Early agriculture in China

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China’s vast landmass ranges across contrasting ecological extremes, from tropical in the south, to sub-Arctic in the north, and alpine in the west (Map 12.1). Seventy per cent of this landmass is composed of mountains, plateaux, and hills, and over a substantial part of the country, particularly the continental interior, the availability of water is critical. These features have led to an agriculture that is diverse in its crop ecology, elaborate in its management of water, and at its most intense in the lowlands in the east of the country.

In the west, the cloud capture and montane glaciers provide a critical source of water, feeding China’s two longest rivers, the Yangtze and the Yellow River. The Yangtze runs approximately 6,500 km to the sea at Shanghai, through hilly regions into swampy lowlands, along its course draining a fifth of China’s land surface. The Yellow River runs approximately 5,500 km through the loess plateau towards the Bohai Sea. The lower reaches of those two rivers frame the northern and southern borders of China’s most productive stretch of lowland, the Central Plain, the arena within which much of the history of Chinese civilization has played out. These two rivers have an enduring association with important staple cereals: the Yangtze with rice, and the Yellow River with the Asian millets (broomcorn and foxtail).

Their catchments also include the loci of the domestication of these cereals, but at some remove from lower reaches and plains in which their cultivation subsequently became the most intense. The earliest archaeological sites for the millets are in the middle reaches of the Yellow River in the loess plateau, and also along the foothills that arise at some considerable distance from the river itself. Long before the water in the valley bottom could be effectively managed, the capture of run-off in foothills and elevated locations was critical to the emergence of northern agriculture. The earliest sites for rice are in the middle and lower Yangtze as well as in the Huai River just to the north. These early rice locales are associated with docile minor
tributaries and the wetlands of distal floodplains where cultivation could be more easily managed. By the second millennium BCE, the agrarian management had extended downstream, and the high energy of the main rivers was moderated by irrigation management of increasing scale and complexity. This practice emerges in the documentary record of the first millennium BCE in the form of substantial hydraulic projects associated with named engineers, such as Sunshu Ao (sixth century), Ximen Bao (fifth century), and Li Bing (third century).

To the north of this principal arena of Chinese agriculture, the Central Plain is flanked by the Gobi desert, and beyond that a belt of steppe that continues westwards across Eurasia. Ecologically, both regions are constrained by water scarcity and the severity and length of the winter season. They have nonetheless been of considerable cultural and agricultural significance. For several episodes of China’s past, the northern communities have held political sway over the south, and their mobility has facilitated the appearance in China of a range of animals of importance to agriculture, such as the horse and camel, and probably also sheep, goats, and taurine cattle. These mobile peoples around the northern and western fringes of China also facilitated the transfer of crops into and out of China.

The ten millennia of the Holocene in which agriculture has expanded is also a time in which the environment has undergone some change. A key dynamic element is the monsoonal system, comprising a warm, wet summer monsoon, and a cold, dry winter monsoon. The summer monsoon brings water from the Indian and Pacific Oceans onto much of the south and east of China and has a powerful ameliorative effect on the intrinsic aridity of the continental interior. The winter monsoon drives the movement of aeolian dust from the Gobi desert to the loess plateau. The sensitivity of that monsoonal system to fluctuations in the relative temperatures of land and ocean has rendered it the most variable part of the physical environment, critically affecting the water availability in many parts of China, particularly towards the south and east. In western China, the westerlies are the stronger determinants of water availability. A widespread consequence of these combined factors is a drier earlier Holocene and a wetter mid-Holocene, followed by a return to aridity. The timing of the moister mid-Holocene varies according to location in China, particularly in relation to the monsoons. In the loess plateau, for example, it runs from c. 8,500 BP to c. 5,000 BP, in other

words following the earliest episodes of cultivation but facilitating the spread and establishment of domestication, while predating the episode of food globalization discussed below.

**History of research**

The study of plant and animal remains in China is as old as archaeology itself. Both were analysed in 1928 during the excavation of Zhoukoudian Cave where skeletal remains of *Homo erectus*, known as ‘Peking Man’, were recovered.² They were also both studied during the 1931 excavation of Anyang, believed to be one of the Shang dynasty capitals. The subsequent development of archaeology in China in many ways mirrors the changing social and political discourse of the twentieth century. Archaeological results are often used to justify social and political theories, whether nationalism or communism. Various authors have noted a close relation between Chinese archaeological practice and the building of national identity in the first half of the twentieth century and then subsequently the Marxist framework of history in the second half.³

Between 1949 and 1979 the People’s Republic was organized under a centralized socialist power system. As in the Soviet Union, archaeological thinking was framed within a theory of linear social evolution. Publications on ancient agricultural systems in this period tended to focus upon relations of production and class struggle. A notable example is Guo Moruo’s (1972) hypothesis on three stages of the development of Chinese societies: primary, slavery, and federalist society, relating to the archaeological records of Neolithic, Early Bronze Age, and Late Bronze Age.

In 1979, a more relaxed political atmosphere following the end of the Cultural Revolution and the implementation of economic reforms stimulated developments in all aspects of Chinese archaeology. More broadly, economic reform also opened China’s doors to the world. Scholarly exchange between China and Western countries was actively encouraged, and Western archaeological methods and theories introduced. The number of articles dealing with prehistoric agriculture multiplied. In the 1980s, two periodicals were launched for publications of articles related to agriculture, *Nongye Kaogu* (Agricultural Archaeology) and *Gujin Nongye* (Ancient and Modern Agriculture).

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Prior to the late 1990s, archaeobotanical data were sporadically collected without systematic use of flotation strategies (washing soil from excavations to retrieve organic remains: Figure 12.1). The documentation of archaeological plant remains was focused upon taxonomic identification. Chinese
archaeobotany (the study of plant remains from archaeological excavations) was initiated at the turn of the 1990s, primarily inspired by international encounters. In 1986, following his visit to the University of Cambridge, Huang Qixu published an article in Nongye Kaogu introducing the flotation system that had been developed in the late 1960s and 1970s by Eric Higgs’s group working on the early history of agriculture.⁴ A subsequent account was published in the same journal by Xiong Haitang describing his observations during the visit to Nagoya University in Japan. This method was then applied in Liluo in 1992, an excavation led by the Chinese Academy of Social Sciences. Meanwhile, flotation machines modified from that originally designed by Patty Jo Watson in America (the SMAP type) were brought to East Asia by Toronto archaeobotanist Gary Crawford, first to Japan and Korea and subsequently to China. The last two decades have witnessed the widespread application of systematic flotation and the rapid development of archaeobotanical studies. Beijing archaeobotanist Zhijun Zhao (Figure 12.1) has played a pivotal role in encouraging the application of flotation in China. Zhao in 2011 reported on flotation-based archaeobotany at more than 80 archaeological sites across China: about 7,000 soil samples had been processed, and a significant quantity of charred plant remains recovered.⁵ This rapid growth in archaeobotanical evidence has been accompanied by qualitative improvements in the analysis and interpretation of such evidence.

Deep-seated culinary traditions of the East: boiling and steaming

Compared to other regions of the world, a striking feature of East Asian archaeology is the early date at which ceramics are found. Current evidence places pottery in the Yangtze region back some 18,000 years, with ceramics nearly as old in parts of Siberia and Japan, while in northern China ceramics were being made by the start of the Holocene 12,000 years ago.⁶ These early ceramics were associated with hunter-gatherers, who used them for boiling fish and plant foods. By contrast, in Southwest Asia ceramics develop relatively late, c. 8,500 years ago, millennia after the beginnings of cultivation and

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domestication. While the Pre-Pottery Neolithic cultures of Southwest Asia made extensive use of querns for flour production and constructed clay ovens (tandoors) for baking bread and roasting foods (see Chapter 8), Neolithic China elaborated forms of ceramic vessel for boiling, steaming, and serving.\(^7\)

So, in Western Asia early crops were processed for a flour-focused food system. While grinding stones were used in prehistoric China, boiling and steaming of grains and other foods appear to have been and remained the predominant East Asian methods for preparing foods. This contrast had consequences for the selection of grain quality features, with gluten proteins being selected in Western Eurasia for bread-making properties and starch properties being more variably selected in East Asian cereals, such as rice, millets, and even wheat varieties. It is clear that cooking traditions have persisted as distinctive and contrasting in China (and East Asia) as opposed to Southwest, Central, or South Asia.\(^8\)

The ultimate expression of the East Asian culinary selection of grain quality is found in the sticky (or ‘glutinous’) cereals, including sticky rice and sticky millets. This stickiness is conferred by mutations to the waxy gene which reduce the amylose form of starch and increase the amylopectin form. Cereals with this trait, the glutinous rice, millets, and maize, are largely exclusive to East and Southeast Asia, defining what has been referred to as the ‘glutinous endosperm starch’ culture area.\(^9\) That this trait has evolved in parallel in several species and multiple times in some of these, such as foxtail millet, points to a strong cultural preference since prehistory in at least part of China.

Beginnings in the north: from millets to soybean and hemp

Two types of millet, broomcorn (\textit{Panicum miliaceum}) and foxtail millet (\textit{Setaria italica}: Figure 12.2), are believed to have originated in northern

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China. While these species are referred to by different names in Chinese in the past and present, the most common names are respectively shu and su. These were the staple calorie sources of the developed Neolithic in central China (the Yangshao, Dawenkou, and Longshan traditions), as well as the staple grains during the Shang and Zhou dynasties.10

The wild ancestor of foxtail millet is *Setaria viridis*, which is an annual grass widely distributed over a large part of East Asia. However, determining its original wild range and habitat is complicated by its proclivity for anthropogenic habits, both as an arable weed and as a volunteer on roadsides, probably including feral populations that derive genetically from the crop. (Indeed *S. viridis* is a widespread weed in North America where it was introduced through European plant translocations in the past few hundred years.) Nevertheless, probable primary habitats can be found in natural disturbed settings such as upper floodplains, including along the Yellow River and its many tributaries.

The wild progenitor for broomcorn millet, by contrast, remains debated. A candidate, at least in morphological terms, is provided by *Panicum miliaceum var. ruderale*, inferred as the wild progenitor by some scholars.11 These *ruderale* types are widespread as weeds from eastern Europe to East Asia, but are

unknown from non-anthropogenic habitats, making them plausibly feral. In contrast to foxtail millet, wild populations in likely primary habitats are unknown, although we expect them to have occurred in the drier north of the loess plateau and the Chinese steppe.

It remains the case that our knowledge about how the domesticated forms of broomcorn and foxtail millet evolved from their wild ancestor is limited. Unlike in the case of rice, wheat, or barley, archaeological data on the loss of seed dispersal, a key domestication trait, are lacking. Nevertheless, in most seed crops an increase in grain size evolved alongside the non-shattering trait. This is one proxy that has shown potential for the Chinese millets. It has been noticed that millet grains show a gradual increase in size and change in shape over the Neolithic period. This has led scholars to speculate that the broomcorn millet (Figure 12.3) from the early Neolithic sites such as Xinglonggou (discussed in Chapter 13) is intermediate in caryopsis size and shape between modern domesticated and wild forms, and therefore

Figure 12.3 Carbonized remains of millet from Xinglonggou, dating to 7700 cal BCE.

represents an early stage of domestication. The increase of grain size and change of shape also appear to be associated with the increasing proportions of millet grains among archaeobotanical assemblages in northern China. Although the timing and process of millet domestication remain to be resolved, the above evidence would suggest that the domestication of millet and the development of early cultivation systems in northern China were a protracted process. Recent genetic research has clarified the geographic relationships of broomcorn millet. While SSR microsatellite studies accommodate both a single (northern Chinese) origin and a dual origin across Eurasia, studies of loci affecting the ‘waxy gene’ (for grain ‘stickiness’, see above) are more concordant with an origin in a single region of northern China and a westward spread from there.

Two terminal Pleistocene sites on the loess plateau in Shanxi province have provided residue evidence and tool use-wear evidence for pre-agricultural plant use. Starch granules from Shizitan (c. 12,700–11,600 BP) have been identified for a range of plants including acorns (Quercus sp.), beans (Vigna sp.), tubers (Dioscorea sp.), and panicoid grasses. The Panicoideae is the subfamily in which both broomcorn and foxtail are placed. In a separate account of the use-wear on grinding implements from Xiachuan (c. 23,900–16,400 BP), archaeologists have observed various patterns that may have resulted from different pounding and grinding movements. One of those patterns appears to be similar to those for the grinding of moistened grains with soft husks. None of these data is directly associated with macrofossil evidence for millet, but they nevertheless indicate the use of post-harvest processing techniques that would be appropriate for incorporating grains in the diet. Prior to the domestication of millets, the development of ceramic vessels suitable for boiling offered another possible method of preparing these hard seeds for consumption.

13 Z. Zhao, ‘Cong Xinglonggou yizhi fuxuan jieguo tan Zhongguo beifang zaoqi nongye qiuyuan wenti (Addressing the origins of agriculture in North China based on the results of flotation from the Xinglonggou site)’, Dongya Guwu, 12 (2004), 188–99.
Turning from the Pleistocene to the early Holocene, the archaeobotanical record for millet in northern China is clearer. Alongside records of charred grains, evidence from phytoliths and starch granules has moved back the earliest published dates associated with millet by two millennia. This comes from a range of sites in Hebei province, including Nanzhuangtou, Donghulin, and Cishan. The earliest date in a published claim is currently in the eleventh millennium BCE. In the case of foxtail millet, processing of *Setaria italica* and/or *S. viridis* by the start of the Holocene at Donghulin, Beijing (c. 7500 BCE), and Nanzhuangtou, Hebei (c. 9500 BCE), has been inferred from recent starch grain studies. In the case of *Panicum miliaceum*, the earliest published claims relate to phytoliths from the site of Cishan, retrieved from pits in stratigraphic section. While morphological identification as *Panicum miliaceum* may be plausible, the wild form cannot be ruled out. AMS radiocarbon dates on associated pit sediments range between 8500 and 7500 BCE.

The earliest macrofossil evidence dates to the turn of the seventh/sixth millennia BCE. Several localities report charred broomcorn and foxtail millet grains from prior to 5000 cal BCE. They include Xinglonggou in Inner Mongolia; Xinle in Liaoning; Yuezhuang in Shandong; Donghulin in Beijing; Cishan in Hebei; Peiligang, Shawoli, and Wuluoxipo in Henan; and Dadiwan in Gansu.

A striking feature of the geographic distribution of the millet sites in this period is their concentration along the margins of the loess plateau and the Inner Mongolian plateau. To the east of these plateaux lie northern China’s two major alluvial plains, the Huabei plain (the North China plain) and the Dongbei plain (the Northeast plain). A chain of low mountains, broadly running northeast–southwest, extends over some 2,500 km along the boundary between the plateaux and the floodplains. The pre-5000 BCE millet sites listed above are all situated on foothills and share a similar relationship to the mountain chain. Beyond this mountain chain, other early millet sites are situated in the same relationship with mountains, as for instance Dadiwan in relation to the Qinling mountains and Yuezhuang to the Yitai mountains.

The common feature of those millet sites is their recurrent location at a position above the nearest river course, at the break of slope between the

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18 H. Lu et al., ‘Earliest domestication of common millet (*Panicum miliaceum*) in East Asia extended to 10,000 years ago’, *Proceedings of the National Academy of Sciences*, 106 (2009), 7367–72.
uplands and the softer sediments of the foothills, at points where rainwater can be captured in freely draining fertile plots.²⁰ Although involving different sediment types and different landform histories, this distribution resonates with the alluvial locales of early farming sites in Southwest Asia. That pattern, described as ‘geological opportunism’ by Claudio Vita-Finzi and ‘catchment farming’ by Andrew Sherratt, chimes with the millet landscapes of northern China.²¹

An enigmatic feature of the records for broomcorn millet is its apparent occurrence on both sides of the Old World. During the sixth and fifth millennia BCE, some twenty sites from Europe and the Caucasus report broomcorn millet identified to species level.²² However, direct radiocarbon dating of grains of European broomcorn millet has indicated that at least some, and possibly all, of these ‘early’ records are spurious (i.e. intrusions of recent-age seeds into Neolithic layers). The date at which Asian millets reached Europe remains a matter for enquiry and confirmation.

Useful as they are for establishing geographic patterns and chronology, the contribution of millet to the diet is difficult to infer from recorded quantities of archaeological grain, sensitive as they are to archaeological site formation processes (the intrusion problem mentioned above). The dietary contribution of millets is more effectively approached through palaeodietary analyses of stable isotope measurements from bone. A growing body of human stable isotopic values indicates that consumption of C₄ crops (which in this region we presume to derive from broomcorn and/or foxtail millet) became common in all regions of northern China from 5000 cal BCE onwards.²³ However, the earlier isotopic pattern is more variable, both between sites and between individual consumers. Among human skeletal remains from the five cultures reporting millet pre-5000 BCE, one is consistent with no millet consumption and two are consistent with a mix of C₄ and C₃ consumption.²⁴ In only one of the five pre-5000 BCE cultures, Xinglongwa, does the carbon isotope signal indicate millet consumption on a significant scale (see Chapter 13).

²⁰ Liu et al., ‘River valleys and foothills’.
Turning our attention from the east of Eurasia to the west, although the archaeobotanical record for this period includes millet taxa, stable isotopic studies have demonstrated that Neolithic Western Eurasian diets were largely based on C_3 resources. The consumption of C_4 crops here is not isotopically demonstrated until the Bronze Age (1500–1100 BCE) in Italy and the Iron Age (800–400 BCE) in central Europe, and it was never as prominent as it was in Neolithic northern China.\(^25\)

In summary, the published records of archaeological grain finds have suggested an expanded reliance on millets throughout northern China by c. 5000 BCE. Prior to this, although many archaeological cultures are recorded as using millet to some degree, there is only one, Xinglongwa, in which millet constitutes a significant component of the carbon diet.

Neolithic peoples did not live by millet alone, and over the course of the middle Neolithic, additional domesticates came to contribute to the diet, including pigs, soybeans, and hemp seed. On the basis of available archaeological finds, the earliest evidence of use, if not cultivation, of soybeans is in central China, south of the Yellow River and in the Yellow River basin, rather than in the northeast. Quantities of glycine have been found, for example, at Jiahu, dating to the later seventh millennium BCE.\(^26\) Soybeans at Jiahu have a small seed size. Changes in seed size suggesting domestication are evident between 3650 and 1450 BCE.\(^27\) Korean archaeological soybeans follow roughly the same chronological trajectory as that of the Yellow River region, which could link these two regions into a single domestication pathway, or two closely parallel pathways. By contrast, an earlier and independent domestication in Japan is indicated by middle Jomon soybeans from Shimoyakebe.\(^28\)

Hemp (Cannabis sativa) has served as both an oilseed and a fibre crop in early China, in addition to its drug uses. It was well established as an edible seed crop and drug by the time of early Chinese written sources.\(^29\) Although its original wild distribution is unclear, Li (1983) regarded it as being a native of the open environments of the semi-arid loess highland of northern China,
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in addition to wild populations that persist across Central Asia. Genetic evidence seems to support distinct western and eastern domestications in Asia. Archaeobotanical finds have been few but include Majiayao culture Linjia, Gansu (c. 4,700 BP), Shang dynasty Taixi, Hebei (c. 3,500 BP), and Daxinzhuang, Shandong (c. 3,500 BP).

Pigs were the domesticated animal par excellence of early China. Recent zooarchaeological work using geometric morphometrics (computerized modelling of animal size) points to a central Chinese domestication. Indeed, pig teeth from Jiahu (9,000–8,000 BP) on the Huai River group with domestic pigs, close to those from the Yangshao period site of Xishuipo. Stable isotopes from the bones of domestic pigs allow detection of when they become a major consumer of millets, plants that wild boar are unlikely to consume in any quantity. Millet consumption by pigs implies that they were either being pen-fed or else consuming scraps from the human kitchen or latrines of millet-eaters. Barton et al. documented how Yangshao-era pigs (after 4500 BCE) at Dadiwan ate millet in contrast with pigs of the early Dadiwan period (5500 BCE).

Beginnings in the south: early rice farmers of the Yangtze basin

It has been posited for some decades that rice farming (Figure 12.4) originated in the Yangtze basin. From the discovery during the 1970s excavations of substantial quantities of rice at the Neolithic waterlogged site of Hemudu (7,000–6,300 BP; Figure 12.5), to discoveries in the 1990s on middle Yangtze sites such as Pengtoushan and Bashidang, the Yangtze region has featured at the start of most accounts of rice origins. There has long been an archaeological

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Figure 12.4 Rice field in Zhejiang province.

Figure 12.5 The Neolithic site of Hemudu.
and genetic case to be made for the separate origins of indica domesticated rice in India, although it now appears that distinct early cultivation practices in India were enhanced by hybridization with introduced domesticated rice forms from East Asia around 4,000 years ago.

Analyses of phytoliths recovered from Pleistocene caves on the southern margins of the Yangtze basin have also led to suggestions of Pleistocene rice domestication in the region, although clear criteria for determining either cultivation practices or morphological domestication of rice have been lacking. Instead what is evident is that, from 18,000 BP, mobile hunter-gatherer societies in the Yangtze region developed ceramics as a novel form of post-harvest food processing, with more sedentary forager villages occurring from around 9,000 BP. Although wild rice was present from at least 15,000 BP, it is unclear how significant this was for these hunter-gatherer systems. More recent improvements in archaeobotanical recovery have indicated that rice domestication was underway during, and only completed after, the Hemudu cultural phase in the lower Yangtze valley, i.e. 7,000–6,000 BP. This points to a start of cultivation in this region of c. 10,000–9,000 years ago; in the middle Yangtze valley it could have begun somewhat earlier but may represent a parallel process to the lower Yangtze. Indeed, sites on the Huai River and other northern tributaries of the Yangtze, such as the Han River, could indicate additional centres of early rice cultivation. Evidence for the very earliest cultivation and the start of the rice domestication process remains obscure: current archaeological evidence makes the end of the domestication process clear, rather than its beginnings.

It has also become clear from recent archaeobotanical studies that rice cultivation emerged in the context of broad spectrum foraging focused on the

38 Boaretto et al., ‘Radiocarbon dating’.
collection of tree nuts, especially acorns of various oak species, and wetland nuts, especially water chestnuts (*Trapa natans*) and foxnuts (*Euryale ferox*). Besides gathering and storing these nuts, increasingly sedentary societies began to manage the shallow freshwater wetland margins for the production and planting of perennial wild rice (*Oryza rufipogon sensu stricto*). Freshwater fish were also heavily exploited in these environments. In the Hangzhou Bay region, the Kuahuqiao and Hemudu cultures had villages of post-built long-houses, suggestive of large extended household groups, continuing a tradition already evident at the earlier sedentary forager village of Shangshan (10,000–8,500 BP). In the middle Yangtze Pengtoushan culture, houses included mainly large ovoid huts with sunken floors, perhaps for smaller groups. There were just a few rectilinear buildings, with rectilinear architecture becoming more standard during the subsequent Daxi period (6,500 years BP). Rice increasingly supplemented nuts and gradually displaced them as a dietary staple over the course of perhaps 2,000 to 3,000 years. During this same period rice evolved domestication traits – adaptations to being cultivated and harvested – including loss of wild-type seed dispersal, a key trait for documenting domestication archaeologically, but also increasing grain size and by inference such traits as closed panicles, increased seed number, erect growth habit, and increased annuality.

The growing quantity of archaeobotanical evidence, as well as sites with preserved field systems, allows the reconstruction of early cultivation systems. Rice was initially managed along wetland margins that were expanded to control water depth, possibly through dry season burning and clearance as well as soil preparation. From the period at which rice remains display clear domestication traits, around 6,000 years ago, artificial field systems are evident, for example in the lower Yangtze region, east of Taihu Lake, at the sites of Chuodun and Caoxieshan. These early fields consisted of small dug-out, ovoid puddle fields in the order of 1–2 m in diameter (Figure 12.6). This technology indicates small-scale but intensive management of rice, in which soils could be fertilized, water readily drained, and harvests easily secured. This is also associated with smaller houses, perhaps indicative of nuclear families. At Chengtoushan in the middle Yangtze, features interpreted as belonging to elongated fields following natural contours and defined by raised banks (c. 2.7 m wide and over 20 m long), in the context of associated archaeobotany, are suggestive of shallow-water, wet rice

40 Fuller and Qin, ‘Water management’.
Houses were also elongated and rectangular, more permanent, and suggestive of larger households than those of earlier Bashidang and Pengtoushan.

By about 6,000 years ago (the Daxi period in the middle Yangtze and the late Majiabang in the lower Yangtze), domesticated rice had become established as the key dietary staple for Neolithic societies, and the basis in subsequent centuries for the emergence of increasing social complexity and population growth. In the middle Yangtze valley the increased productivity and reliance on rice supported the growth of population, as reflected in the scale of the third-millennium BCE settlements of the Qiujialing and Shijiahe cultures. In the lower Yangtze, Liangzhu society (3300–2300 BCE), with its centres of urban character, elaborate jades, and other craft objects, was supported by intensively cultivated landscapes of rice. The central site of Liangzhu included impressive city walls, canal systems for transport, artificial platforms for occupation, and elite burials (such as the Mojiashan site). The nearby site of Maoshan has yielded extensive paddy-field systems that would be familiar to a modern rice farmer, with long walkways and embankments defining

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square to rectilinear fields that could be irrigated from local streams (Figure 12.7). Pigs, melons, and bottle gourds are the only other clearly documented domesticates aside from rice. Cultivation of fruit trees like persimmon and peach, and fibre crops like ramie and mulberry for silkworms, is also probable. The first preserved textiles come from Liangzhu contexts and indicate production of ramie and silk, but spindle whorls suggest that textile traditions extend back to the early rice cultivators of Kuahuqiao and Hemudu, as well as the Neolithic middle Yangtze.

The established rice agriculture of the later Neolithic of the Yangtze provided the basis for the spread of agriculture further south, to the southern provinces of Fujian, Guangdong, and Guangxi. The arrival of rice in these regions took place around 5,000–4,500 years ago. Foxtail millet also spread, at least to Guangxi, pointing towards the middle Yangtze as the source region, as millets were unknown in the lower Yangtze. This is supported by material culture parallels as well. From southern China rice and millet

had spread further to mainland Southeast Asia by 4,000 years ago.\textsuperscript{44} Prior to the arrival of rice, there is evidence for the consumption of starchy foods, such as palm starch, bananas, arrow root, and Job’s Tears, although it is unclear whether any of these were cultivated, as opposed to gathered.\textsuperscript{45} Once adopted, rice cultivation probably remained limited for some time, with evidence for population growth, and agricultural impacts on the wider landscape evident in erosional signatures in offshore ocean sediments, only from around 500 B.C.E.\textsuperscript{46}

Unlike in northern China, with its two millets, there was no complementarity of crops in the basic subsistence of the Neolithic Yangtze, nor were any secondary crops of importance added to the subsistence suite, as soybean was in the north. This is in contrast with the diversity of crops domesticated in Southwest Asia or parts of South Asia, which included multiple cereals and legumes (see Chapter 10). The first two to three millennia of farming in the Yangtze basin focused almost exclusively on rice, although there is evidence for small-scale cultivation of adopted foxtail millet in the middle Yangtze. There is also the possibility that the mint ‘shiso’ (\textit{Perilla frutescens}) and melon (\textit{Cucumis melo}) were cultivated at Chengtoushan from the Daxi period, although we lack clear morphological evidence of domestication.\textsuperscript{47} While agriculture in the Yellow River region diversified through secondary domestications (e.g. soybean, hemp) and adoptions (e.g. wheat, rice) and developed an ideology of diversity (the ‘five grains’ tradition discussed below), early Yangtze agriculture was single-mindedly about rice. Agriculture eventually diversified in the region, especially after 4,000 years ago as the Yangtze was drawn into the orbit of the states that emerged along the Yellow River, and crops such as wheat and soybean spread to the south.

**Influence from the west: from wheat to wheels**

The same general era which witnessed the florescence and decline of several regional complex societies of the advanced Neolithic was also the period when central China came into contact via trade with Central Asia, facilitating the adoption of domesticates and other technology from the west. Uncertainty remains over how early broomcorn millet appears in Western Eurasia as well

\textsuperscript{44} C. Castillo, ‘Rice in Thailand: the archaeobotanical contribution’, \textit{Rice}, 4 (2011), 114–20; and see Chapter 16 below.
\textsuperscript{45} X. Yang et al., ‘Sago-type palms were an important plant food prior to rice in southern subtropical China’, \textit{PloS ONE}, 8 (2013), e63148.
\textsuperscript{46} D. Hu et al., ‘Holocene evolution in weathering and erosion patterns in the Pearl River delta’, \textit{Geochemistry, Geophysics, Geosystems}, 14 (2013), 2349–68.
\textsuperscript{47} Nasu et al., ‘Land-use change’.

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as the east. From the third millennium BCE, however, the presence of Chinese millets beyond China was paralleled by the eastwards spread of crops and livestock, notably wheat and barley, and cattle and sheep, into China. This era has been referred to as one of Bronze Age globalization, and in the northwestern parts of India and Pakistan as a ‘Chinese Horizon’, as several plants of Chinese origin appear to have arrived around or just after 4,000 years ago, including millets, japonica rice, peach, apricot, and hemp. An important Central Asian site with evidence relating to these Old World crop dispersals is Begash in Kazakhstan, with direct dates on wheat and broomcorn millet that fall between 2450 and 2150 cal BCE.

Within China, wheat mostly dates from 2000 BCE onwards, although earlier dates are known. A single radiocarbon date from the Zhaojiazhuang site in Shandong province places bread wheat in China at 2500–2270 cal BCE, currently the oldest record of a Southwest Asian crop in China. During the course of the Han dynasty the adoption of rotary querns allowed the development of flour foods like noodles and buns.

This same period provides the first clear evidence for domesticated sheep, goats, and cattle, which were also likely introduced from the west around 4,500 years ago. Unlike in Western and Central Asia (including Xinjiang) or India, there are no ethnographic or historical traditions of major reliance on dairying these animals in central China. During the course of the second millennium BCE, other technologies moved eastwards across the continent, including bronze metallurgy by c. 2000 BCE and horses, wheels, and chariots by 1200 BCE.

50 M.D. Frachetti et al., ‘Earliest direct evidence for broomcorn millet and wheat in the Central Eurasia steppe region’, *Antiquity*, 84 (2010), 993–1010.
The second millennium BCE sees a substantial increase in evidence of Southwest Asian crops in China as well as in Central Asia. During this period, wheat and barley are frequently reported from dated contexts in western China, including in Gansu and Qinghai provinces and Xinjiang and Tibet autonomous regions. Evidence from western Yunnan at the site of Haimenkou and in southern Tibet at Changgougou (on the Yarlung Tsangpo River) indicates the presence of wheat and/or barley by perhaps as early as c. 1400 BCE, but certainly by c. 1000 BCE. This early episode of food globalization, linking east to west through crop exchanges, is mirrored in the south by increased contacts between the Yangtze, southernmost China (Lingnan), and Southeast Asia, by which rice and millets spread southwards.

**Conclusion: the ‘five grains’ and their origin**

Agriculture plays a vital role in modern China, employing millions of people and feeding 20 per cent of the world’s population. The Chinese word for ‘food’ or ‘meal’ is 田, which denotes a cereal food such as boiled rice or millet porridge. For those who eat in a Chinese way, 田 is essential to everyday life; only 田 will satisfy hunger. This emphasis upon plant crops in the East contrasts with the importance accorded to livestock in the West. In Europe grain production has repeatedly been integrated with animal husbandry in a system of mixed farming. In China, farming has concentrated upon grain production throughout the historical period, and may have done the same in prehistory. Up until recently, the Chinese diet has largely been vegetarian, a pattern undergoing fundamental change in recent years.

China ranks first among nations in cereal output, primarily producing rice, broomcorn millet, foxtail millet, wheat, barley, maize, potatoes, and peanuts. The cultivation of those crops is consequent upon several episodes of global agricultural exchange between different parts of the Old World, and between

the Old World and the New. Maize, potatoes, and peanuts originating from the New World were introduced into China in the sixteenth and seventeenth centuries following the European discovery of America. Southwest Asian crops, notably wheat and barley, were adopted into Chinese farming systems in the third and second millennia BCE, as a key component of trans-Eurasian exchange. Parallel prehistoric exchanges between East, Southeast, and South Asia and North Africa have also recently been documented. Many such exchanges conversely brought Chinese domesticates to other regions of the world.

The earliest textual evidence of multiple cropping comes from a Shang dynasty oracle bone from Anyang. This script arguably contains evidence for rotation of autumn-sown wheat or barley and spring-sown millets. Such evidence resonates with a recurrent theme of intensively farmed landscapes in various parts of Eurasia, including Mesopotamia and the Indus valley during the third and second millennia BCE. For example, accounts of Mesopotamian farming systems on cuneiform clay tablets depict estate-based agriculture combining an early harvest of autumn-sown barley and a later harvest of spring-sown millet and oilseeds.

Legendary accounts of the invention of agriculture by Shennong (the divine farmer) credit him with first cultivating *wūgǔ*, ‘five grains’, and teaching people how to sow them. The lists of ‘five grains’ vary and very often include such grains as hemp and sesame that are principally used for oils and flavouring. One list in the *Classic of Rites*, a manuscript ascribed to Confucius in the sixth and fifth centuries BCE, comprises broomcorn and foxtail millet, soybeans, wheat or barley, and hemp. In another version of *wūgǔ*, hemp is replaced with rice. Stories of Shennong’s ‘five grains’ are often mythologically charged. Sometimes the crops themselves were regarded as sacred; at other times their cultivation was regarded as the source of agrarian society and civilization itself.

The Anyang oracle bones include characters which may be ascribed to the five grains. Recent advances in archaeobotany and the increasing application of flotation in China have enriched our knowledge of grain production in prehistory. By 2000 BCE, all of the legendary ‘five grains’ were in evidence at sites in central China, in Henan and eastern Shaanxi provinces. Recent excavation at Erlitou, presumed to be the capital city of the first Chinese dynasty (Xia), yielded charred remains of broomcorn and foxtail millet, rice, soybeans, wheat, and hemp. This list is concordant with the two versions of the ‘five grains’, completing a chain that links mythology, text, archaeology, and the contemporary world of Chinese agriculture.
Further reading


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