooking sherds from Qasr Ibrim (Copley et al. 2001). Such date sugar could have in turn been fermented as an alternative to grape wine or beers.

Figure 46.5 Depiction of New Kingdom Nubian plantation with harvesting of doum palms and dates (top) and other trees, including possible carob (Ceratonia silique) (below), from tomb of Nubian prince Djehutyhotep at Debeira (19th Dynasty) (after Säve-Söderbergh 1960).

Symbolic significance came to be attached to the date palm, represented by its pinnate leaf. This was to prove a long-lasting sacred motif, best known from much later Meroitic period temple reliefs and funerary offering tables in the early centuries ce (Žabkar 1975:111–12; for a complete Meroitic date palm relief on an offering table, see Woolley and Randall-MacIver 1910: pl. 20:7108). In the Meroitic period, and continuing into the limited corpus of Post-Meroitic art through the 5th century ce, palm fronds are carried by those depicted adoring gods, by royalty, and sometimes by deities themselves, and, in some cases, a palm frond staff is surmounted by an ankh. The palm frond is also a recurrent motif on painted Meroitic pottery (e.g., Adams 1986; Williams 1991a: fig. 195c). The earliest occurrence of this was mica inlays from Kerma (Reisner 1923:273, pls. 57, 60; Žabkar 1975:112). It seems likely, therefore, that at least some consumption of dates began by the Kerma period, but the large-scale production of fruits as an exportable commodity had to wait until the innovations at the end of the Kerma period or during the New Kingdom.

Grapes and the production of wine had been part of Egyptian agricultural traditions since the Predynastic, and imported Egyptian wines were long valued in Nubia. Rich A-Group graves in Lower Nubia from the middle and late 4th millennium bce included imported Egyptian jars that might have carried wine (Williams 1986), and Egyptian wines would remain a recurrent import, notable also in Meroitic and Post-Meroitic (p. 939) ceramic assemblages. Cultivated grape originated in the greater Fertile Crescent, perhaps in its northern part, but it seems to have been cultivated by the end of the Chalcolithic or the Earliest Bronze Age in the Levant, ca. 5000 bce (Weiss 2015). It would have been introduced to Egypt then not long after wheat and barley during the Late Neolithic or earlier Predynastic (Murray 2000c).

In Nubia, grape cultivation was perhaps rare; however there is archaeobotanical evidence that suggests various efforts to grow grapes locally. Among the many inscriptions of the Nubian pharaoh Taharqo (690–664 bce) is an inscription in the Amun Temple at Kawa in which he boasts about the wine produced there (Macadam 1955:36). The (p. 940) recovery of charred grape pips among archaeobotanical samples seems to confirm the textual record (Fuller 2004b), although it is unclear how much wine was produced or how long this tradition lasted. Also in Taharqo's reign, inscriptions from Sanam indicate that grapes and dates, alongside cereal foods, were among the donations to the temple (Pope 2013:480). Later in the Late Meroitic period (3rd–4th century ce), wine production appears to have been taken up in parts of Lower Nubia, as inferred from several sites with Roman-inspired wine presses (Adams 1966) and evidence for local wood charcoal of grape at Arminna West (Fuller 1999). This Lower Nubian experiment in viticulture was facilitated by an innovation in irrigation, namely the cattle-powered water well, or saqia, which seems to have come into Nubia around the 3rd century ce (Williams 1991b; Fuller 1999, 2014; Edwards 2004), and was a key component in the re-organization of agricultural systems in the Post-Meroitic period (see below). Nevertheless grape vines were a favorite decorative motif in Meroitic art on painted pottery (Fig. 46.6), which suggests familiarity of the artists with grape vines; so perhaps they were widespread in small-scale production, such as household garden vines.

Figure 46.6 Example of grapes on Meroitic painted pottery from Karanog: vine leaves (left) and grape clusters (right) (after Woolley and Randall-MacIver 1910).

Agricultural Innovations of the Meroitic Kingdom and the Post-Meroitic Re-organization

The agricultural basis of the Napatan period, such as that represented by Kawa (Fuller 2004a), remains largely the same as that known from the Middle Kingdom and New Kingdom Egyptian occupations in Nubia (van Zeist 1983, 1987; Cartwright 2001; (p. 941) Ryan et al. 2012, 2016). The focus was on winter cereals (emmer wheat, barley) and associated pulses (lentil, pea, grasspea), but including clear evidence of broad bean, Vicia faba, which had become established in Egypt in the Middle Kingdom (Murray 2000a), and flax which was cultivated since the Predynastic (Cappers et al. 2004; Newton 2004). Nevertheless some summer crops were present, including Panicum miliaceum, so-called common millet or broomcorn millet, of ultimate Chinese origin (van Zeist 1987; Boivin and Fuller 2009), and a foxtail millet, but apparently not the Chinese Setaria italica, which is found in Nubia and Egypt today, but a lost indigenous foxtail millet, Setaria sphaceleata. These summer cereals were minor components in the studied samples from Kawa (Fuller 2004a). It is highly probable that some sorghum was present as well, since this was clearly domesticated and cultivated in the Sahelian areas to the south, for example around Kassala (see above). These summer savanna crops are likely to have been catch crops, cultivated on distal parts of the floodplain and lower wadi, where sufficient soil moisture was provided by the maximum flood levels without destroying the crops that had remained through the low Nile season, but which were situated high enough as to not be completely destroyed by flooding. The challenge of these species is that their season for sowing corresponds with the Nile flood period, and high floods could kill these crops through waterlogging. It is possible that a few were grown beyond the flood water with artificial irrigation, but the labor requirements of the shaduf are likely to have restricted its use for higher-value crops, such as fruit trees, vines, and melons.

In reality, millets and sorghum are likely to have been more important further south. As highlighted by Pope (2013), the Sahelian grassland zone is likely to have extended further north than present, including much of the Bayuda Desert during the Napatan period. As such, Sanam and Jebel Barkal would have been at or near the intersection between the northern savannah agricultural traditions and the Nile floodwater farming traditions. The Napatan center would have held together a kingdom split across two very different ecologies and culinary traditions (see below). Kawa, located further north, can be expected to represent predominantly the floodwater tradition.

The Meroitic period expansion of settlement further south and east through the Butana implicates a role for sorghum, both economically and symbolically (Fuller 2014, 2015). With the shift of the capital, reflected in the royal burial ground, from Napata (Nuri) to Meroe beginning in the 4th century bce, there is evidence for the cultivation of savannah crops with summer seasonality on an appreciable scale. Sorghum features in Meroitic art (Fig. 46.7) and has been recovered in archaeobotanical assemblages from Meroe, nearby Hamadab, and during the Wellcome expedition to Abu Geili on the Blue Nile, along the White Nile at Jebel Tomat, as well as in the Fourth Cataract

(Fuller 2014). Other millets would have complemented sorghum, such as Setaria and pearl millet (Pennisetum glaucum), both of which are also in samples from Meroitic Hamadab (authors' ongoing analysis). Sorghum and pearl millet both occur at Qasr Ibrim from the later Meroitic period onwards and attest to the increasing importance of summer cereal cultivation in northern Nubia (Clapham and Rowley-Conwy 2007). This savannah cultivation system also suited oasis situations. During Roman rule of Egypt, sorghum and pearl millet appear in oasis agriculture, for example at Dahkleh (Thanheiser 2011; Thanheiser et al. 2016).

Figure 46.7 Examples of Meroitic evidence for advanced, dense-ear sorghum cultivation (probably race durra). (A) Jebel Qeili rock carving of King Shorkaror receiving sorghum from Sun god (after Hintze 1959); (B) Meroitic spindle whorl from Abu Geili with incised sorghum panicle motif (after Yvanez 2016); (C) Scene from the Lion Temple at Naqa, showing god Apedemak greeting King Natakamani, who holds an apparent dense sorghum panicle in his right hand (after Žabkar 1975); (D) Scanning electron micrograph of sorghum grain from Meroitic Hamadab that suggests plump grain of a race durra like sorghum (by authors).

Another crop of the savannah zone, liking high temperatures but requiring reliable water, was cotton. Cotton textiles apparently made locally in Nubia have long been known (e.g., Griffith and Crowfoot 1934; Mayer-Thurman and Williams 1979; Yvanez 2016). The technology for spinning and weaving is also widespread in the Meroitic world (Yvanez 2016). Recently archaeobotanical sampling at Hamadab has produced evidence for charred cotton seeds, suggesting local cultivation and on-site spinning (authors' analysis). Like the savannah millet crops, cotton is also found at Qasr Ibrim from the Late Meroitic period, and in cultivation in the Roman Egyptian oases (Clapham and Rowley-Conwy 2009). Cotton cultivation continued throughout the occupation of Qasr Ibrim, and ancient DNA analysis has confirmed the presence of the indigenous African Gossypium herbaceum (Palmer et al. 2012). This raises the possibility that African cotton was first cultivated somewhere in or near the southern parts of the Meroitic world. There is also some likelihood that tree cotton (Gossypium arboreum), which had been grown in India and Pakistan since the Neolithic (Fuller 2015) was also introduced to parts of the Nubian region at this time. It should be noted that both of these cottons were originally perennials grown as shrubs or trees over several years, and the modern annual cotton crops one encounters in Sudan today are of New World origin and colonial introductions. Managing these early cottons would have been akin to dealing with grapevines, figs, or even date palms in terms of land management.

As already noted, the introduction of the cattle-powered saqia (Persian waterwheel) during the 3rd century ce was an important development. This system would have facilitated the expansion of both cultivation systems, the Middle Eastern winter staples and the sub-Saharan summer staples. In the winter paleo-alluvium no longer reached by Nile floods could be cultivated, while the drying valley edges left behind by receding floods could be readily irrigated. It would have been an area safe from waterlogging but irrigable and would have been ideally suited to the expansion of cotton crops. The saqia then would have facilitated cash crop production of cotton, trees, and vines as well as extending caloric staple production. More staple crop production, over two seasons of agriculture, in turn would have demanded more agricultural labor. This availability of new land and draw for labor would have been factors promoting immigration and new settlers in Lower Nubia and plausibly increased birthrates (Fuller 2015). Increased population together with increased arable potential would have laid the basis for the reliable staple surpluses on which diversification into more commodity crops and perennials would have been built, and it is in this context that the innovation of the Late Meroitic to Early Post-Meroitic both laid the economic foundation for the emergence of states in Northern Nubia. Meanwhile, expansion into cash crops, perhaps especially cotton, would have facilitated long-distance trade that in turn supplied many of the luxuries that elites demanded (Fuller 2014, 2015).

This agricultural innovation in irrigation together with the diverse range of staple and commodity crops would have created positive feedbacks for agricultural change and population growth. And while these innovations might have initially promoted various forms of economic growth within the Meroitic world they can also be seen as creating the foundations for regional states, like Nobadia and Makuria, that could break away from Meroitic hegemony (Fuller 2014, 2015).

The Shifting Frontier of Bread and Porridge Traditions

In addition to representing a long-term frontier where winter cereals overlapped with savannah crops like sorghum, Nubia was also a long-term frontier in cooking traditions, between a world of bread in the north and one of liquid preparations, porridges, and beers in the South. Nubia represents a porridge and beer tradition since the Neolithic distinct from the Neolithic and Bronze Age baking world that included the Egyptian bread world, as explored by Edwards (2003), Haaland (2007), and Pope (2013). On a broader geographical scale the Fertile Crescent, with its basis in pre-ceramic farming, was a zone in which bread developed early, in contrast to pre-agricultural ceramic zones with boiling-based cooking traditions, like those of the Early Holocene Sahara or Neolithic eastern Asia (Fuller and Rowlands 2011). With the rise of urbanism in (p. 944) Mesopotamia, ceramics were also deployed as bread molds, such as the bevel-rimmed bowl, regarded as a form of bread-making that spread as far east as Pakistan (Chazan and Lehner 1990; Potts 2009). In Egypt both domed ovens for baking breads (tabun or firin) and ceramic bread molds were established since Predynastic times (the Naqada period), such as the oven remains reported from Hierakonpolis, ca. 4000–3500 bce (Hoffman 1980). In Egypt, since Predynastic times (4th millennium bce) breads were baked in ceramic molds (Samuel 1989, 1999; Rampersad 2008). From the Naqada period ovens were also made. Ovens are found as far south as Elephantine during the 2nd Dynasty (ca. 2800 bce) (Ziermann 2003). Samuel's (1989, 1999) review of the artistic evidence, mainly from Egyptian tombs, indicates that tannurs (specialized cylindrical bread-making ovens) are represented starting in the New Kingdom (from ca. 1600 bce). Ovens at Kerma during the Classic period can be attributed to Egyptian influence, with tannur excavated at the New Kingdom Egyptian enclave of Amara West, ca. 1200–1100 bce (Spencer et al. 2014). Subsequently tannurs were found at Kawa in the 7th century bce (Welsby 2014).

Under the influence of pharaonic religion, represented by Amun temples, apparent mold-made breads like those of Egypt feature in Meroitic temple depictions and funerary offering scenes (Shinnie 1967). Haaland (2014) infers that bread of wheat/barley would have been consumed by elites while "the ordinary people relied on African cuisine based on millet porridge" (Haaland 2014:657). Certainly, bread ovens as well as ceramic bread molds and associated box ovens are known from some sites, such as a Middle Kingdom Mirgissa, an Egyptian army fortress, and the temple complex at Dokki-Gel (Kerma) dating from the 1st millennium bce (Maillot 2016). At the Late Meroitic "castle" at Karanog (ca. 50–250 ce), a presumed residence of a lower Nubian governor, a large tannur was preserved in the central courtyard (Woolley 1911:23), supporting the idea that some Nubian elites partook in baked breads. The presence of ceramic bread molds, however, may be misleading. These were found in quantity in excavations at the Dangeil Amun Temple in Upper

Nubia (Anderson and Ahmed 2006), but archaeobotanical analysis of preserved encrustations found that they contained a sorghum (Sorghum bicolor) product, better characterized as a stiff porridge rather than a bread (Anderson et al. 2007; Maillot 2016). This highlights that the symbolic importance of a shaped bread loaf had been adapted to the culinary traditions associated with savannah agriculture of the Meroitic heartland.

These distinct culinary traditions are reflected in both material culture of cooking and concepts of appetite and food reflected in inscriptional evidence. The differing cooking traditions are preserved in the distinct vessel repertoires in Egypt and Nubia, and in the context of Egyptian enclaves in Nubia in the Middle and New Kingdoms Smith (2003) has used these distinctions to explore ethnic identities in mixed communities and to infer intermarriage of Egyptians with Nubian women. Pope (2013) has suggested how in the Napatan inscriptions of Taharqo from Sanam, a food stuff called "iwesh," apparently a mixed viscous cereal product brought in necked globular jars, featured prominently, alongside breads, grapes, and dates. He argues that this represents a distinctive "porridge-and-pot culture" foodstuff from the Sahelian/Sudanic tradition. (p. 945) Pope (2013) has also identified in Egyptian Demotic literature the term "eater of iwesh" (or variants) as an epithet applied to Nubians (the eaters of sticky or gummy foods). The key culinary division thus appears to have been recognized among ancient Egyptians and Nubians themselves in the 1st millennium bce.

The importance of sorghum in the Meroitic heartland has been argued to be connected to beer, and based on ethnographic parallels the large jars so common in Meroitic graves have been interpreted as beer jars (Edwards 2003, 2004). Such jars, although differing in form and size, continued to be a prominent part of Post-Meroitic burial rituals indicating that despite many aspects of cultural change at the decline of the Meroitic state in the 4th century ce, the importance of beer made of sorghum was a tradition that cut across many cultural groups in Nubia and Central Sudan, and which presumably had its roots in the later Neolithic of the Butana and surrounding areas.

Edwards (2003) further suggests that bread rose to prominence with the Christianization of Nubia from the 6th century ce. Among the new cooking ceramics that began in this period is the flat, griddle-like doka. However, rather than deriving from northern Egyptian cooking traditions, this can more plausibly be connected to the griddle traditions of the Ethiopian highlands, where fermented batters are turned into pancakes on griddles (metad), particularly Ethiopian enjera bread, made from a variety of flours (sorghum, wheat, indigenous tef) (Lyons and D'Andrea 2003). This cooking tradition presumably spread westwards through the savannah and sahel zone, giving rise to the kissra bread of Sudan. It is possible that a similar tradition had also developed in or spread to southwest Libyan, where similar ceramics are found from the Garamantian era, 1st century bce/ce (Mattingly et al. 2001; Pelling 2007). While the history of cuisine may have been additive, diversifying with new food crops and new methods of preparation, it can also suggest that bread, in various forms, through the course of Nubian history, increasingly displaced the centrality of the Neolithic savannah porridge traditions.

Concluding Remarks

Regardless of the gaps in archaeobotanical evidence and the bias towards cemetery contexts, a review of the plant data from greater Nubia tells a story of overlapping agricultural systems and cooking traditions through both time and space. Further, this chapter demonstrates the impact of systematic sieving and flotation programs on our understanding of agricultural regimes and their contributions to changing cultural developments. With expanding datasets from secure settlement contexts and improvements in taxa identifications, the initial establishment of winter cereal cultivation systems from the North (of Middle Eastern origin) is increasingly well-established, with the summer cereal cultivation systems from the South (sub-Saharan origin) becoming clearer. Subsequent diversification and intensification through an integration of these two systems coupled with improvements in irrigation technologies and the introduction of (p. 946) cash crops facilitated the development of the Meroitic state. Alongside these developments were changes in cooking traditions as a result of intersecting worlds, one of bread and baking and the other of liquids and boiling. Nubia was thus a dynamic frontier between traditions of food preparation and agricultural systems that drew from both the indigenous Sub-Saharan and Mediterranean worlds.

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Figure Captions

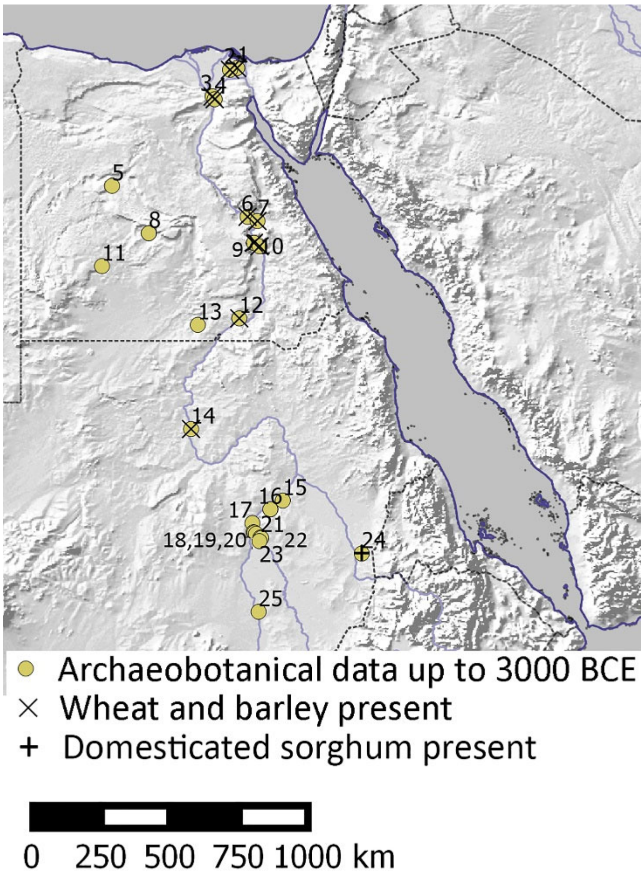

Fig. 1. Map of sites with archaeobotanical evidence, upto 3000 BC. Egyptian sites are selected and represent high quality data. Sites listed include: 1) Minshat Abu Omar; 2) Tell Ibrahim Awad; 3) Maadi; 4) El Omari; 5) Farafra Oasis; 6) El-Abadiya 2; 7) Nagada South; 8) Dakhleh Oasis sites; 9) Adaima; 10) Hierokonpolis; 11) Abu Ballas; 12) Afyeh; 13) Nabta (E-75-6); 14) NDRS: R12; 15) El Kadada; 16) Ghaba; 17) Shaheinab; 18) El Zakiab; 19) Kadero; 20) Um Direiwa; 21) El Mahalab; 22) Sheikh el-Amin; 23) Sheikh Mustafa; 24) Khashm el Girba (KG23); 25) Rabak.

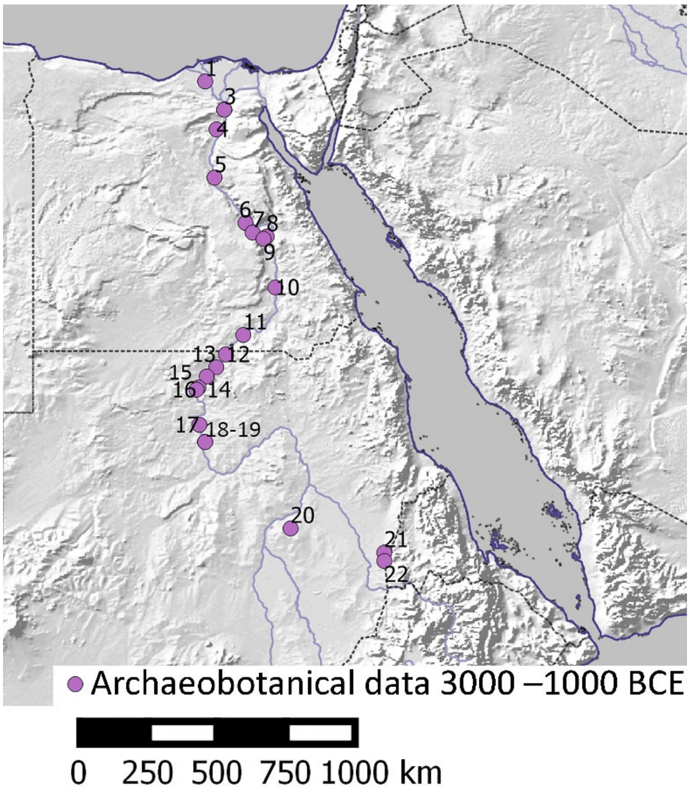

Fig 2. Map of sites with archaeobotanical evidence, 3000-1000 BC. Map of sites with archaeobotanical evidence, upto 3000 BC. Egyptian sites are selected and represent high quality data. Sites listed include: 1) Kom el-Hisn 3; 2) Saqqara AKT01; 3) Saqqara AKT02; 4) Lahun; 5) Amarna; 6) Abydos; 7) Jebel Roma/ Wadi el-Hol A; 8) Tutanhkamun's tomb; 9) Armant: MA 21; 10) Elephantine; 11) Toshka West; 12) Buhen; 13) Semna temples; 14) Ukma; 15) Amara West; 16) Sai: 8-B-25A; 17) Doukki Gel; 18) NDRS: P1; 19) NDRS: P37; 20) Shaqadud cave; 21) Mahal Teglinos (K1); 22) Kasala: JAG 9/SEG 1.

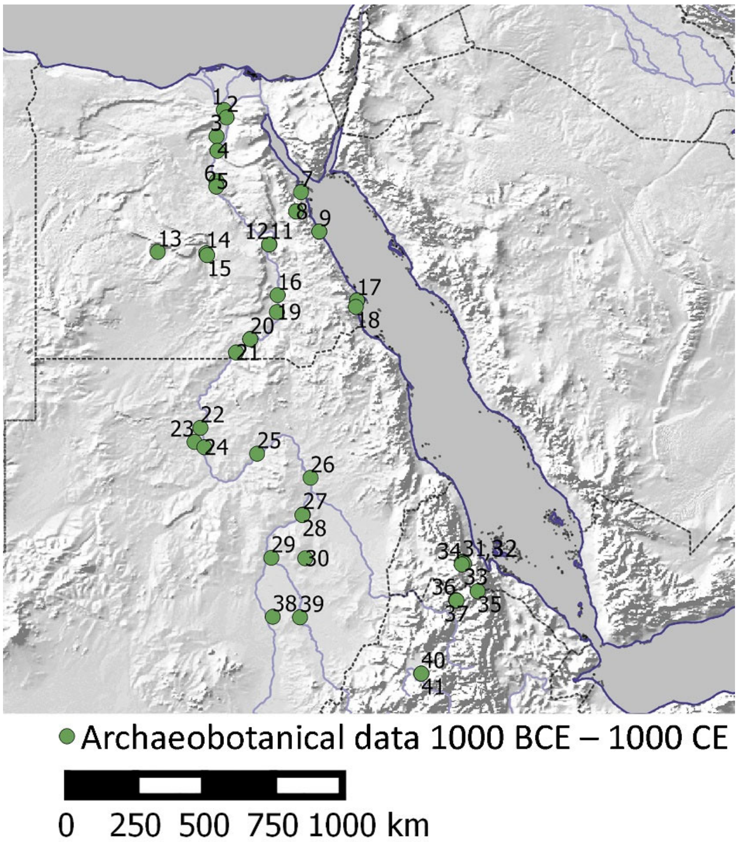

Fig. 3. Map of sites with archaeobotanical evidence, 1000 BC-AD 1000. Map of sites with archaeobotanical evidence, upto 3000 BC. Sites listed include: 1) Karanis; 2) Saqqara; 3) Hawara; 4) el-Hibeh; 5) Antinopolis; 6) Kom el-Nana; 7) Abu Sha'ar; 8) Mons Claudianus; 9) Quseir al-Qadim; 10) Quseir al-Qadim; 11) Phoebammon; 12) Epiphanius; 13) Kellis; 14) Karga Oasis; 15) Douch; 16) Elephantine; 17) Berenike; 18) Shenshef; 19) Wadi Qitna; 20) Qasr Ibrim; 21) Faras East; 22) Nauri; 23) EL Hamra (EH-4-008); 24) Kawa; 25) Umm Muri; 26) Dangeil; 27) Meroe; 28) Hamadab; 29) Soba; 30) Jebel Qeili; 31) Mai Hutsa; 32) Weki Duba; 33) Mai Chiot; 34) Sembel; 35) Mezber; 36) Ona Nagast; 37) Axum; 38) Jebel Tomat; 39) Abu Geili; 40) Lalibela Cave; 41) Natchabiet.

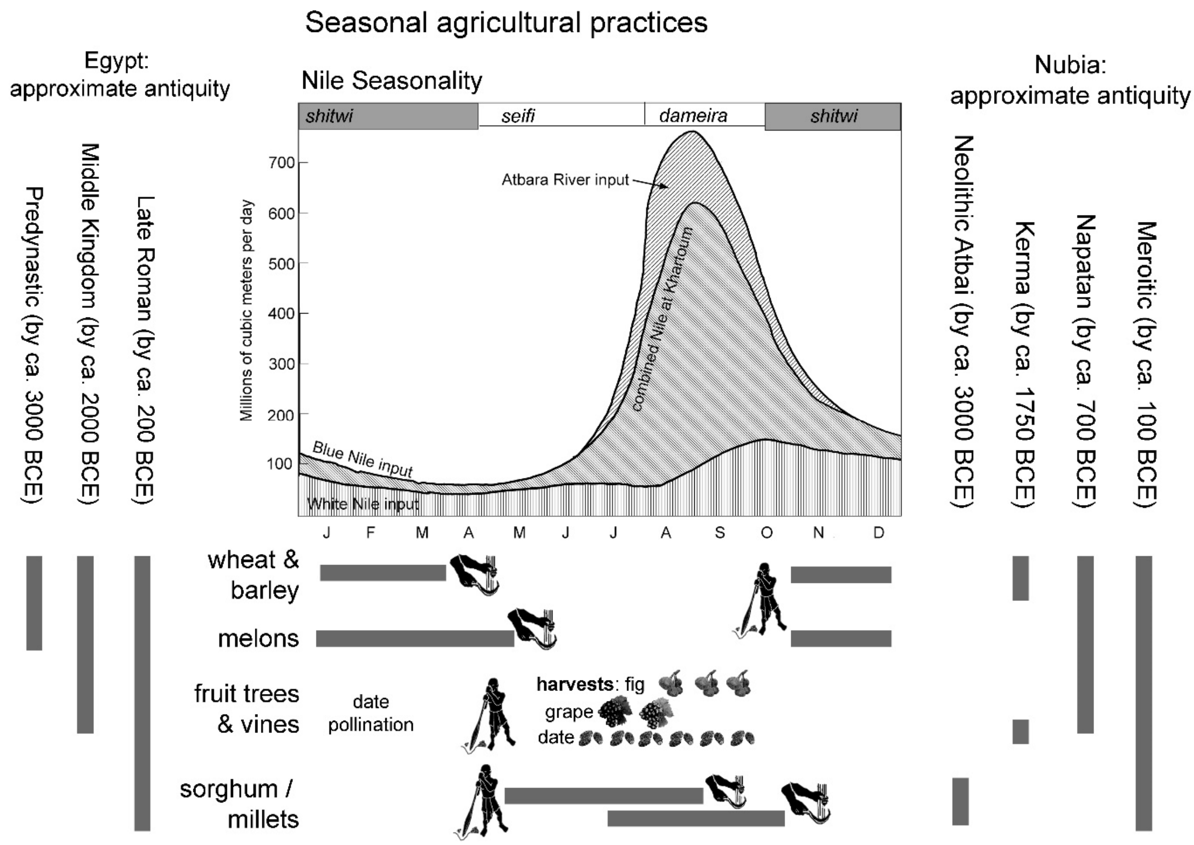

Fig. 4 Seasonality of cultivation in Nubia, with an indication of the diversity of agricultural techniques in key periods of the cultural histories of northern (Egyptian) versus, to left, and southern, to right.

Fig 5. Depiction of New Kingdom Nubian plantation with harvesting of doum palms and dates (top) and other trees, including possible carob (*Ceratonia silique*) (below), tomb of Nubian prince Djuteyhetep from Debeira (19th dynasty) (after Save-Soderbergh 1960).

Fig. 6. Example of grapes on Meroitic painted pottery from Karanog: vine leaves (left) and grape clusters (right) (after Woolley and MacIver 1910).

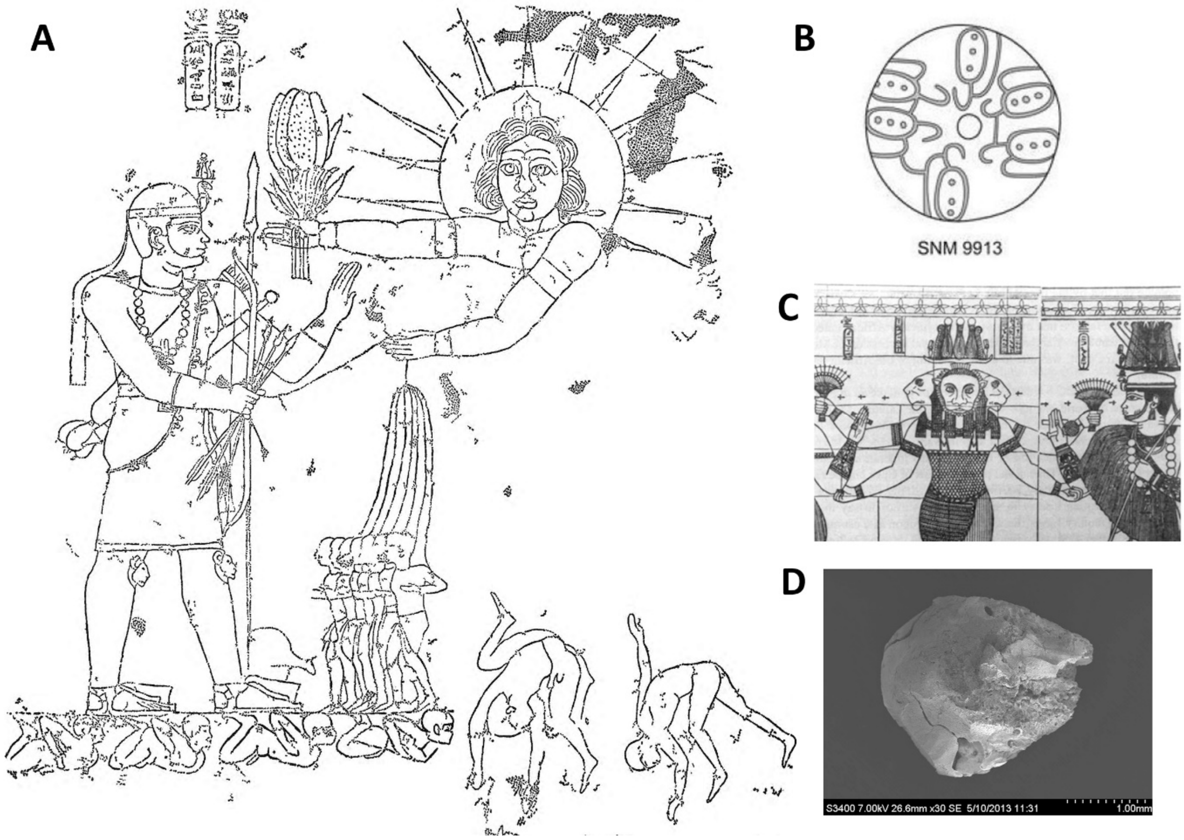

Fig. 7. Examples of Meroitic evidence for advanced, dense-ear sorghum cultivation (probably race durra): A. Jebel Qeili rock carving of King Shorakaror receiving sorghum from sun god (after Hintze 1959); B. Meroitic spindle whorl from Abu Geili with incised sorghum panicle motif (after Yvanez

2016); C. Scene from the Lion Temple at Naqa, showing God Apedemak greeting King Natakamani, who hold an apparent dense sorghum panicle in his right hand (after Zabkar 1975); D. Scanning electron micrograph of sorghum grain from Meroitic Hamadab that suggests plump grain of a race durra like sorghum (by authors).