

2 From raw resources to food processing

Archaeobotanical and ethnographic insights from New Kingdom Amara West and present-day Ernetta Island in Northern Sudan

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Introduction

Archaeobotanical evidence from Amara West is being studied to investigate diet and agriculture in a New Kingdom colonial town (Fig. 2.1). The archaeobotanical record for food from settlement sites most commonly provides evidence for the raw resources and stages of preparation, by-products and waste as opposed to finished foodstuffs. An ethnobotanical study of agriculture and diet in Nubian villages, and especially on Ernetta Island nearby Amara West, is providing insight into crop cultivation, processing and food preparation in a Nile island environment (Fig. 2.2).

New Kingdom Nubia and Amara West

Amara West was originally founded on a Nile island, although a secondary channel north of the island began to dry out during the second millennium BC (Spencer et al. 2012). Islands are important today and in the past in Nubia because the Nile banks are generally higher with fewer areas of floodplain and flood basins than in Egypt (Welsby 1996). There are also fewer islands in Egypt compared with the middle Nile valley. There have been archaeological projects on several islands in Sudan; however, there have been few studies concerning Nile island archaeobotany (Sai Island, Hildebrand 2007; Umm Muri, fourth Nile cataract, Fuller 2004).

Upper Nubia was conquered by Egypt in the New Kingdom (1500–1070 BC), with colonial settlements founded as far upstream as Kerma-Dokki Gel and a ceremonial centre at Gebel Barkal by the Fourth Cataract. Under Thutmose I and III, Egyptian armies penetrated further upstream, leaving inscriptions at Kurgus. Originally located on an island between the Dal and Third Cataracts, Amara West was founded as the new administrative centre of Upper Nubia from around 1300 BC for the final two centuries of New Kingdom occupation (Spencer 2014; 2015).

Amara West was originally excavated in the late 1930s and 1940s by the Egypt Exploration Society (Spencer P. 1997; 2002) and fieldwork was



Figure 2.1 Map showing the location of Ernetta Island (modern) and New Kingdom towns in northern Sudan including Amara West

renewed in 2008 by the British Museum, with a focus on residential quarters and two associated cemeteries (www.britishmuseum.org/AmaraWest). Whilst Amara West was established as a pharaonic town, there is also evidence for Nubian cultural elements. Most architecture is typically Egyptian in style, such as the temple, storage magazines and residential areas, but an oval building (E12.11) of unclear purpose echoes indigenous Nubian architectural traditions (Spencer 2010). Artefact assemblages recovered from houses are broadly consistent with those found within contemporary settlements in Egypt, although aspects of Nubian culture are present, more



Figure 2.2 The walled town at Amara West, with Ernetta Island on the horizon (Photograph by Susie Green: copyright, P. Ryan, N. Spencer & S. Green).

markedly in the cemetery (Spencer 2015). Notably, although most pottery was of Egyptian style, handmade basket-impressed Nubian cooking pots are one of the most commonly found types of vessel and the proportion of Nubian pottery increases in the later phases of occupation (Garnett pers. comm. 2015; Spataro et al. 2014).

Ernetta Island, Nubian agriculture today and comparisons with Amara West

While immigration, cultural and religious change have obviously considerably transformed societies in northern Sudan over the last 3000 years, many ‘traditional’ agricultural practices still persist today or until relatively recently. Interviews with farmers about flood irrigation and agriculture – particularly before the Merowe Dam construction (operational since 2009) and the uptake of irrigation pumps (1950s–70s) – are throwing light on land use, cultivation and crop choices in an island context (Ryan 2015).

A key reason for a comparison between Amara West and villages on Ernetta Island is because of their shared island status, and this paper explores which sorts of potential insights might be possible to learn from present-day farmers about cultivation in an island context. Although many of the more ‘traditional’ crops grown today (or until recently) in Sudan were introduced later than the pharaonic period, there are nevertheless several crops relevant to both these timeframes.

Ethnographic data discussed in this paper is part of a broader project ‘Subsistence and sustainability in a changing Sudan’ which explores how comparisons of present-day and ancient crop choices can inform on risk management within agricultural strategies of small-scale riparian Nile village settlements (Ryan 2015). Nubian agricultural practices are rapidly changing due to infrastructure development, technological and environmental changes. The project has included interviewing Nubian farmers to investigate the characteristics of customary agriculture and in what ways these have been impacted by new farming methods, population movements, dam and road-building – as well as changing patterns of imports and trade. Some practices have remained relatively traditional till very recently, particularly on car- and electricity- free Ernetta Island. For instance, harvesting is still done by hand, and a threshing machine was only introduced to the island in the mid-2000s.

The intention in this paper is to draw on evidence from the contemporary study of farming on Ernetta Island which may specifically contribute to our understanding of pharaonic agriculture. As such, only data from the ethnographic study potentially pertinent to the pharaonic timeframe are drawn on here – for example, concerning crops used today as well as the pharaonic period or potentially similar technologies, such as the *shaduf* for irrigation.

Sources of information on ancient Egyptian plant foods and agriculture

Information about ancient Egyptian agriculture and food is available from a range of sources. Artistic scenes in New Kingdom tombs include depictions of typical agricultural practices as well as food offerings such as fruits and bread (Murray 2000; 2000a; Robins 1997, p. 185). The tomb of Menna (TT69), for example, shows the sequence of crop husbandry stages including cereal sowing, harvesting, threshing with animals and winnowing. Although detailed, images or models are created in an idealized form for funerary purposes (Robins 1997, 20). It is possible that not all small-scale methods of crop processing are depicted in such stylized scenes (Murray 2000). Some plant identifications are not clear in these sorts of illustrations, for example it is not possible to distinguish between wheat and barley. Artistic and textual evidence also provide detailed information about the state organization of agriculture (Kemp 1989, 324). One of the Nebamun paintings at the British Museum, for example, shows a farmer checking a boundary stone near a cereal field and officials checking crops (BM EA 37982). Textual evidence from Egypt provides detailed evidence about, for example, yields and the central role of cereals in taxes and wages, as well as sometimes differentiating between wheat and barley (Murray 2000).

A wide range of food offerings have been recovered from tombs where exceptional preservation conditions have halted decay (Hepper 1990, 50). Archaeobotanical remains from tombs, such as fruits, seeds, cereal grains and spices allow very precise identification of plant taxa (Murray 2000a).

There are also many examples of bread and possible beer mash from tombs in Egypt (Cartwright and Taylor 2015; Samuel 2001), including several examples at the British Museum (e.g. BM EA 35976; BM EA 5391). However, it is possible that dietary evidence from funereal paintings and offerings may not be typical of daily life or representative of the non-elite (Cartwright and Taylor 2015; Murray 2000; Robins 1997, 18). Similarly, textual evidence may also be biased towards official classes (Kemp 1994; Robins 1997, 18). Archaeobotanical information from settlements can investigate the dietary practices of households of varying social status as well as differences amongst settlements and regions, and such considerations are especially pertinent to colonial towns such as Amara West.

In general, examples of actual processed food products from the Nile valley are mostly recovered from very well sealed burial chambers. Bread examples are virtually all from tombs, although possible beer residues have also been recovered from some settlements (Samuel 2000). Macrobotanical remains (grains, chaff and other seeds) from ancient Egyptian settlements can represent the remains of food, fuel, plants present in animal dung and temper from materials such as mudbricks (e.g. Murray 2009; Newton 2004). These plant remains are often preserved at ancient Egyptian sites through coming into contact with fire, for instance in ovens and hearths, or in deliberately burnt deposits. At some ancient Egyptian sites seeds and chaff also survive through desiccation and in such instances a wider range of plants are sometimes identified, and occasionally more specifically in their actual location of use (Fahmy et al. 2011; Samuel 2000; Stevens and Clapham 2014). Microbotanical remains (phytoliths, starch) can provide further evidence about foodstuffs and preparation. Phytoliths are opaline silica particles formed in some groups of plants, within or between certain plant cells and are released into sediments through decay or being exposed to fire (Piperno 2006, 5). The greatest quantities and categories of identifiable phytoliths are produced by grasses (which includes cereals). Phytoliths are not formed within cereal grains themselves but instead represent chaff (straw, leaves and the seed bracts surrounding the grains). Microbotanical remains can provide evidence for activity areas such as cereal processing, or potentially the use of grinding stones and vessels (Anderson et al. 2007; Berlin et al. 2003; Piperno et al. 2004).

Archaeobotanical evidence (charred seeds and phytoliths) at Amara West is being used to investigate agriculture and diet, including whether there are variations amongst buildings or over time and whether there is any evidence for potentially Nubian dietary practices, such as the presence of non-pharaonic crops.

Methods

Archaeobotanical methods

Sediment samples are collected from a wide range of archaeological contexts at Amara West, including ovens, hearths, fire-pits, storage bins and

floors. Most of the macrobotanical remains at Amara West are preserved through charring. These charred remains are retrieved through sieving sediments in the field and then sorting through the remains with a low-powered stereo microscope at the British Museum (Ryan et al. 2012). Phytoliths are extracted from sediment samples in a series of laboratory steps following Rosen (2005) and are mounted onto slides for analysis using a light transmitting microscope. Silica skeleton formation (areas of conjoined phytoliths) can be so extensive that traces of whole plant parts survive (Ryan 2011), and macroscopically visible silica skeletons occasionally survive at Amara West.

Ethnographic methods

Villages were visited in 2014 and 2015 between the Dongola Reach and Dal cataract, with a focus on car- and electricity-free Ernetta Island and the nearby town of Abri. Interviews with farmers have included recording the full range of crops grown, their relative importance, uses (such as for home use or trade) and changes over time. A questionnaire was originally devised but it was more productive to follow a more conversational approach. Interviews were carried out in Arabic and Nubian with the help of an interpreter. A key aim of the interviews was to inventory crops grown today and in the recent past to enable comparison temporally and between villages. We have recorded crop processing techniques, land use and irrigation, seasonality, cuisine and animal foddering. Conversations with farmers have taken place both on farms and within the home with their families. Farmers interviewed have ranged in age between 18 and over 90, but a focus has been to interview as many older farmers as possible in order to learn about agriculture prior to the introduction of water pumps. Because traditional threshing was no longer carried out, it was not possible to collect actual remnants of by-products created by different crop processing stages. Many of the interviews, particularly of activities no longer practiced, are effectively ‘oral histories’.

Of the villages studied, Ernetta Island is focused on in this paper. Ernetta is 4 km long and has three contiguous villages, the transition between villages is not visibly discernible but there are three separate mosques. Houses are made from mudbrick and rooms are arranged around rectangular inner courtyards. Maps and satellite imagery from the mid-twentieth century show that many houses are old, and particularly on the eastern end of the island farmer’s families have been in their houses for several generations. These older houses are surrounded by fields and sometimes small gardens, whilst the inner area of the island is denser with newer houses arranged along alleyways. Fifty-five interviews have been carried out on Ernetta overall so far. The broader project is concerned with all of the traditional crops and practices from over the last 100 years. For purposes of this paper, only specific information about particular crops, wild plants or land-use potentially pertinent to the pharaonic period are drawn on.

Plant foods at Amara West and perspectives from Ernetta Island: cultivation, crop-processing and food preparation

Summary of plant foods at Amara West

Results from phytolith and macrobotanical analyses are summarized here and are discussed more fully in Ryan et al. (2012; in press). In the charred macrobotanical record, the cereals present were identified as *Triticum dicoccum* (emmer wheat) and *Hordeum vulgare* subsp. *vulgare* (hulled barley). There were higher proportions of cereal crop processing by-products in comparison to grains and greater quantities of barley grains than wheat grains. The phytolith record also testifies to the presence of wheat and barley chaff and sometimes from contexts where no macroremains were recovered (as phytoliths are not dependant on burning for preservation). Vegetables identified in the charred macrobotanical record so far include *Lens culinaris* (lentil), *Pisum sativum* (pea), *Citrullus colocynthis* (colocynth), *Citrullus lanatus* (watermelon) and *Cucumis* sp. (possibilities include *C. melo* var *cantalupensis* melon or *C. melo* var *chate* chate melon and *C. melo* var *flexuosus*). Melon identifications, and possible varieties, are discussed in El Tahir and Pitrat (1999) and Murray (2000a). Fruits present and possibly used for food are *predominantly* wild species – including *Ficus sycomorus* (sycomore fig), *Ziziphus spina-christi* (Christ's thorn) and *Hyphaene thebaica* (doum palm). Finds of *Phoenix dactylifera* (dates) are very rare at Amara West, with a small number of desiccated examples recovered from one cemetery context. Phytoliths from Arecaceae (palm family) and possibly from Cucurbitaceae (melon family) have also been identified from sediment samples. More plant foods are represented by the macroremains than the phytoliths, but phytoliths preserve information about leaves and stems so can provide more insight into non-food plant uses, such as for fuel and basketry (Cartwright and Ryan in press). Crops grown at Amara West were pharaonic winter crops, but equally these were crops typical of Nubia up until this timeframe. As yet, there is no evidence for the exploitation of local African crops, as noted from later Nubian sites (Fuller 2014).

Perspectives from Ernetta Island on crops and wild plant foods found at Amara West

Several plants grown today on Ernetta, or until recently, are found at Amara West including hulled barley, lentils, peas, watermelons, melon varieties, as well as wild fruits. Hulled barley is the most analogous contemporary cereal to pharaonic times. Other cereals grown today, like sorghum (*Sorghum bicolor*) and bread wheat (*Triticum aestivum*) were introduced to the Nile region after the pharaonic period (Fuller 2014) and are not discussed here. Hulled barley is difficult to process for food, but during interviews, farmers told us that it used to be an important food crop on Ernetta Island up until the late 1950s and was used for making bread (including a form of flat bread/pancake). Barley is still grown in small quantities today in a few

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villages on Ernetta for animal fodder and also to make a (non-alcoholic) beverage, but mostly only by older farmers.

There is a wide range of pulses grown today in northern Sudan, and lentils and peas are the two pulse crops grown on Ernetta Island which are also found at Amara West. Like emmer wheat and barley, lentils and peas are 'winter crops' grown in the cooler months of the year whereas many of the other pulses and cereals introduced to the region in periods subsequent to the pharaonic period can also be grown in hotter months. The leaves from pea plants (on Ernetta) are eaten more than the seeds themselves (which are not numerous produced and often are eaten by birds). Leafy greens will not often leave any record in charred deposits and the leaves from peas do not leave diagnostic phytoliths. The multipurpose use of pea plants for the seeds and leaves may help to explain the low numbers of peas recovered from Amara West. Lentils were not being grown at the time of the interviews, but were grown on Ernetta by farmers until the opening of the Merowe Dam in 2009. Farmers told us they grew a local variety of lentil which had hardy pods that helped protect against bird attack.

Interviews with farmers also helped clarify the potential uses of wild plant foods recovered in the archaeological record from Amara West. Doum palm fruits have an extremely tough outer surface. However, when taken from the tree (from which fruit can be dislodged by throwing rocks) the outer layer is soft enough to eat. On Ernetta, they are just eaten occasionally directly from trees rather than stored. They are available, however, in the large markets in Khartoum, but once stored the surface becomes extremely hard. Usually the tough endocarps (which are located in the middle of the fruit) are recovered from Amara West, but occasionally whole charred fruits are found. Farmers told us there used to be more doum palm trees in the mid-twentieth century and their infrequency today is partly due to clearance and the dominance of date cultivation. There are still large clusters of doum trees present in some more remote areas of northern Sudan. Christ's thorn is another fruit found at Amara West which is found today on Ernetta and sometimes eaten. Whilst these trees occur very occasionally, for instance only two were seen on Ernetta Island, they have a wide geographic distribution throughout and beyond the region (Bacon 1948). Colocynth also grows wild in sandy wasteland areas of Ernetta, but the farmers do not touch the plant, referring to it as poisonous; however, the dried fruit is widely sold in Egypt for medicinal purposes and the seeds can be made edible through roasting (Zohary and Hopf 1993, 182). *Ficus sycomorus* 'seeds' (technically drupelets) are extremely common in the samples from Amara West and several examples of whole charred fruits have also been recovered. There are no *Ficus sycomorus* trees in the immediate vicinity of Ernetta or Abri today, but they are still present further south, for instance in the Dongola Reach. Only cultivated sycomore fig trees are present in Egypt today, but wild sycomore fig trees still thrive in some areas of Sudan (Zohary and Hopf 1993, 157). Farmers near Kerma told us that no one eats the sycomore fig fruits today. However, examples are found as tomb offerings in ancient Egyptian

tombs and the tree has been used for its timber and fruits until modern times in the lower Nile valley (Hepper 1990, 58; Zohary and Hopf 1993, 157).

Cultivating Nile Islands: land-use, irrigation and food crop choices

An ethnographic study of Nile island cultivation can provide new insight into land-use, agricultural possibilities and how this might influence food crop choices. Changes to the distribution of plant resources or the capacity to grow certain crops can potentially impact food choices and cuisine. Landscape exploitation can be affected by seasonal, intra-annual and longer term changes to vegetation and agricultural land, and cereal production would have been greatly affected by very low or high Nile floods (Butzer 1976; Hassan 1997; Ingold 1993).

The shifting Nile channels over the millennia, as well as the reworking of alluvial land during the annual flood, means that the identification of actual areas of cultivation or of field surfaces are generally not recoverable. An exception to this are garden plots which are occasionally recovered at ancient Egyptian settlements (Griffith 1924, 303; Stevens and Clapham 2014; Vercoutter 1967–8). Possible garden plots located adjacent to some Amara West house areas have been excavated in 2014 and 2015, and were also recovered during excavations by the EES in 1948–50 (P. Spencer 1997, 205). These plots are around 0.5 m² in size, separated by low mud-moulded divisions and have no irrigation channels, suggesting that individual plants/small areas of plants were possibly watered by hand. Samples taken from these areas will be analysed in the future for phytolith and macrobotanical remains. Beyond these garden plots, however, the exact areas where broader expanses of crops were grown are not located. However, ethnographic information can provide useful insight into cultivating crops in a Nile island context.

Farmers on Ernetta Island explained to us about the different types of crops grown on particular soils and how to irrigate them. The area that could be flooded, often called ‘*Saluka*’ land (Arabic (A)¹) after the name of the stick used for planting, can be further subdivided into that closest to the water and including river banks ‘(A) *jarf* / *gerf*¹ / *jerif*²’ and the quicker draining higher soils ‘(A) *qurir lere* / *gorair*’. Before petrol-run water pumps were introduced to Ernetta Island around the 1950s–70s farmers used the waterwheel ‘(A) *sagia*, (N) *eskalay*’ and a water lifting devise ‘(A) *shaduf*, (N) *keeyay*’. The *shaduf* was adopted by the New Kingdom with clear illustrations in tomb scenes of orchards and gardens and was probably used for cultivating fruits that required year-round irrigation (Butzer 1976; Eyre 1994). Names for new categories of land particularly appear in texts from the New Kingdom, possibly in connection to the creation of canal-fed land, and there is also debate as to whether one these names might be connected with the use of the *shaduf* (Eyre 1994). The waterwheel, introduced in Egypt around the second century BC but in Sudan around the third century AD, revolutionized agriculture since crops could be grown using irrigation

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throughout the year and cultivation extended far inland of the flood area (Fuller 2014). On early to mid-twentieth century Ernetta Island not everybody had a *sagia* and some poorer farmers, or farmers with small families, only used a *shaduf*. After the replacement of the *shaduf* and *sagia* by water pumps, floodwater irrigation was still practiced on Ernetta up until the completion of the Merowe Dam in 2009. Since the dam construction, the river is still high in the summer months, enabling small-scale cultivation of *jarf* soils in some areas without the need for artificial irrigation. The continued existence of the *shaduf*, as well as cultivation of soils exposed by receding floodwaters, until recent times enables some possible analogies with the pharaonic period.

Older farmers on Ernetta Island described how they used to use the *shaduf*. A *shaduf* consists of a cross bar supported by two posts and a further bar balanced across the cross bar, with something heavy at one end, such as a stone, to act as a counterweight and a container on the other end, such as a leather bag, to collect water which it can raise up to around 3 m (Allan and Smith 1948). It is possible to irrigate up to 8.4 m² per hour using a *shaduf* (Foaden and Fletcher 1908, 173). Farmers on Ernetta explained that in the summer it is easy to raise water from the river during the flood months whilst it is high (which in northern Sudan is between approximately July to late August/early September), but that at other times of year they used more than one *shaduf* to reach higher places. This can be done by digging small channels from the river to the river bank and positioning *shadufs* (or *sagias*) at different heights on built platforms. Water could also be channelled across hollowed out palm trees. In some other areas visited, such as the Seleim basin in the Dongola Reach, deep holes were dug inland of the Nile and used for irrigation when the land was comparatively low lying/the water table high enough. How the *shaduf* was used and for which crops also depended on the soils available. The *shaduf* was mostly used for irrigating areas of the sometimes flooded higher *qurir* land on Ernetta Island, particularly for growing small areas of vegetables but also to some extent for cereal cultivation. Even in a year when areas of higher *qurir* soils were not reached by the flood, the soils were fertile enough to not require additional fertiliser (so long as the soils had been flooded in the previous few years). In less fertile soils animal dung was commonly used prior to the uptake of chemical fertilisers. In pharaonic times, the wide areas of floodplain and basins in Egypt may have meant that cereals and pulse crops required little artificial irrigation (Butzer 1976). It is possible, however, that further south in Nubia in areas with higher river banks (common in the middle Nile valley) the *shaduf* may have played a slightly more important role in crop cultivation.

Until the mid-twentieth century on Ernetta Island, some farmers grew hulled barley on river bank *salwka* land (*jarf* and *qurir* soils) immediately after the floodwaters receded in September (*décrue* agriculture) and higher areas (of quicker draining *qurir* soils) sometimes needed extra irrigation towards the end of the barley growing season using the *shaduf*. Other farmers on Ernetta Island used a different approach, growing their barley entirely

using artificial irrigation from the *sagia*, sowing the crop slightly later sometime between October – December. Farmers on Ernetta told us barley takes around 90 days to grow, and this timing is also noted by Bacon (1948). Farmers were growing hulled barley as a key food crop until the mid-twentieth century, but from the 1950s-60s onwards wheat became increasingly important. Wheat grown over the last century is all ‘bread wheat’ (*Triticum aestivum*) and several ‘improved’ varieties of this species have been introduced to Sudan since the 1960s. Farmers described bread wheat as only being irrigated by the *sagia* and later by irrigation pumps because of the high water requirement of this crop. Barley is more arid tolerant than wheat and emmer wheat is more arid tolerant than bread wheat (Riehl 2011). Given the technology available during pharaonic times, we can assume that the cultivation of emmer wheat was very similar to that of hulled barley and dependant on soils exposed by receding floodwaters with the possible use of the *shaduf* on higher quicker draining soils if required towards the end of the growing season.

High river banks around parts of Ernetta – and possibly in the past around Amara West – contrasts with Nile areas where there are larger tracts of floodplain or flood basins such as around the Dongola Reach in Sudan or further north in Egypt. *Jarf* soils, in recent and ancient times, would have been of primary importance for *décrue* agriculture, but where river banks are steep in the middle Nile valley there can be minimal low-lying soils. Around Ernetta Island, some farmers have very little or no *jarf* soils.

Other categories of ancient and modern land-use include possible access to seasonally exposed soils of river channels that only flow in the summer months, or to small Nile islands which are very common in some areas of the middle Nile valley. Several villages north of Ernetta have access to (uninhabited) seasonal islands and channels and these areas of land demonstrate how variable access to such land can be amongst villages and how such channels can offer large tracts of easily cultivable land. At Amara West the character and disappearance of the northern channel at the end of the second millennium BC, especially if it was seasonal, would have greatly reduced the available agricultural land to the town’s inhabitants.

The land around Ernetta Island has changed during the lifetime of elderly farmers. The decadal timing of changes around Ernetta Island shows how fast the categories of land around a Nile island can change and the extent to which farming strategies and crop choices, ancient or modern, would have to adapt. Large protrusions of sand banks to the west of the island have disappeared since the 1960s and areas of *jarf* land have been eroded from several areas of the island. The reduction in watermelon and melon cultivation in recent decades on Ernetta is a good example of how changing available land can directly impact on food crop choices. Elderly farmers said that before they disappeared, the extensive areas of sandy soils on the edges of Ernetta Island were the main areas for growing melons and watermelons and that they were grown before and after the annual flood. When these crops were grown very close to the river, they did not require irrigation. In

recent decades, farmers grow watermelon and melons in irrigated fields and along irrigation channels in summer months, but overall far fewer farmers grow these crops compared to the mid-twentieth century (on Ernetta).

Pre-storage crop processing

Before the introduction of the threshing machine in the mid-2000s, farmers on Ernetta Island threshed wheat and barley using donkeys to trample the cereals (A. *noré*¹, *noreigh*²). The donkeys would be harnessed together and driven around a central pole on a specially prepared surface within a field (N. *dar*- meaning ‘the threshing place’). Occasionally, for smaller episodes of threshing, wheat and barley were sometimes beaten (but this was more usual for crops such as sorghum). Further south, farmers near Kerma told us that occasionally ox-drawn threshing carts with rows of iron wheels (A. *noraj*) were sometimes used, mostly by wealthier farmers. Both of these methods, as well as the threshing sledge (also *noraj*) are reported in early twentieth-century agronomy studies, but the threshing sledge is noted as a relatively recent introduction from Egypt (Burnett 1948). Afterwards, crops would be winnowed and sieved before storage. Farmers on Ernetta winnowed crops using flat baskets to throw the cereals into the air. The breeze carries away light waste elements and this would also take place in the *dar* (the location of threshing). Such techniques are attested across the Near East, Egypt and throughout Sudan in ethnographic studies (e.g. Al Batal 1991; Bacon 1948; Burnett 1948; Foaden and Fletcher 1908; Hillman 1984). The artistic record from New Kingdom tombs seems to similarly emphasize the role of animal trampling (cattle) to thresh crops (Murray 2000).

Scenes from the Tomb of Menna (TT69) and other New Kingdom tombs show cereal ears being cut and collected in baskets during harvesting, prior to threshing using animals and winnowing. Crop processing tools made from organic materials such as wooden winnowing fans and sieves made from palm leaves have occasionally been recovered from some settlement sites and tombs, including examples on display at the British Museum (BM EA18206; BM EA55130). These sorts of tools have not survived from Amara West. Evidence for some pre-storage agricultural processes can also be under-represented in the archaeobotanical record since these activities can take place away from settlements; however, threshing remains can be gathered for secondary purposes, such as for fodder, fuel and temper (e.g. Newton 2004; van der Veen 1999). Some crop weeds and other processing debris can also be present in storage deposits (discussed below).

Storage

Storage bins (Fig. 2.3) in Amara West houses are generally rectangular, although one extramural villa had circular silos, and are made from brick and mud plaster. They are typically separated from the surrounding mud floors with a series of upright schist stone slabs (Spencer 2009). Storage bins

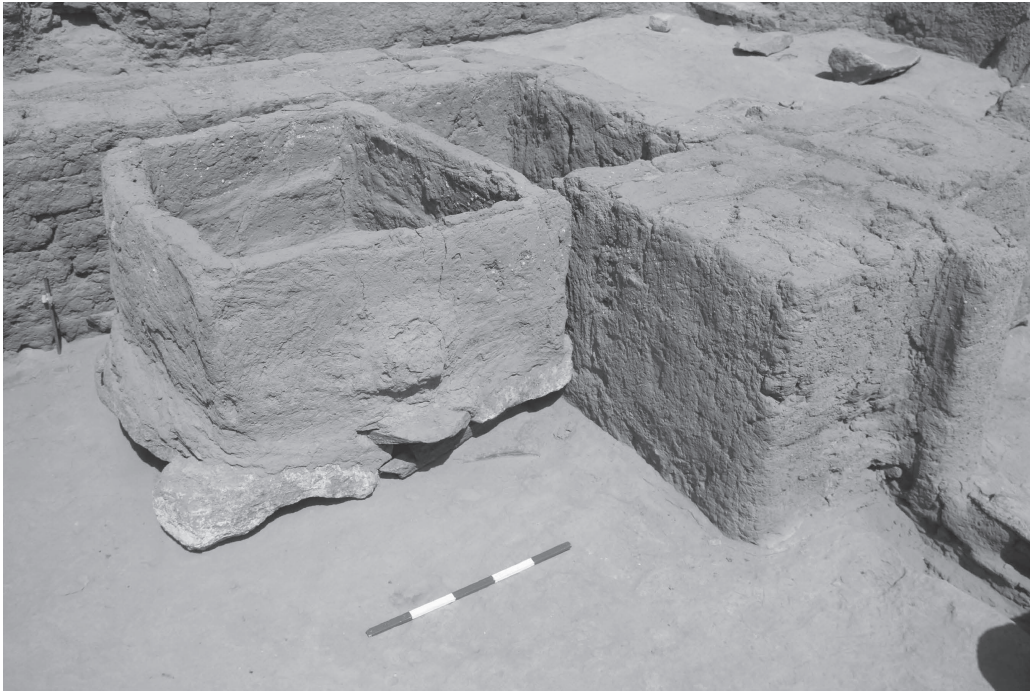


Figure 2.3 Storage bins in house D12.6.5, Amara West (Copyright, N. Spencer)

are present within some houses but not others, for instance storage bins were present within extramural villa E12.10 but not in the smaller houses E13.3-S and E13.3-N which were situated within the town walls (Ryan et al. *in press*). This may suggest differential access to cereals and that some houses were supplied cereals from centralized supplies. The presence of storage bins within some houses and not others is also observed at Amarna, and Janssen (1983) suggests larger households may distribute grain. There are also some large houses at Amara West without storage bins, such as D12.7.

The presence of cereal processing waste (in the phytolith and macrobotanical records) in Amara West buildings both with and without storage bins suggests that cereals were also stored in pottery or perishable containers. Occasionally, pots were found set into floors, which would have maintained a cool temperature. House D12.7 has a small room that may or may not have been used for storage; such small rooms are quite a common feature of houses but their purpose is not clear. Patches of macroscopically-visible phytoliths from several small rooms (eight samples including from D12.7.2 [12066]), support the idea that some of these rooms were potentially connected with some form of storage. The phytoliths were all from cereal stems consisting virtually entirely of multicells with smooth long cells and square short cells (cf. Rosen 1992). There were small numbers of (< 5 per cent) silica skeletons which also had occasional husk phytoliths (mostly papillae), but not enough to clearly distinguish wheat from barley. The phytoliths are not likely to be actual remnants of stored cereals as otherwise greater

quantities of husk phytoliths would be present. One possibility could be that these phytoliths are remnants of matting/basketry made from straw, which would explain the limited range of phytoliths (as the leaves could be stripped off before weaving). Equally, silica skeletons from barley rachis (the stem within the ear) are composed almost entirely of smooth long cells. As such, these phytolith deposits may alternatively represent initial barley processing waste created from breaking up the ears (if barley was stored in ear form) – barley processing is discussed further below. Charred seeds and phytoliths retrieved from pots and storage bins have not yet helped to reveal actual stored content. Bins from Villa E12:10 only contained sand (Ryan, Cartwright and Spencer *in press*), whilst charred items present in several pots including a large pot dug into the floor within house E13.3-N were interpreted as deriving from a general low density of ‘background noise’ and could represent a number of sources.

On Ernetta Island few farmers have traditional storage bins (*N. guse guseiba*) today, with those we saw no longer used, although one household we visited had a storage room with large lidded pots raised up from the ground on pot stands. Raising storage facilities from the ground helps to protect the contents from pests (such as birds, termites and rodents). Most farmers on Ernetta now use sacks of synthetic material for storage. Nevertheless, they still sometimes raise these sacks from the ground; for instance, one farmer had two large wooden beams lying in a courtyard with sacks of different types of seeds balanced along them. Storage jars or bins are always kept shut. Some households on Artigasha Island (near Kerma) still use large clay built storage bins (Fig. 2.4). These have apertures, about



Figure 2.4 Storage bins on Artigasha Island (Copyright, P. Ryan)

10 cm in diameter near the base of the bin, which can be opened and shut again by removing and then replacing a rough patch of plaster. Farmers told us that the bin contents can be stored for around a year, but that they can never be refilled during that time. Before filling the bins, farmers would smoke the bin with a burning palm frond and add a thin layer of ash to help protect against insects. The raising of storage containers from the ground today in Nubia is reminiscent of storage strategies at Amara West, where storage bins were also elevated from the floor.

Post-storage crop processing

Depending on how well crops are sieved and winnowed prior to storage, some threshing waste such as crop weeds and small pieces of straw might still be present in storage bins. On Ernetta Island, post-storage small-scale winnowing (using a tray to bounce cereals into the air), final sieving and hand cleaning of crops takes place, still today, outside of houses on mats placed on *mastabas* (an outdoor bench build around the outside of some houses) or nearby paths. Today the wheat used is ‘free-threshing’ meaning that, in contrast to emmer wheat, the grains are easily separated from chaff during threshing. At Amara West, de-husking emmer wheat also would have involved an additional post-storage processing step. When emmer wheat is threshed, the ears break into individual spikelets and a second processing, usually by pounding, is needed to release the grain. Emmer spikelets have sturdy outer glumes with rachis segments still attached, which enclose the grains (usually two) and further components of light husk chaff (lemma, palea) (Nesbitt and Samuel 1995). The sturdier lower parts of spikelet chaff can survive charring and are identified in the macrobotanical record as ‘spikelet forks’, or if split, as individual ‘glume bases’. The presence of emmer wheat de-husking waste in buildings at Amara West suggests that the cereals were stored in spikelet form and de-husked in the home prior to grinding. The storage of cereals in spikelet form is also supported by evidence from funerary contexts in Egypt; for example model granaries from Middle Kingdom tombs have included wheat and barley spikelets (Nesbitt and Samuel 1995). Weed seeds recovered from Amara West might include crop weeds removed after storage, but also their presence can reflect several origins including dung. Crop weeds are routinely collected for animal fodder on Ernetta Island due to the lack of grazing areas. One ashy fire spot in grain grinding room E12.9 at Amara West may represent a particular episode of crop debris disposal, however; the material was entirely ashed and there were no seeds but there were very high proportions of wild grass inflorescence phytoliths (Ryan, Cartwright and Spencer *in press*).

Mortars used for de-husking emmer wheat have not yet been identified at Amara West. At the Amarna Workmen’s Village in Egypt, limestone mortars were found set into floors and mudbrick emplacements. Over half the houses at the workmen’s village in Amarna had mortars present and there were also (possibly communal) mortars in streets (Samuel 1999); such mortars are conspicuous in their absence from the Amara West houses. De-husking is

very time consuming and in Ethiopia, where hulled cereals are still grown for food, emmer is considered a very labour-intensive cereal (d'Andrea and Haile 2002). Mortars for emmer processing in Ethiopia can be made from wood (d'Andrea and Haile 2002), so this may be one explanation for their absence at Amara West (since wooden objects have not survived in the pharaonic town).

Many of the houses at Amara West have raised emplacements of brick and stone, upon which grinding stones would have been placed; large grinding stones (often of saddle quern shape) are also commonly found in the houses. Most grinding stones are small and portable and many were probably used for cereal grinding, but are generally found away from their place of use. Phytoliths will be analysed from grinding stones to further investigate potential use. Some very large grinding stones are set into floors, are often of harder stone and may be associated with mineral processing (e.g. gold extraction and pigment preparation). At the Workmen's Village at Amarna most houses had quern emplacements and many had both mortars and quern emplacements which were generally found together in a front room (Samuel 1999).

Interestingly, large quantities of charred cereal crop processing debris were present within the dedicated grinding emplacement features in room (9) of villa E12.10 at Amara West (Ryan et al. in press). The de-husking waste was also intermingled with burnt fuel and may indicate the burning of debris and perhaps the deliberate spreading of ash to ward against pests. Ash was also found beneath saddle querns at Tell el-Amarna, and Miller (1987) has argued that this may be because ash has insecticidal properties. This is similar to the recent practices on Ernetta Island of putting ash from burnt palm leaves in the base of storage bins to protect against pests.

Some 'traditional' grinding stones are still present on Ernetta Island. These are most commonly the '*gao*' which is a rotary quern and was not present in pharaonic times, but there were also some grinding stones that had a very similar appearance to the saddle querns at Amara West. Until a mechanical mill was installed (on Ernetta in the 1960s and in the nearby town of Abri in the 1950s) the *gao* was used for wheat, barley and sorghum. The saddle quern was routinely used for a second stage of sorghum or pearl millet grinding (with the addition of water prior to grinding), and more occasionally of wheat and barley to make a finer flour. Sorghum and pearl millet are African cereals not present at Amara West, but which appeared in the middle Nile valley in the late first millennium BC and early first millennium AD, respectively (Fuller 2014). The saddle querns on Ernetta can be picked up and are very portable – and in a demonstration of sorghum grinding the quern was brought to the place of use (a courtyard in a non-inhabited house used as a workshop and for food processing) and put away again afterwards.

Hulled barley threshes differently to emmer and this affects de-husking methods. During threshing barley grains detach from the rachis (the stem within the ear) and a thin but tough lemma and palea (hull) stays tightly

attached to the grains (Fig. 2.5). Charred hulled barley grains from Amara West sometimes still have the hull visible, but generally separated fragments of lemma and palea rarely survive charring. Instead, it is generally charred rachis segments which are recovered in the macrobotanical record for chaff. The presence of charred barley rachis chaff is difficult to interpret – because it is separated during threshing which takes place commonly off-site. The presence of rachis chaff within domestic contexts may indicate either that the chaff was brought onto the site to use as tinder, that it was in animal fodder present in dung burnt as fuel, or potentially that barley was stored in ear form before processing. The excellent preservation of barley rachis chaff at Amara West suggests at least some of this chaff was not present within animal dung – although chaff can be trampled into penning deposits which may offer an explanation for good preservation. Farmers on Ernetta demonstrated potential ways to process hulled barley grains for food and how to remove the hull.

Hulled barley processing for food in recent times is particularly little documented globally. Farmers on Ernetta demonstrated how they used to grind hulled barley on the *gao*. The grains are ground whilst still encased within



Figure 2.5 Modern hulled barley grain (left) from Ernetta Island; charred hulled barley grain and rachis (right) from house D12.7.7 Amara West (Copyright, P. Ryan)

the hull. Afterwards the papery fragments of lemma and palea are sieved out from the flour and this sieving process is repeated up to eight times. The same processing steps, using the *gao*, has been recorded ethnographically on the island of Melos in the Cyclades where hulled barley is used to bake a form of ‘rusk bread’ (Procopiou 2014). Hulled barley processing has also been demonstrated experimentally in Egypt, using saddle querns similar to those found in ancient Egypt (Cappers et al. 2013). In northeastern Ethiopia hulled barley is reported as being dehulled in a mortar, but in slightly varying ways depending on the food type and locality. These methods include partial dehulling using a mortar, followed by a light roasting of grains before grinding and then by sieving to remove the remaining hull before using the flour to make porridge (Shewayrga and Sopade 2011). Irrespective of the type of ground stone, the examples demonstrate that the lemma/palea can be removed from flour after grinding.

Cooking and baking

Most recovered loaves from funerary contexts are made from emmer, although there are some examples of barley inclusions (Cartwright and Taylor 2015; Samuel 2000). Some tomb bread contains spices and fruits, including an example made entirely of figs (Hepper 1990, 53; Samuel 2000). It is not clear to what extent such examples are representative of normal food as opposed to being specifically produced as elite funerary offerings, and as such the use of barley for bread might be underrepresented. Beer residues from tombs and settlements in Ancient Egypt indicate that both emmer and barley were used for making beer (Samuel 2000). However, whether barley was mostly used for beer as opposed to bread is not clear, and this is also difficult to interpret from the seed record due to the various possible uses of barley and reasons for grains to become charred (Murray 2000).

Thirty forms of bread and cakes are mentioned in the Papyrus Harris I (c. 1200 BC; Goody 1982, 100). Recovered loaves from funereal contexts in Egypt have a variety of textures, some are coarse with whole or roughly cracked grains and others have a finer texture (Cartwright and Taylor 2015). In experimental work, Delwen Samuel has investigated grinding methods and bread texture: such as whether emmer flour is sieved, whether there are two stages of grinding and whether coarser inclusions are deliberately re-added (Samuel 2010). Cappers (et al. 2013) has also conducted bread-making experiments using barley flour and found that the quality was not much different from emmer loaves.

The ovens and hearths at Amara West are often well-preserved and sometimes contain *in situ* charred remains. Apart from testifying to evidence for fuel, the plant remains often represent debris from cooking and discarded waste from everyday food preparation activities. The cylindrical ovens are similar to those identified at other sites such as at Tell el-Amarna and the Amarna Workmen’s Village (Samuel 1999; 2000; see Malleson, this volume). Nearly all of the houses at Amara West have bread ovens, often three

installed side-by-side suggesting, like at Amarna, that households were mostly self-sufficient in bread production (Janssen 1983, 281). Studies from modern Turkey indicate that even with two-three ovens in a house, use is rotated between households, since this prolongs the life of ovens which are prone to cracking (Parker 2011). However, there are also some communal oven spaces such as E13.13, a small courtyard shared by two small houses (E13.3-N and E13.3-S) in the latest phase of their occupation (Spencer 2015). Open hearths are found in many houses in central rooms. These hearths are similar to those found at New Kingdom settlements in Egypt and were probably not used for making bread (Samuel 1999). Nubian style cooking jars, possibly used for cooking on some of these hearths, are distinctive indigenous elements that suggest some difference to typical Egyptian practices. Residue analyses from cooking pots (and other vessels such as 'beer jars') have not yet provided evidence regarding their use (Deviese and Stacey 2009).

At first glance 'traditional' bread ovens on Ernetta Island appear similar to those used at Amara West. However, as Samuel (1999) points out in respect to present-day and New Kingdom ovens in Egypt, the way they operate is quite different. Secondly, although the bread ovens in homes on Ernetta and elsewhere in Nubia are little used today they are also actually quite recent according to interviews with farmers. Little used in the early twentieth century, their prominence increased after wheat became more important from the 1950s with the introduction of wheat cultivars that were easier to grow (all *T. aestivum*) and a new trend towards adopting the lighter wheat loaves associated with 'city food'. The 'traditional kitchens' within houses more commonly consist of two low hearths, one used for boiling stews (of meat or pulses) and the other covered with a large metal plate to make (occasionally today but commonly in the past) thin crepe-like pancakes/flatbreads '*kisra*' or slightly thicker '*gurassa*' (Sudanese Arabic) from a variety of flours (wheat, barley, sorghum, pearl millet, pulses). The bread ovens were often later additions to houses on Ernetta and are sometimes situated within kitchens but are often in other rooms if there was no space. Today the bread ovens are largely redundant (in homes) as bread is more commonly bought instead from bread sellers who visit Ernetta or in the market of the nearby town of Abri. Rather than the modern Egyptian or Nubian ovens, ancient Egyptian ovens (including those at Amara West) instead resemble the 'tannour' ovens which are widespread in some areas of Africa and Near East (Samuel 2000). In these, flat discs of bread are slapped onto the hot inner walls, and this mode of cooking is also suggested in several New Kingdom tomb scenes from ancient Egypt (Samuel 2000).

Barley is also still today used to make a beverage on Ernetta Island. To make the beverage, the grains are roasted and then ground into a powder and added to water, boiled and then left to cool and consumed as a cold drink. Barley is still used today in neighbouring Ethiopia to make a diverse range of foods, including beverages (alcoholic and non-alcoholic), bread varieties, roasted grains and porridges (Shewayrga and Sopade 2011). The

wide range of ways barley can be prepared into food stuffs diversifies the potential reasons why grains can be exposed to fire and preserved as charred grains in the archaeological record.

Conclusions

The ethnographic study from Ernetta Island and other Nubian villages is helping us to consider where in the environment some of the food resources were sourced or cultivated and the potential uses and processing methods for several crops and wild plants identified in the archaeobotanical record (with a range of technologies available in ancient times). The categories of land available to farmers have changed around Ernetta Island in recent decades and this has had an impact on cultivation practices, crop choices and foodstuffs. The phenomenon of environmental change has implications for interpreting food procurement strategies and dietary practices in the archaeological past: when the paleochannel north of Amara West dried up during the occupation of the town, the reduction in agricultural land would have impacted on agricultural strategies and ultimately the ability to inhabit the area. Demonstrations of hulled barley processing and its importance on Ernetta until recent decades helped to reinforce the possibility of this cereal as an important food crop, including for bread, in New Kingdom Sudan. Textual and linguistic evidence suggest that emmer became more important than barley in New Kingdom Egypt, but also that possibly barley was more important in Upper Egypt and emmer in Lower Egypt (Murray 2000; Kemp 1994). The high proportions of barley at Amara West may reflect its tendency to be easy to grow and a comparatively arid and saline tolerant cereal. Average temperatures are higher in Sudan than northern Egypt and *décrue* agriculture would have been more problematic along steep areas of riverbank where slightly higher soils dry faster than wide flooded areas of lower lying land (which was more common in Egypt). Thus, high proportions of barley at Amara West may reflect local choices, but also climatic factors and local soil configurations.

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Notes

- 1 Local words included here are in (A) Arabic/Sudanese Arabic unless noted as (N) Nobiin (Nubian). Transliterations are mostly based on examples found within Tothill (1948) or Al Batal (1991).
- 2 Some additional spelling variations, based on discussions with our interpreter and pronunciations during interviews, are also noted when these diverge from the examples found in publications. Both forms are used to reflect as closely as possible pronunciations during the interviews and to allow comparability with written sources.

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