Crops and Culture: Dispersal of African Millets to the Indian Subcontinent and its Cultural Consequences

Randi Haaland

Abstract

In this paper I will discuss the spread of African crops to the Indian subcontinent. The spread was probably related to the Indus civilizations trading network in the Indian Ocean during the late 3rd millennium BC. It was at this time African food plants, the so-called big millets were dispersed across the African savannah to the horn of Africa and further to the Indian sub-continent. The big millets were cultivated as monsoon summer crops complementing the existing barley/wheat winter crops. The African pot/porridge cuisine was added to wheat/barley oven/bread cuisine. Recent study in Nepal shows that the African crops are cultivated today on marginal agricultural land in the foothills of Himalaya. We will look at Nepal as an example of the production and consumption of African big millets. The crops are processed into porridge and beer, and this cuisine is a food tradition similar to the pot and porridge cuisine we find in sub-Saharan Africa.

Keywords: African millets, dispersal Indian subcontinent, cuisine porridge pot, beer, Nepal

1. Introduction

Domesticated crops are concrete material objects that are cultural products shaped by human technology. They are used for the utilitarian purpose of nutritional satisfactions, but they are also used for symbolic purposes. The technological aspects relate to production of the crop as well as to the preparation of crops for consumption purposes (so-called cuisine), while the symbolic aspects relates to the use of crop associated activities and objects to

communicate ideas about non-technological aspects, e.g. social relations or religious beliefs. This raises an important methodological problem: when we document dispersal of the material object from one region to another, what can we assume about diffusion of symbolic ideas between the regions? This problem will be discussed with reference to dispersal of African big millets to the Indian subcontinent, where indigenous cultivation of small millets had taken place. There are striking similarities between the two regions with regard to technological aspects of production and preparation of millets. More surprising is the symbolic similarities associated with millets. This problem shall be addressed by stepwise presentation of the emergence of the big millets in Africa with reference to technological and symbolic aspects, followed by discussion of their dispersal to India and how it fitted into the existing food ways (this will include a presentation of other food systems that co-existed with the indigenous small millets). An important point in this context is that the existing millet culinary tradition in India was based on a food preparation technology essentially similar to the African technology, namely, the so-called pot and porridge cuisine (contrasting with the West Asian bread and oven cuisine associated with wheat and barley). The West Asian culinary tradition had already a long tradition in the Indus valley and was an important part of the Indus Civilization before the introduction of the African millets. It is therefore reasonable to assume that African millets dispersed independently as a material object and that the similarities we find in millet based cuisine had been invented independently and was caused by the fact that technological requirements involved in converting millet grain into a consumable form favoured innovation of a similar porridge/beer and pot cuisine. Technologically this shared similarities with the boiled (steaming) rice and pot cuisine of the eastern `rice-cultures'. However there was a difference in the millets preparation was based on the technology of grinding the cereal into flour before boiling. Concerning the symbolic aspects the issue seems to be more complex. In Africa millet products particularly beer plays an extremely important role. In Nepal we find ritual uses of beer very similar to the African use. Does this reflect diffusion or does alcoholic drinks have qualities that make them particularly convenient for communicating important ideas about social and religious concerns? This will be discussed with

reference to comparative material from India showing the symbolic use of alcoholic drinks in a community.

2. African food crops in India

It was within the African savannah environment that the cultivation and domestication of big millets took place. The Deccan plateau in South India has a similar environment an area where domestication of indigenous crops such as the small millets took place and where food crops from other regions such as Africa and the Near East had been adopted. Both the African big millets and the local small millets were part of the same cooking-pot cuisine where the cereals had been processed by grinding (Fuller & Rowlands, 2011). The indigenous domestication of the local small millets had taken place here two thousand years before the introduction of the African crops. There was of course the rice cuisine, which became important in most of the Indian sub-continent from the late-3rd millennium BC. The food preparation technology associated with rice can be seen as a variation of boiling-pot (steaming) tradition and was not made into porridge. The earliest crops to arrive on the Indian sub-continent to the Indus Valley and Gujarat were the west Asian wheat/barley and pulses. These crops diffused as a package and later spread South Eastwards to the Deccan plateau **(**figure 1**).**

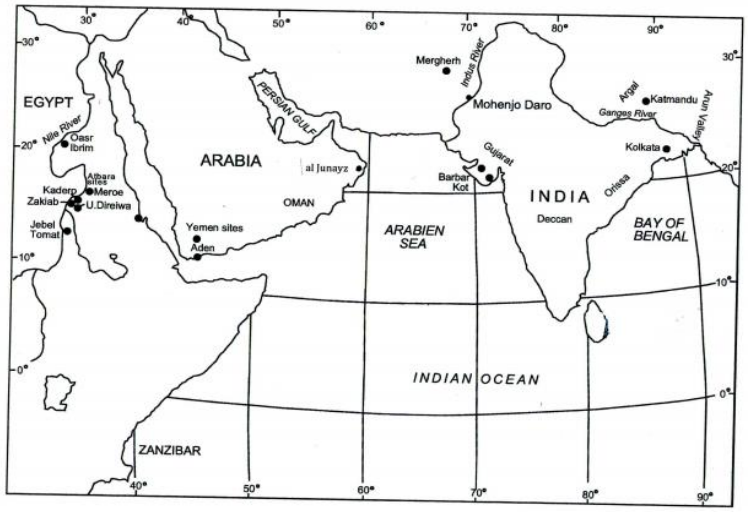

Figure 1: The main locations mentioned in the text.

Summer growing African crops was introduced 4000-3800 years ago to the Indian sub-continent (Fuller, 2003). They consisted of three types of millets: sorghum (*bicolor*), pearl millet (*Pennisetum glaucum*) finger millet (*Eleusine coracana*) and two types of pulses: cowpeas (Vigna ungicalata) and hyacinth beans (*Lablab purpureus*). The earliest paleo-botanical remains of these plants are found in the area of the Indus valley and Gujarat and spread towards central India and east as far as to Korea and Japan by 1400 BC (Fuller, 2003). The dispersal of these crops appears to have been across the sea (Fuller, 2009). However there is no clear evidence for trade objects with Africa, which could indicate the kind of exchange system of which it could be part. Blench (2003) has argued that the earliest evidence for ships sailing down the Red Sea along the southern coast of Arabian peninsula and across to India took place as early as 4000 BC, either coasting the Iranian Coast or perhaps sailing across open sea. The dispersal of African crops seems primarily to have been adopted in areas where one already had summer crops, millets and pulses of Asian origin. Perhaps foxtail millet (*Setaria itallica)* was introduced from East Asia (China) at the same time. There is a great genetic diversity of these African crops indicating that the dispersal took place over time. The Harappans in the Indus valley and Gujarat first adopted them (Fuller, 2007; 2009), argues for at least 3 different introductions, these were probably adopted selectively, as a supplement to agricultural diets based on other species such as indigenous millets and pulses of south Indian origin. For the Harappans these crops proved very useful and made it possible to cultivate twice per year since the African millets were summer growing crops while the West Asian wheat and barley cereals was winter growing crops (Fuller, 2006; 2009; Possehl, 1999; 2003). Possehl (2003) suggests that the introduction of these African monsoon crops implied an agricultural revolution since it allowed for a much higher yield and made it possible to cultivate more marginal areas. Some scholars have been critical to their importance and think they have been overrated (Fuller, 2009). Their advantage was that they could readily fit into the already existing pot/porridge and beer cuisine based on small millets. The Indian evidence of domesticated African millets has until recently appeared to be older than the African evidence, which has created

quite a discussion on the problem of the domestication of these crops in Africa (Rowley-Conwy, 1997; Haaland, 1999; Fuller, 2003). This will be discussed more fully below.

3. Deccan plateau a fringe area, cross road and core area

As noted earlier the savannah region of the Deccan plateau has been seen as an important area for domestication of small millets. This region will be used comparatively with the African savannah region of Sudan to try to get an understanding of the process towards domestication of these cereals and their cuisines.

In the south Indian region archaeological material documenting these transitions from gathering to cultivation is scarce probably due to the sites being less sedentary (Pratap, 2001; Fuller, 2009). The sites with remains of agriculture are those, which had become sedentary. The material one can build on consists mainly of distribution of modern wild plant progenitors (Fuller, 2009). This semi-arid plateau has received increasing attention as a region of domestication of monsoon adapted crops in the later middle Holocene (Fuller & Korisettar, 2004; Korisetter, 2001 et al.; Fuller, 2005), these were two types of millets: (*Brachiaria ramose*) and (*Setaria verticillata*) and two types of pulses, mung beans (*Vigna radiata*) and horsgram (*Macrotyloma uniflorum*) (De Wet, 1995; Pandy, 1990). Local domestication of these indigenous crops seems to have taken place around the beginning of 4th millennium BC almost two thousand years before the introduction of the African crops (Fuller, 2003; 2005). However there seems to have been 6 different types of monsoon adapted of small millets that were domesticated besides Deccan also in Gujarat, and Middle Ganges (Fuller, 2009). The first African crops, to have been introduced, were sorghum, hyacinth bean and cowpea (Fuller, 2003)- They would have fitted readily into the seasonality and cultivation regime of native crops, as these are all summer growing crops. They could be applied to the existing consumption practices, probably based on the same pot/ porridge/ culinary tradition that we find in Africa. This is manifested in the presence of large open bowls and globular pots (Allchin, 1960; Allchin & Allchin, 1982 fig. 10.24 nos. 10, 13, 14); these were probably used for boiling porridge and gruel (Fuller and Rowlands, 2011). There has been

little focus on the indigenous beer tradition however the globular pots were probably also used for production and consumption of beer comparable to the tradition that we will later describe for Africa. Over time winter growing wheat and barley cereals were introduced selectively and added to the southern cuisine. Spreading from north-west to south-east, southern Deccan thus was on the fringes of the wheat/barley complex.

The adoption of these new crops over time seems to co-inside with a time of increased social inequality, and was related to elite consumption. Their attraction appears to have been only for beer and was not used to make bread. The social changes manifested in the presence of new ceramic jars used as beer containers, while the bread platters which are usually associated with bread is absent. The winter growing pulses were not adopted; these became part of the cuisine much later during the Iron Age, almost 2000 years later. Is it likely that the West Asian pulses were not integrated into the new food system since they could not be used to produce beer and were not used in elite consumption? The adoption of these crops seems to correspond to a period of increasing culinary elaborations as inferred from ceramics. It was also a time of increased long-distance trade and exchange of cultural influences with the emerging chiefdoms of the northern peninsula. The more differentiated finds in burials from earlier communal megalithic graves and changes to individual graves with more elaborated grave goods, as an indication of rising social inequality (Fuller, 2005).

The new type of beer made of wheat/barley was served in new types of necked pots. Alcoholic beverages, such as beer were an important item used for elite consumption in a context of social display, probably feasting. There are none of the flat bread platters, which appear in the north (Fuller, 2005). Bread was apparently not incorporated into the culinary tradition, it was a selective up take of new crops used in specific social contexts. Beer made of indigenous millets, and the African millets added to this consumption pattern were not part of an elite consumption. The preparation of big and small millets was part of a cooking pot tradition and was probably an important part of day-to-day diet (Haaland, 2009).

The millet beer was used in different contexts; in daily household consumption, in mobilization of labour for different productive tasks as well as for ceremonial constructions, as part of the reciprocity in social relations. An important change occurred with the emergence of more complex societies expressed in adoption of new type of beer and new serving vessels. There appear to have been a long-term continuity in the technologies of preparing and consuming of food, new food was added to the existing cuisine as elaborations but the essential cooking pot culinary tradition was maintained. Parallel culinary changes with reference to the African context of Sudan will be discussed below.

Deccan is interesting as a fringe area for the West Asian crops wheat /barley since the crops were adopted and modified into the Deccan cuisine. In general the African crops probably played a major role in diversifying summer cultivation as risk buffering without apparent adoption of new preparation and consumption practices and became part of the local Deccan cuisine, which already had an emphasis on small and big millets. There was a dispersal of these indigenous small millets to the North and Northwest in the opposite direction of the wheat/barley and African millets. Suggesting the importance of Deccan as a crossroad between the different cuisines. The small and big millets including the various pulses were thus important crops from the 4th millennium BC. Today these crops are of less importance and are cultivated in marginal areas based on monsoon rain (*kharif* summer crops), areas where hoe agriculture is practiced.

There is continuation today of culinary practices of boiling of porridge, however interestingly sorghum is used to make a type bread (*roti*) used for special occasions. Another new component in preparing food is the use of popped sorghum, prepared in especial rituals such as worship of snake (as symbols of fertility). Beer made from different type of millets is still part of their food system, and is of ceremonial significance (with an increased importance on hard liquor). Millet crops are regarded as crops of less prestige than rice and wheat/ barley, which are grown as irrigated crops (Haaland, field notes 2007). One can today see the practice of three different cuisines, the pot/ porridge /beer, as well as the bread /oven tradition, and the rice a cooking tradition which can be seen as variation of boiling in the pot (steaming) practice. However important in all three cuisines is the alcoholic beverages, used for everyday food as well as ritual occasions.

4. African food crops across the African continent

In the following I will turn to archaeological material from the Sudan in Sub-Saharan Africa to follow the transition from gathering to cultivation and domestication of the big millet sorghum as well as the development of the African cuisine based on the pot and porridge/beer tradition.

Plant gathering

Here material from the so-called Atbara sites, which show the long history of utilization of wild grains, will be presented (Haaland, 1995; 1999; Magid, 1995). These sites are dated to the 8th and 7th millennium BC. The large number of potsherds that were recovered from these sites appears in a food-gathering context, where a broad range of resources were utilised, aquatic and plant food such as wild sorghum. The presence of grindstones suggests the grinding of plant food (Haaland & Magid, 1995; Haaland, 2007). The archaeological material indicates that these sites were remains of a sedentary population. The ceramics consist of large pots probably used for storing and of smaller pots, which could have been used for cooking or possibly serving. Boiling of food during this period most likely consisted of aquatic resources and porridge. Beer may already have been in use at this early period, some small vessels might have been used to serve beer. This ceramic tradition was maintained with some changes for several thousand years to the 4th millennium BC, during the so-called Khartoum Neolithic period

Cultivation

It was during this time that changes from gathering of wild cereals to cultivation of these took place; this was before morphological changes indicating domestication had happened. The terms cultivation and domestication are different processes. Cultivation is a socio-economic process that constitutes the selection pressures affecting the biological process leading to the evolution from wild to domesticated cereals (Haaland, 1987; 1999). This will be discussed in more details for sorghum since it appears the process from cultivation to domestication took several thousand years. It is suggested that cultivation of morphologically wild summer growing sorghum was practised; plant imprints on pottery show morphologically wild sorghum (Stemler, 1990; Haaland, 1999). The arguments the inhabitants were cultivating sorghum in the 4th millennium BC is

based on the large sedentary sites, and the presence of plant impressions of sorghum with a high amount of grinders, some sites have up to 30 000 fragments (Haaland, 1995)

The selection for domesticated varieties may thus have been operative for a long time. This assumption is strengthened by the fact that the greatest genetic diversity of domesticated sorghum (450 local strains) occurs in Sudan. McGovern (2009) has suggested that sorghum might have been cultivated as early as 6000 BC. The paleo-botanical evidence suggests that evolution from cultivated to domesticated sorghum took several millennia in Africa. Sorghum bicolor (domesticated) sorghum has now been recovered from the eastern savannah region at the site of Mehel Teglinos in the Kassala area, dated to 3860+/-60bp, uncalibrated (Beldados & Constantini, 2011). Imprints of sorghum identified on pottery show the presence of both wild and morphological domesticated types, which shows that both were exploited. When calibrated the date is from early 3rd millennium BC and places them prior to the plant material recovered in India. An important date since until recently the earliest findings were no more than 2000 years (Clark & Stemler, 1975; Rowley-Conwy, 1991; Rowley-Conwy et al., 1997; Stemler, 1980). Indication of earlier dates is presented by Fuller (2004) who published material of sorghum with features that suggests a more advanced race of cultivated sorghum (caudatum or possibly durra) dated to 2450 bp (500 BC).

The emergence of sorghum from gathered, cultivated and domesticated cereal have been presented in some details since we expect that the other millets, pearl and finger millets probably developed much along the same line. Sorghum and pearl millets are found within the savannah belt from West Africa to Sudan. Finger millet has a more restricted distribution and is found mainly in East Africa. The available material indicates that pearl millet was domesticated around 2nd millennium BC, from the site of Dar Tichitt in West Africa (Amblard, 1996; MacDonald et al., 2003). Equally early dates have been reported from Ghana (DÁndrea et al., 2001). As discussed earlier the new dates from sorghum now suggest that pearl millet and sorghum were domesticated around the same time period.

Finger millet is rather problematic since reliable dates are limited (Phillipson, 1998). Cowpea another plant, which was introduced to India, seems to have been domesticated during the 2nd millennium BC. Dates from Ghana shows the presence of domesticated cowpea around

1850-1595 BC, interestingly cowpeas are commonly intercropped and cultivated together with pearl millet (Andréa et al., 2007a, b). This date barely predate the earliest dates of cowpea and millets in India 1700-1500 BC, and indicates a very rapid dispersal across the African Savannah to India. Dates for the hyacinth bean plant, which originated in East Africa, is not well known, however, it is found in India around 1500 BC (Fuller, 2009).

There has been a focus in this article on material discussing the transition from gathering to cultivation and domestication. I will below discuss in some details the type of cuisine that was practiced and here use material from Sudan when tracing the development of the African cuisine. It was probably during early Neolithic time, in the 4th millennium BC that the typical African food system based on porridge and beer emerged (Håland, 2007). Earlier work has taken it more-or-less for granted that the main consumption items would have been porridge (Haaland, 1987; 1999). However grains used to prepare cooked and fermented foodstuffs, beer, which were to become the staple of much of sub-Saharan Africa, may be traced equally early (Edwards, 2003; Edwards, 2004: 35; Haaland, 2007; Haaland, 2009).

From the Khartoum Neolithic we observe over time the emergence of an increased variety of pottery types (small vessels, such as cups and goblets) related to the serving of liquid foods and drink (Krzyzaniak, 2004). This was probably related to increased social differentiation where drinking was part of social display. Thus one sees the beginning of a long-term trend in which small drinking vessels became more prominent and more varied and the presence of also larger vessels, which could have been used both for storing food and brewing beer. In this area beer was made from summer growing crops such as sorghum and millets. Edwards has examined the archaeological material from the Middle Nile region and finds that the importance of beer is manifested in the ritual spheres from the early part of 3rd millennium BC and increased over time. Large jars used for beer were found in graves and they seem to increase in numbers over time. Many of the jars from the later Merotic civilization (2nd century BC-4th century AD) had the capacity to contain several hundred litres of beer. Edwards (2003) sees the finer pottery from Meroitic period, such as drinking cups and goblets, to have been used in special contexts of ritual consumption.

Dirar (1993) has argued that fermented foods such as beer made of sorghum has a long time depth in the Sudan since it is quite diversified, i.e. beer occurs in 30-50 different varieties, and beer can be considered liquid food (porridge). Beer is today of fundamental importance, it is used as a foodstuff that binds people together and reinforces hospitality and communality in everyday life. The two food items, porridge and beer, and the objects and activities involved in their preparation serve as important sources for symbolic elaborations and rituals in a wide range of African communities.

Among the Fur there is a metaphorical association of millet beer and sex, and gruel with mother's milk. The material content of the mother child relationship will with the growth of the child change from mother's milk as evidenced in the fact that gruel mixed with millet/flour is called "milk white –mother's milk". This is also what is uttered when gruel sprinkled on the participants in various ritual occasions such as initiations (see Figure 2) (G. Haaland, 1998).

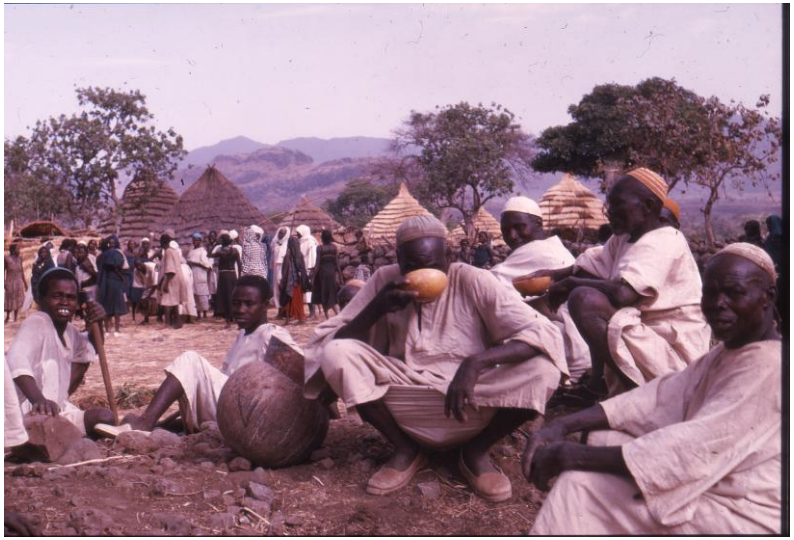

Figure 2: Drinking of beer during a communal work party among the Fur people, Sudan (Photo by Gunnar Haaland)

Beer among the Iteso of Kenya is also closely associated with mother's milk. The first name given to the child is called the

sucking name. This is related to two kinds of sucking, sucking of its mother's breast and then sucking of beer off the finger, which the grandmother offers during the naming ceremony. The difference as Karp sees, it is that the child sucks at its mother's breast before it accepts the name, while the sucking of beer is indicative of accepting its name and thus can be accepted as a member of society. The capacity to drink is seen as a prerequisite for the capacity to engage in social life (Karp, 1980). Beer provides the occasion for an important expression of sociability, especially beer drinking connected with communal work, and rituals. The case of the Iteso is illustrating the processes whereby the child is incorporated into society.

The Afro-Arab circuit

We will look at the Horn of Africa, which appears to have had a similar position as Deccan in that it was a core area for local domesticates such as finger millet (locally domesticated food crops such as teff and ensete never dispersed to other areas). The Horn was on the fringes of the Near Eastern wheat/barley bread making cuisine and a cross road in the adaptation and dispersal of different African cultivars such as pearl millet, sorghum, hyacinth bean and cow pea.

The Horn of Africa also served for millennia as a crossroad for cultural contact and dispersal point for the African food plants which spread across the Indian Ocean to the Indian subcontinent about 4000 years ago. The dispersal of food crops probably took place in two phases and within what Fattovich calls the Afro-Arab regional network, the first phase connecting the Persian Gulf to the Red Sea existed already from the Early Holocene, 7^{th}-4^{th} millennia BC. The early dispersal of African crops could have taken place during this early phase from the Horn of Africa across the Red Sea to South West Arabia (Fattovich, 1988; 1990, 1997). The distance across the sea from the Horn of Africa to the Arabian Peninsula is less than 17 km. Diffusion of both cultural features and people in an aquatic oriented economy would pose no problem, and was at a time when we expect sorghum to have been cultivated but not domesticated (Haaland, 1999).

The first phase would have included cultural contact and exchange between people in a broad-spectrum based economy including plants and aquatic resources. From the Nile valley at the site of Kadero dated to the 5th millennium, marine shells from the Red Sea has been recovered, and shows contact between these areas (Krzyzaniak, 1991). Along the coast of Southern Arabia several sites have been recorded and excavated which show that the inhabitants had a broad-spectrum type of economy, some with a heavy emphasis on aquatic resources similar to the Nile sites along the Nile Valley (Potts, 1990; 1993; Fattovich, 1990; 1997). In an aquatic adaptation the water between the Horn of Africa and the Arabian Peninsula would have been a medium of contact rather than an obstacle to contact. This is manifested in obsidian lithic artefacts found on both sides of the Red Coast. The obsidian raw material most likely originated from the East African highlands (Zarins, 1990; 1996). Finds from pre-dynastic Egypt of obsidian is further evidence of contact and maritime activity in the Red Sea. Zarins (1996) argues that the Egyptians were participating in obsidian trade and this goes back to Pre dynastic times. Trades in incense products were probably equally early (Wengrow, 2006).

The evidence for maritime activities and trade are even more striking in the Persian Gulf. Large shell middens with remains of trade objects such as pottery from Mesopotamia, and flint and obsidian objects have been recovered testifying to a wide exchange network. The network was not only coastal but also circulated inland in what appears to have been a more locally based network (Carter, 2006; Boivin & Fuller, 2009). A boat remains consisting of reed fragments coated with bitumen have been recovered and testifies to the use of boats and seafaring (Carter, 2006). A maritime exchange network seems to have been in place in which the dispersal of African food crops could have been part at this early phase.

5. The dispersal of African food plants to India

The second phase widened the exchange network also to include dispersal of crops across to the Indian sub-Continent. Sauer has characterized the way these crops were introduced as coastal, and suggested that the route followed the east coast of Africa to Arabia

and on to the southern coast of Asia "may be a lost corridor of mankind" (Sauer, 1952: 36). It is during this time 4000 BC, Blench (2003) argues that trade across the Indian Ocean took place.

The Indus Civilization had a strong maritime orientation. Trade to Mesopotamia, Oman, Bahrain is well documented in written sources. For Mesopotamia it was recorded in the Akkadian language and described as Melhua (Harappa) trade from the end of the third millennium (Possehl, 1996). It also describes the trade between Makkan (Oman) and Harappa, Oman had rich copper deposits. Harrappan material is also found in Oman at such sites as Ras al-Junayz (Possehl, 2003: 219). Chemical analysis on copper from Oman shows that these were traded to Mesopotamia and to Indus sites. Possehl (2003) argues that there was an intercultural style shared by the people within this interaction sphere, which he calls the Middle Asian sphere. Indus artefacts have been found at a number of Mesopotamian sites, even artefacts with the Indus script and Mesopotamian material from the Indus sites, although there are fewer artefacts from Mesopotamia found on Indus sites (Possehl, 2003).

Strong maritime oriented fishing cultures appear as discussed earlier along the coast of Oman as early as the 6th millennium BC. Based on this observation it seems likely that these fishermen took part in the trade not only across to the coast of Iran but later also in the dispersal of crops through the coastal interchange (Biagi, 2006). The distance across the Gulf of Oman to the Coast of Iran is barely 40 km. We expect that Indus traders who probably reached Africa would have used the African millets as food, which were consumed by the boat crew and thus reached South Asia during the early 2nd millennium BC or late 3rd millennium (Possehl, 2003). Another scenario is presented by Fuller & Boivin (2009). They discuss the possibility that there were two possibly key players both, which could have been active seafarers in transmission of crops. The first could have been the coastal societies of Oman who demonstrate quite early and long-term maritime activities and seafaring. They developed deep sea fishing, wooden boats just before the time when the African crops are recorded in India. The other likely candidate is the Harappans with the main trading centre and ports in Gujarat. The Harappan maritime activities seem

to have shifted from Indus-Kush region to the coast of Gujarat coast around 2000 BC. An area, which has better, ports and is known for their trading activity till the present. The dispersal of African crops was most likely via this area since Gujarat region already had in place the same system of cultivation of mainly summer crops such as small millets. This cultivation arrangement had more in common with the African crops than did the winter growing cultivation of the Indus region. The Gujarati Harappans involvement in crop movements seems supported by what appears to be paucity of African crops in Oman at the relevant time period. The question of who was responsible for the movements of species between Africa is quite open until more material is recovered.

On the African continent we see the dispersal point of African crops most likely to have been in the region between the lowland Savannah and the Highlands of Ethiopia. The people involved during the first phase is seen as local people in a multi-resource adaptation, and in the second phase it would have involved traders and boat crew from as far as the Indian sub-continent. The African millets were hardy and could keep well during long transport both as food for the crew and brought back as valuable food crops. The network was not only coastal but also circulated inland in what appear to have been a more locally based network

Nepal

Today one can observe the wide distribution of these African crops cultivated along the foothills of the Himalaya from western Nepal to the east. The focus in this article is on the African plants and cuisine the otherwise varied Nepalese food traditions will not be discussed, and just briefly mention that since Nepal is part of the Indian sub-continent, people are cultivating a variety of crops, reflecting different cuisine; such as the bread and oven based on wheat/barley to rice which can be seen as a variation of boiling in the pot (steaming) tradition (Fuller & Rowland, 2011).

The past

No archaeological research on plant crops has been done in Nepal, and the time for the introduction of the different crops is unknown. One way of getting an understanding of the introduction of food plants will be to look at the comparative research which has taken

place in the Indian sub-continent (south Asia). Dorian Fuller is the archaeo-botanists who has probably done most extensive research on early cultivation and has outlined the early agricultural traditions in south Asia. In the outline presented here I will to a large extent build on the work by Fuller 2003; 2005; 2007 and 2009. In his survey he makes an outline of five key agricultural zones.

First the Northwest

Including the greater Indus Valley and its hilly flanks to the west and north (characterised by winter rain with only limited summer monsoon rain). The cultivation depends to a large extent on winter rains or river water. Possehl (1996; 2003) view this area as part of the west Asian region of agricultural origin, stretching from the Mediterranean to the Indus, which he labels the middle Asian. He argues that this whole region is the natural habitat of species that were domesticated. The early dates from such sites as Merhgerh in East Pakistan is an example of presence of early domesticates, interestingly there are several cultural similarities between the archaeological materials recovered here with sites such as Catal Huyuk in Anatolia (Mellaart, 1967 & 1975; Hodder, 2003). The absence of pottery with the use ovens built into the house structures suggests that the characteristic bread and oven cuisine was developed. This type of cuisine was typical of the Near East from early Neolithic to the present. It was also an important part of the Indian culinary tradition as manifested in cultural features such as the bread platters (Allchin, 1960; Allchin & Allchin, 1982). This was later taken over by the cuisine based on rice and boiled food in the pot, which became important from the late 3rd millennium BC.

As discussed earlier the culinary tradition based on small and big millets prepared as porridge/ beer that we discussed for Africa and the Deccan was in place probably somewhat later. These different food systems later spread across most of the Indian sub-continent and are present in Nepal today.

Second Western India

Centred on Gujarat, possibly towards Rajasthan, characterised by semi-arid monsoon rainfall, an area where small millets and monsoon-adapted pulses different from those in the Deccan and

southern India were domesticated. Material might indicate that this took place before millets in the southern region, such as Deccan were domesticated. It is in this area that the earliest dispersal of African big millets might have taken place in the early 2nd millennium BC.

Third Orissa in Eastern India

Eastern India is regarded as probably a distinct area for domestication of rice. Rice became common in south Asia from around 2500 BC. We will not discuss the problem of origin and dispersal of different species of rice in the Indian sub-continent in this paper just briefly mentions the two main species. The present available knowledge categorizes rice into two distinct species indica and japonica. The Indian or south Asian indica rice is likely to have been domesticated in Orissa, while Fuller (2007) places the japonica domestication in south China probably along the Yangzi river during the 6th millennium BC (Crawford and Shen, 1998; Lu, 1999; Crawford, 2006; quoted from Fuller, 2007).

Fourth -the Southern Neolithic

Centred on the Deccan plateau. This region was discussed earlier in relation to dispersal of African crops and cultivation of indigenous cereal and pulses.

The Fifth region the Middle Ganges

Is of special interest for the purpose of this paper, since it is bordering in the north towards Nepal and the Himalayan foothills? Summer monsoon rain and numerous perennial rivers where some winter crops could be cultivated characterize the middle Ganges zone. There is large cultural diversity in the area, Fuller finds it likely that domestication of Indian monsoon growing crops pulses, and small millets could have taken place in the Himalayan foothills or along the Yamuna Doab region. He makes specific reference to the mungbean (*Vigna radiata)* as well as cucurbit, and various gourds such as cucumbers, which have wild progenitor-populations in parts of the Himalayan foothills and central Indian hill ranges.

Winter growing crops such as wheat/barley diffused from the west later (1800-1500 BC), and became integrated into the agricultural practices. Rice was most likely introduced later from the east,

possibly from Orissa. To our knowledge data to suggest the presence of African food crops during the 2nd millennium BC are lacking, still we see it as likely that the dispersal of these crops to the foothills of Nepal might have been via the middle Ganges zone, where they could be well integrated into the agricultural practice since small millets were already cultivated, The African plants and cuisine could thus be easily integrated. Interestingly pottery has been recovered and dated back as early as ca. 7-6000 BC long before there is apparent evidence for agriculture (Fuller 2006). A parallel development that was previously discussed for Africa. However one should not dismiss a possible dispersal rout via north-western region.

There is much to be resolved in terms of dates and the domestication status of botanical remains from this region. The brief survey of early cultivation in south Asia has shown the complexity of the problem of early agriculture. Interestingly it appears to be several centres of domestication of a variety of plants. There does not seem to have been one-way dispersal of crops. The indigenous summer growing crops, small millets and pulses, had several regions of domestication, and the dispersal appears to have been along several routes. The diffusion of crops and the circumstances in adopting crops also seem to have been selective. One has to consider that the process of adapting new crops would have been dynamic and involved new production practices as well as consumption; cuisine.

Nepal a case study

African big millets are cultivated along the Himalayan foothills. The consumption practices associated with millets are similar to the African `pot and porridge' cuisine. This is seen as linked to similar technological aspects of food preparation. There are however also symbolic similarities in the ritual use of millet products and these are more difficult to explain - do they reflect diffusion of symbolic ideas or do the prepared products, primarily beer, have qualities that lend themselves to similar symbolic constructions? In Africa millet products particularly beer plays an extremely important role. In Nepal ritual uses of beer appears to be very similar to the African use. The cuisine of Nepal is as varied as the Indian cuisine and is influenced by different traditions, the

boiling in the `pot and rice' tradition, as well as the `bread and oven' tradition (a variation of this is the *tandouri* cuisine) which is influenced by the later Moghul kitchen introduced in connection with the invasion of the Indian sub-continent during the 12th century AD**.**

The summary and interpretation here is based on the ethnography of the Sherpa's in the Arun valley in eastern Nepal ((1), the Magar's of western Nepal (2) and from data collected from hill villages outside Kathmandu, mainly the Tamang people (3). In discussing cuisine items are included that are related to preparation and consumption of food. Different varieties of finger millet are the important food of the hill tribes. People express that it is much more nourishing than rice and if heavy work is to be done millet is needed and can sustain you for a longer period. It is a food tradition similar to the pot-porridge and beer tradition found at the Deccan plateau, India and which was recorded from Africa. As will be discussed below there are variations in cooking techniques and new elements are added such as popping of sorghum similar to pop corn, this is probably a late phenomena related to the introduction of maize. Similar to what we observed on the Deccan plateau.

Among the Sherpa of the Arun valley and the Tamang of Kathmandu valley different varieties of finger millets are predominant, while sorghum is of minor importance.

The African big millets–are the staple food cultivated by the Sherpa's along the foothills of the Himalaya. It is mostly cultivated on quite steep slopes in mid-hill areas in altitudes ranges from 1500-2500 meter above sea level. The land is regarded as marginal and unsuited for rice cultivation. The most common crops appear to be finger millets and sorghum. Cultivation of pearl millet was not observed. The importance of these plants, however seem to vary within different regions. The fields are prepared by cutting and burning of the vegetation (shifting cultivation) and the land is left fallow for a length depending on soil and forest vegetation. The growth season varies between 5-6 months. Very often the millets are intercropped with lentils or beans. At present with growing population pressure, seedlings are frequently replanted and the use of chemical fertilizers are also increasing in importance. It is here a

monsoon-growing crop and takes 5-6 months from planting in March-April to harvesting in July-August (khoriya cultivation).

Among the Magars in the western foothills both sorghum (*junelo*) and different varieties of finger millets are of importance. The field preparation and planting is done with a hoe. Millet beer is used for communal work such as clearing the fields, harvesting and house building. The technique of food preparation is by grinding and pounding the cereals into flour. These tools are all gendered in the sense that the lower grinder and mortar are symbolically perceived as the female while the upper grinder and pounder are male. The whole food preparation process symbolise the sexual act (Dhakal, 1999). Comparatively we see this type of symbolism expressed within Sub-Saharan Africa as well as a general trend within agricultural communities (Haaland, 1997).

Rituals are carried out during the annuals cycle of farming. It is especially the white finger millet, which is of ritual importance. The agricultural rituals coincide with their concept of the crop seasons. It is crucial that they are performed to the gods of the land when clearing the land and before planting and harvesting. It is a central element in worship of the ancestors. It seems that beer (jaar) and liquor made of millet is of special significance. Rituals are not only vital during the main seasons like planting and harvesting, they have to offer part of the harvested crops to their ancestors, they can not use any part of the harvested crop before rituals are performed. However every time they eat and drink they have to offer some as well.

Among the Magar's living in the two villages Argal and Tangram in Western Nepal finger millet and sorghum are the important food, and they are usually planted side by side. By Hindu high caste people these cereals are considered polluting and are not used for religious purposes. Sorghum is made into a variety of food types; mush, gruel and bread (*roti*).

Figure 3: Finger millets growing in the village of Argal (Photo by Man Bahadur Khattri)

Figure 4: Woman harvesting sorghum outside Village of Nagarkot (Photo by Randi Haaland)

Millet is a key element in rituals among in both the villages of Argal and Tangram, though it appears to play a more significant role in Argal. Sorghum is a sacred grain, especially puffed

sorghum which is used during initiation ceremonies, such as puberty rites for boys and burial rites, it is eaten during rituals of blessing of the food and used in ceremonies related to the agricultural activities as well as to initiation ceremonies.

Millet beer is symbolically elaborated in several rituals among the Magars. It is vital during rituals for the ancestors; during ancestral worship the beer has to be prepared 3 months before the ceremonies. This beer is called "*nau dhara khane*" (nine fountain taps) which is seen as a symbol of mothers milk "*das dhara*" (ten fountains) this emphasise the mothers contribution to her children by the saying "I fed you ten fountains of milk". Furthermore much of millet mush as well as beer are used during these ancestor rituals. During the night before the ceremonies, the sister's son has to prepare the beer during the night and is an important source for symbolic elaborations. It cannot be touched by women and is kept in a copper pot shaped like a woman's vagina called "*Khagu*" (Khattri, 1999).

Millet beer is prepared in special pots and used in ritual greetings, which are important part of initiation ceremonies especially in exchanges taking place during marriage ceremonies, when the groom brings it to the bride's family and the bride brings it to the groom's house. The pot and the beer are used symbolically in marriage ceremonies, and at the birth ceremonies for - marriage and birth are seen as connected and the same elements (beer and pot) are used in the greetings as an expression of this connection. Beer is central part of ceremonies, from birth to marriage and death. Not only is millet used for making beer, but also is millet and sorghum gruel considered ŧ sacred. Puffed sorghum is of special significance and is offered during initiation ceremonies (especially burial rites) when puffed sorghum is cast along the way to the cemetery. Ancestor worship also include preparation and use of a mush/porridge made of millet which is sprinkled during the rituals. Millet beer too is an important part of communal work such as work parties related to house building. This is seen as a social obligation and rituals will be performed when the house is completed.

The above material indicates that millet beer binds people together and serves to reinforce social hospitality during rituals and on community occasions like work parties. In general food as well as beer is of fundamental importance as a medium for initiating and maintaining social relations. Interestingly it is the metaphoric association between mother's milk and beer, which is underlined in rituals of ancestor worship and marriage. The metaphoric association of beer with the mother is expressed in the form of the beer making pot that is shaped like a female vagina as well as the exchange of pots to signify marriage. This underlines the importance of solidarity within family past and present.

6. Conclusion

The dispersal of African crops across the Indian Ocean to the Indian sub-continent around 4000 -3800 years ago is supported by archaeological material. A summary has been made of the archaeological material available at present. As regards Nepal, so far no archaeological material exists. However what one do find is the presence of African finger millets and sorghum cultivated today along the foothills of the Himalaya. We do not know when these crops spread north to Nepal; it is nevertheless evident that these crops were introduced sometime during ancient time. Different regions (the middle Ganges area being most likely) have been briefly discussed as likely candidates for dispersal points of African millets to Nepal.

I do not think the technology of the culinary tradition of pot/porridge and beer was dispersed from Africa. What is remarkable is the way food items were symbolically elaborated in a similar way when comparing this Nepalese case study with societies in sub-Saharan Africa. I am struck by "family resemblance" in the ways the cooking-pot syndrome and its metaphoric association serves to express solidarity. These similarities were probably caused by technological requirements involved in converting millet grains into a cooked food, which favoured a similar pot/porridge beer culinary tradition.

A more complex issue is the similarity in symbolic associations of millet grain converted into beer with mother's milk. The

fundamental aspect of woman as a nurturer is underlined - she produces food and milk, with her own body. The metaphorical associations are grounded in experiential structures of meaning where the role of women as "the nurturer" is pronounced. This is the basis for the metaphorical projections of other relations for quality of thrust and solidarity embedded in the mother-child relationship. Concrete bodily experiences not only constrains the metaphorical projection, but also the nature of the projections themselves or the kind of mappings that can occur across domains (Johnson, 1987: XV).

Notes

1) The information on the Sherpa's presented here is based on Suresh Dakhals Master Thesis 1999. "Shifting Cultivation Technology and Socio-cultural Context". (Bergen University).

2) The information from western Nepal is based on Man Badur Khattri's Master thesis 1999, "Sacrificial Places: An Ethno-archaeological study of the ritual landscape from Argal VDC, Western Nepal". (Bergen University). Similarly, Man Bahadur Khattri collected field data during 2009-2010.

3) Information on the Magar's of the Kathmandu valley is based on field data collected by Suresh Dhakal and Randi Haaland during 2009-2010.

References

Allchin, B. & Allchin, R. (1982). *The Rise of Civilization in India and Pakistan*. Cambridge: Cambridge University Press.

Amblard, S. (1996). Agricultural evidence and its interpretation on the Dhar Tichitt and Ooulatta, south eastern Mauritania. *In Aspects of African Archaeology, 421-42*. eds. G. Pwiti & R. Soper. Harare: University of Zimbabwe Publications.

Anderson, J., D'Ándrea, A., C., Logan, A., & S. M. Ahmed (2007). Bread Moulds from the Amun Temple at Dangeil, Nile State-an Addendum. *Sudan and Nubia*, 89-93.

Appadurai, A. (1981). Gastropolitics in Hindu South Asia. *American Ethnologist 8, 494-511*.

Beldados, A. & L. Constantini. (2011). Sorghum exploitation at Kassala and its environs, North Eastern Sudan in the second and first millennia BC. *Nyame Akuma (75), 33-39*.

Biagi, P. (2006). The shell-middens of the Arabian Sea and Persian Gulf. Maritime connections in the 7th millennium BP. *Adumatu, 14, 7-16*

Biagi, P. ,Torke, W., Tosi, M. & H-P Uerpman. (1986). Qurum: A case study of Coastal Archaeology in Northern Oman. *World Archaeology_16, 43-61*.

Blench, R. (2003). The movement of cultivated plants between Africa and India in Prehistory. *In Food, Fuel, and Fields. Progress in African Archaeobotany*, eds. K. Neumann, A. Butler & S. Kahlheber, 273-288. Africa Praehistorica 15: Køln.

Carter, R. (2006). Boat remains and maritime trade in the Persian Gulf during the sixth and fifth millennium BC. *Antiquity*. 80, 52- 63.

Clark, J. D. & A. B. L.Stemler (1975). Early Domesticated Sorghum from Central Sudan. *Nature* 25, 588-91.

D'Ándrea, A.C., Kahleber, S., Logan, A. L. & D. J. Watson (2007a). Early domesticated cowpea (Vigna uniguiculata) from Central Ghana. *Antiquity* 81, 686-698.

D' Ándrea, C., Klee, M., & J- Casey (2007b). Archaebotanical Evidence for Pearl Millet (Pennisetum glaucum) in Sub-Saharan Africa Evolution of Plant crops. *Antiquity* 75, 341-348.

De Wet, J.M.J. (2005). *Minor cereals. In evolution of crop plants*, eds. J. Smartt & N.W. Simmonds, 202-207. London: Scientific and Technical.

Dhakal. S. (1999). *Shifting Cultivation. Technology and Socio cultural Context*. Master Thesis: University of Bergen: Bergen.

Dietler, M. (1990). Driven by drink: the role of drinking in the political economy and the case of the early Iron Age France. *Journal of Anthropological Archaeology 9*, 352-406.

Dirar, H A. (1993). The Indigenous fermented Food of the Sudan: A study of African Food and Nutrition. Wallingford Oxfordshire: CAB International.

Edwards D. N. (1996). Sorghum, Beer and Kushite Society. *Norwegian Archaeological Review* 29, 65-77.

Edwards, D. N. (2003). Ancient Egypt in the Sudanese Middle Nile: A case of Mistaken Identity. In *Ancient Egypt in Africa*, eds. D. O´Connor & A. Reid, 137-150. London: London University Press.

Edwards D. N. (2004). *Nubian Past. An Archaeology of Sudan*. London: Routledge.

Fattovich, R. (1988). Remarks on the Late Prehistory and Early History of Northern Ethiopia. In *Proceedings of the eight International Conference on Ethiopian Studies*. Addis Ababa: Institute of Ethiopian Studies, 85-104.

Fattovich , R. (1990). Remarks on the Pre-Aksumite Period in Northern Ethiopia. *Journal of Ethiopian Studies 23* (1990), 1-33.

Fattovich, R. (1997). The Near East and Eastern Africa: their interaction. In *Encyclopedia of Precolonial Africa*, ed. O. J. Vogel. 479-484. Walnut Creek: Altamira Press.

Fuller, D. (2003). African crops in prehistoric south Asia. In *Food, Fuel, and Fields. Progress in African Archaeology*, eds. Neumann. K., Butler, N., & A. S. Kahleber, 239-272. Africa Praehistorica 15: Køln.

Fuller, D. (2004). Kawa. *Sudan and Nubia* 6, 70-74.

Fuller, D. (2005). Ceramic Seeds and Culinary Change. *Antiquity* 79, 761-778.

Fuller, D. (2007). Non-human genetics, agricultural origins and historical linguistics in South Asian. In *The evolution of human populations in South Asia*, eds. Petraglia, M.D. & B. Allchin, 393-443. Dordrecht: Springer

Fuller, D. (2009). Silence before Sedentism and the Advent of Cash Crops. *In Linguistics, Archaeology and Human Past in South Asia*, ed. T. Toshiba, 147-187. New Dehli: Manohar.

Fuller, D. & N. Boivin. (2009). Shell Middens, Ships and Seeds: Exploring Coastal Subsistence. Maritime Trade and the Dispersal of Domesticates in and around the Ancient Arabian Peninsula. *Journal of World Prehistory*, 22, 113-180

Fuller, D. & Korisettar (2004). The Vegetational Context of Early Agriculture in South India. *Man and Environment*. 29, 7-

27

Fuller, D. & M. Rowlands (2011). Ingestion and Food technologies- Maintaining Differences over the long-term in West, South, and East Asia. In *Interweaving Worlds in Systemic Interactions in Eurasia 7th to 1 millennium BC*, eds. Wilkinson, J., Sherratt, S., & J. Bennett. Oxford: Oxbow books.

Gosden, C. & J. Hather (1999). *The Prehistory of Food*. Appetites for Change. London: Routledge,

Haaland, G. (1998). Beer, Blood, and Mothers Milk: The Symbolic Context of Economic Behaviour in Fur Society. Sudan Notes & Records 2, 53-76.

Haaland, R. (1987). Socio-Economic Differentiation in the Neolithic Sudan. Oxford: *Cambridge Monographs in African Archaeology 20*. Oxbow.

Haaland, R. (1995). Sedentism, Cultivation, and Plant Domestication. In the Holocene Middle Nile Region. *Journal of Field Archaeology 22*, 157-173.

Haaland, R. (1997). Emergence of Sedentism: New Ways of Living, New Ways of Symbolizing. *Antiquity* 71,: 374-385.

Haaland, R. (1999). The Puzzle of the late domestication of Sorghum. In *The Prehistory of Food. Appetites for Change*, eds. C. Gosden & J. Hather, 397-419. London: Routledge.

Haaland, R. (2007). Porridge and Pot, Bread and Oven: Food Ways and Symbolism in Africa and the Near East from the Neolithic to the Present. *Cambridge Archaeological Journal.* 17, 165-182.

Haaland, R, (2009). Middle Asian and African culture areas defined by cuisines: Core areas and interactions. In *Food and foodways in the Middle East*, ed. N. Naguib, 15-37. Bergen: Bric Press.

Haaland, R. & A. M. Magid (1995). *Aqualithic sites along the Rivers Atbara and the Nile.* Bergen: Alma Mater.

Hodder. I. (2003). Chatalhóyók in the Context of the Middle Eastern Neolithic. *Annual Review of Anthropology*, 3, 105-111.

Johnson, M. (1987). *The Body in the Mind*. Chicago: University of Chicago Press.

Karp, I. (1890). Beer drinking and social experience in an African society: an essay in formal sociology. *In Explorations in African thought*, eds I. Karp & C.S. Bird, 83-119. Bloomington; Indiana University Press.

Khattri, M. B. (1999). *Sacrificial Places: An Ethno-archaeological Study of the Ritual Landscape from Argal VDC, Western Nepal* (Master thesis University of Bergen: Bergen.

Korisettar R., P. C. Venkatasubbaiah & D. Fuller (2001). Brahmagiri and beyond: the archaeology of southern Neolithic. In *Indian archaeology*, in retrospect, eds. S. & R. Korisetter. Vol.1 Prehistory Dehli (Manohar,: 151-356.

Krzyzaniak, L. (1991). Early Farming in the Middle Nile Basin. Recent Discoveries at Kadero (Central Sudan*). Antiquity* 65, 159-172.

Krzyzaniak, L. (2004). Kadero. In Sudan Ancient Treasures, ed. D.A. Welsby & J. R. Anderson, 49-53. London: British Museum.

MacDonald, K.C., Vernet, R., Fuller, D. & J. Woodhouse (2003). New light on the Tichitt Tradition: A preliminary report on survey and excavation at Dhar Nema. In *Researching Africa's Past. New contributions from British archaeologists*, eds. P. Mitchell, Hour A. & J. Hobart, 73-80. Oxford: Oxford School of Archaeology.

Magid, A. M. (1989). *Plant Domestication in the Middle Nile Basin. An Archaeoethnobotanical Case Study*. Oxford: British Archaeological Reports International series 523. Oxford: Oxbow.

Magid, A. M. (1995). "Plant Remains from the sites of Aneibis, Abu Darbein and El Damer and their implications". In *Aqualitic sites along the rivers Nile and Atbara Sudan*, eds. R. Haaland & A. M. Magid, 147-177. Bergen: Alma Mater Press.

McGowern P. E. (2009). *Uncorking the Past.* Berkley: California University Press.

Mellaart, J. (1967). *Catal Huyuk: A Neolithic Town in Anatolia.* London: Thames and Hudson.

Mellaart, J. (1975). The Neolithic of the Near East. London: Thames and Hudson.

Pandey, J.N. (1990). Mesolithic in the Middle Ganga Valley. *Bulletin of the Deccan College.Post-Graduat and*

Research Institute 49, 11-316.
Phillipson, D. W. (1998). *Ancient Ethiopia.* London: British Museum Press.
Potts, D.T. (1990). The Arabian Gulf in antiquity. Volume 1: From prehistory to the fall of the Archemidenid empire. Oxford: Clarendon Press.
Potts, D. J. (1993). Rethinking some aspects of trade in the Arabian Gulf. *World Archaeology*. 24, 423-439.
Possehl, G. L. (1996). Melhua. In *The Indian Ocean in Antiquity*, ed. J. E. Read, 133-208. London: Kegan Paul.
Possehl, G. L. (1999). *Indus Age: The Beginnings*. Philadelphia: University of Pennsylvania Press.
Possehl, G. L. (2003). The Indus Civilization. A contemporary Perspective. Walnut Creek: Altamira Press.
Pratap, A. (2001). *The hoe and the axe. An ethnohistory of shifting cultivation in Eastern India*. New Dehli: Oxford University Press.
Rowley-Conwy, P. (1991). Sorghum from Qasr Ibrim, Egyptian Nubia, 800 BC-1811: a preliminary study, New light on Early Farming. *In Recent Developments in Paleoethnobotany ed.* J. Renfrew, 191-212. Edinburgh: Edinburgh University Press.
Rowley-Conwy, P., P. W. J. Deacon, & C. H. Shaw. (1997). DNA from archaeological sorghum (Sorghum Bicolor) from Qasr Ibrim, Nubia. Implications for Domestication and evolution and a review of the archaeological evidence. Sahara 9, 23-34.
Sauer, C. O. (1952). *Agricultural Origins and Dispersal*. New York: American Geographical Society.
Stemler A. B. L. (1980). A scanning electron microscopic analysis of plant impressions in pottery from the sites of Kadero. El Zakiab, Um Direiwa, and el Kadada. *Archaeologie du Nil Moyen 4*, 87-105.
Vats, M. S. (1940). *Excavations at Harrappa*. Government of India.
Wengrow. D. (2006). *The archaeology of Early Egypt. Social transformation in North-East Africa 10 000 to 2650 BC.* Cambridge: Cambridge University Press.
Willcox, G. (1999). Agrarian Change in the Near East. In *The Prehistory of Food. An appetite for Change*, eds.C.

Gosden & J. Hather, 478-500. London: Routledge.
Zarins. J. (1990). Obsidian and Red Sea trade. *South Asian archaeology* 1987, ed. M. Taddei, 509-541. Rome: Instituto Universitario Orientale.
Zarins. J. (1996). Obsidian in the larger context of Predynastic/Archaic Egyptian Red Sea Trade. In. *The Indian ocean in Antiquity*, ed. J. Read, 89-10. London: Keagan Paul