People and Plants in Ancient Southwest China

3,000 Years of Agriculture in Yunnan from the First Villages to the Han Conquest

Rita Dal Martello

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Abstract

Today Yunnan is a highly productive agricultural region within Southwest China. Located at the ecological transition between temperate and tropical East Asia, the mild year-round climate supports up to three crop harvests per year in some areas. This has allowed it to become the fourth largest exporter of vegetable products in the country, despite having been considered to have only 6% of land originally suitable for agriculture. How did Yunnan become such an agriculturally productive region? This book examines the accumulated archaeological evidence for ancient plant remains in Yunnan and reconstructs the origin and development of farming practices in the province. Covering the period from the first sedentary villages to the Han conquest of the Dian Kingdom (third millennium BCE to early first millennium CE), the book also explores the local evolution of farming in the broader context of external connections and local adaptations. Special attention is given to the Sanjiang area, where the Yangzi, Mekong, and Salween rivers converge, creating a hub for connections between East, South and Southeast Asia, as well as the Dian Basin, the core region of the Dian Kingdom. By analysing crops cultivation and uses, and comparing findings from Yunnan with those from broader Southwest China and mainland Southeast Asia, this monograph addresses the question of early human migrations in and out of Yunnan, and how these impacted the evolution of the region's first agricultural societies, ultimately laying the basis for the flourishing agricultural production we see in the province today.

Keywords Yunnan. Neolithic Archaeology. Bronze Age. Archaeobotany. Agriculture. Rice. Millet. Wheat. Austroasiatic languages.

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To my grandfather

Preface

Dorian Q. Fuller
University College London, UK

As anyone who follows Chinese archaeology is aware the past quarter century has witnessed massive growth in the field, with more excavations, more data and major methodological advances. Archaeological sciences have had particular expansion and that has included archaeobotany – the systematic sampling, sorting, identification and interpretation of preserved plant remains from archaeological excavations. The history of the growth of this field in China and its impact on understanding processes of early agricultural evolution is just one of the topics covered in this book. While there are a few books in the Chinese language that offer overviews of this methodology the present volume takes this method as its central vantage point for viewing the cultural history of the prehistory of Southwest China, Yunnan. This offers a refreshing alternative to histories focused on pottery typologies and grave goods assemblages. There is no holistic cultural history without a history of resources and subsistence!

The transition to agriculture was a fundamentally transformative episode in cultural and environmental history. While foraging societies that had peopled the world for hundreds of thousands of years may have sometimes impacted the population of large game mammals or altered vegetation succession by intentional burning, it was with the advent of agriculture that systematic long-term environmental modifications were set in place. Agricultural systems are fundamentally early successional vegetation, a local environmental reset, and the dominant species – those planted by people – are very often non-native, introduced from somewhere else. The increased productivity per unit of land and the increased reliance on delayed returns and storage laid the basis for key changes to human groups – higher population densities, surplus that could be translated into wealth and influence, and less mobility for most people.

These changes set challenges to social systems and health but opportunities for innovation. Increased sedentism and population density set the social challenge of either creating ideologies of redistribution that aimed at egalitarianism within extended families/communities or transitioning into systems of hierarchy, land ownership and hereditary status and wealth. Less mobility and higher population densities meant new epidemiological regimes, and the setting in which the diseases of herd animals could transition in the human herd, a process that continues to challenge humanity today.

Surpluses, however, also could support a minority of humans with higher mobility – trade expeditions that tied regions together and allowed for the translocation of new ideas, new crop varieties and new technologies. Processes of diversification took place in agriculture – more cropping seasons, annual and long-term perennial crops (diversification), increased labour inputs (intensification), and more commodification of crops through specialization and exchange, such as in textile production, dried and preserved fruits, oils and wines. Processes of diversification in crafts, stone working, ceramics, metallurgy, textiles, took place in parallel. Regions with different agricultural potentials and access to different mineral resources, and crafting traditions, could become linked in systems of direct and down the line exchange that might be identified as emergent 'world systems'. Some regions, like Yunnan, could be key players to such networks.

Geographically, Yunnan is a potential network hub where the development of commodification, specialization and exchange would play a long-term role in historical dynamics. The land 'south of the clouds' (or cloud topped mountains), that is *Yún-nán*, is linked by the thread of the Yangtze river, and its many tributaries, to central China. Equally it is linked to the South by four major rivers that radiate outwards to Southeast Asia (Irrawaddy, Salween, Mekong, and Red River), and the Pearl River that flows east the regions of China grouped as Lingnan. This connectivity has played a major role in theorizing macroregional archaeological patterns. In exploring the idea language-farming dispersals authors have often theorized from this fact that language families or rice farming spread via these rivers, but as Dal Martello shows in this book the growth of empirical evidence for agriculture in Yunnan, elsewhere in southern China, and in Southeast Asia, is against this simple view of a single wave of advance of rice farmers. Reality appears more complex, with migrating millet farmers, some also spreading rice, from central China up the Yangtze to Yunnan, while other flows were over the hills from the Yangtze to Guangdong and around the southeast coast of China. Crops likely came to Southeast Asia in various ways, sometimes rice and millet together, sometimes separately, later waves of migration and adoption of new crop varieties through trade took place also. To Yunnan a later wave of migration came with wheat, barley and sheep in Yunnan, while other diversifications included domestications of buckwheat and *Chenopodium* native perhaps to the surrounding Yunnan hills. Bronze working techniques also spread around this time. Even later waves of diffusion, perhaps more trade than migration, brought sticky forms of rice, moved some *Citrus* fruits (oranges southwards, pomelo northwards), and various cucurbits (winter melons, bitter melons, snake gourds). Thus, there were wave after wave that layered cultural and agricultural diversity in Yunnan.

Despite its networking role with Southeast Asia, Yunnan was also a cultural frontier, a fracture zone in bio-cultural diversity. Interestingly, in the evidence described in the book that follows there is little sign of crops that originated in India (with a possible exception to be confirmed of ancient tamarind from Shifodong). From mungbean and pigeonpea, to sawa millet, and species like African sorghum or Lablab bean that traversed India, there are numerous important aspects of traditional agricultural diversity in Yunnan and South China that had their origins to the Southwest in India, or traversed India. While some of these species are evident in Southern Thailand just over two thousand years ago in the last centuries BCE (for example, at Khao Sam Kaeo), they are not yet evident in Yunnan through the Dian period as outlined in this book. Thus, we must look to a later period, after the Han Dynasty, for the increase in more direct diffusion between Yunnan and northeast India. In traditions of diet and cooking, western Yunnan is a frontier zone, with use of dairy products more common towards the west, increasingly so in India and high Tibet, with sticky cereals, like glutinous forms of millet, as well as rice, more frequent in the east.

Therefore, while Yunnan as a whole may play a role in the flow of cultural practices, ideas, crop species, and moving human populations. It was more of a constructed valve than an open channel: flows were not constant or continuous. It was sometimes closed, sometimes selective, and always to be understood in terms of local contexts of agricultural environments and cultural traditions that included cooking practices. Archaeobotanical details, like those elegantly analysed in this volume provide an inherently local dataset, speaking to practices in the creation of landscape, but also the macroregional implications for how people of different regions shared in wider trends in heritage that is agriculture. This book offers a new baseline from which to expand the investigation of agriculture in cultural crossroads.

Introduction
Understanding Humans and Plants in Early Southwest China

Yunnan Province is located on the southwestern end of modern continental China. To the northeast, it borders with the Chinese provinces of Tibet (*Xizang* 西藏 in Chinese), Sichuan 四川, Guizhou 贵州[1] and Guangxi 广西, and to the southwest with the countries of Myanmar, Laos, and Vietnam **[fig. 1]**. Ecologically, Yunnan sits between temperate East Asia and tropical Southeast Asia, acting *de facto* as a transitional belt between the two regions (Tang 2015). The Yunnan landscape descends from high mountains and an alpine climate in the northwest to tropical rainforest in the southeast, creating vertical zonation in vegetation and environment. This provides the province with the highest biodiversity within mainland China, counting 14,822 of native seed plants, which corresponds to ca. 49% of the total recorded seed plants in the whole country, giving Yunnan the title of 'Treasure Garden of China'.[2] Yunnan's biodiversity attracted many 'botanical explorers'[3] in the early nineteenth century, who travelled to the region and identified and exported the local flora, contributing to document the vegetation of the province before its economic modernisation.

Note on Chinese terms and names: this volume uses Pinyin, the official romanization system of the People's Republic of China, for the transliteration of Chinese terms. Chinese characters are presented as per the original publication, either in simplified or traditional form, depending on the version adopted by the original authors. Chinese personal names are listed according to the standard practice, with the surname preceding the given name.

1 Geographically, the region of Southwest China includes the provinces of Yunnan, Sichuan, Guizhou and Chongqing 重庆 Municipality. Tibet is sometimes also included in broader Southwest China, and other times given its own regional division.

2 Wu 1977-2006; Walker 1986; Myers 1988; Zhao 1994.

3 Botanists that went on expeditions to Yunnan include, for example, French missionary Père Jean Marie Delavay (1834-95), Scottish botanist George Forrest (1873-1932), and British botanist Ernest Henry Wilson (1876-1930; see Godfrey 2017).

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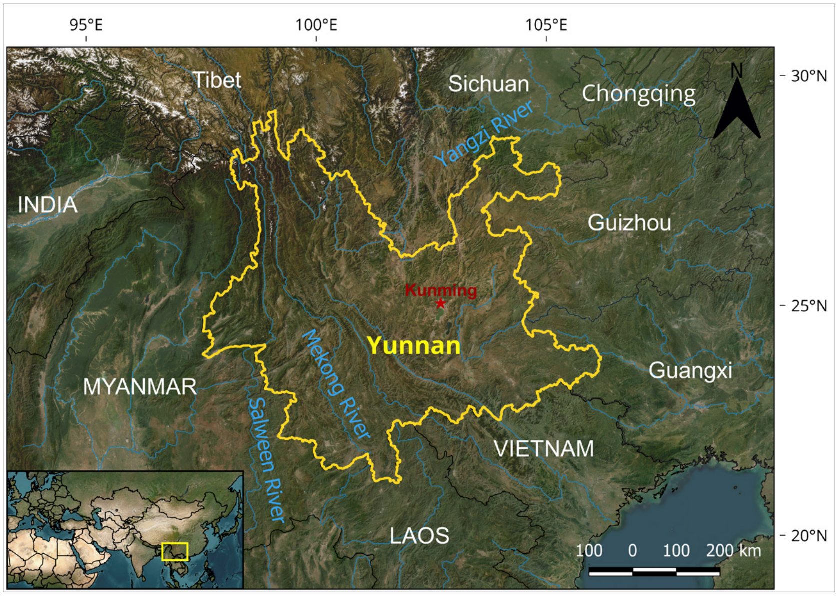

Figure 1 Location of Yunnan Province with indication of capital city of Kunming, major rivers, neighbouring Chinese provinces and Asian countries. Made by the Author with QGIS 3.28.5. Firenze, Natural Earth and ESRI Imagery basemap

Yunnan is also home to the largest number of ethnic groups in China. According to the 2020 Chinese National Census, the province had a population of 47,209 million people, accounting for 3.34% of the total Chinese population (NBS 2021). At least 25 recognised ethnic groups live in Yunnan, representing over 33% of the total provincial population. The 2020 Chinese Population Census further states that, within modern China, some of these groups are only found in Yunnan (NBS 2023). These include, for example, the Hani 哈尼, Dai 傣, Va (*Wa* 佤), Lahu 拉祜, Naxi 纳西, Jingpo 景颇, Blang (*Bulang* 布朗), Achang 阿昌, Pumi 普米, Nu 怒, Jino (*Jinuo* 基诺), De'ang 德昂, and Drung (*Dulong* 独龙) people. This contributes to an unparalleled diversity of cultural traditions and customs, and the vertical zonation of Yunnan's vegetation offers insights into the distribution of those ethnic populations, with the same group inhabiting similar landscapes sharing elevation, vegetation, climate and derived lifeways across distinct areas of the province (and across with neighbouring countries; Zhao 1994). The great diversity in landscapes and people of Yunnan has contributed to the current popularity of the province for both domestic and international travel, with an attested 5% increase in annual visitors in the last few years (SCIO 2024). The fascination with Yunnan's modern life, culture, and landscapes is counteracted by the still rather limited knowledge about its early cultural and social development. Yunnan's remote location might have hindered systematic archaeological research. Other contributing factors include the general short history of archaeological research in the country as a whole and the greater focus placed upon the investigation of the Central Plains, seen as the 'cradle of Chinese civilisation'.[4] This narrative

4 Falkenhausen 1993; Shelach-Lavi 2015; Lu 2012; Liu, Chen 2012; Yao 2016.

puts the Central Plains in contrast to more peripheral areas and as such traditionally considered of secondary importance to the development of Chinese civilisation. This is well exemplified by the scarcity of information about Yunnan contained in recent major English language reference books of Chinese archaeology, which reflects the lower number of archaeological excavations undertaken in the province.[5] The assumed secondary role of Southwest China in the formation of Chinese civilisation is being increasingly challenged.[6] On one hand, archaeological finds such as the incredible hundreds of bronzes, jades, gold, and ivory artefacts from two sacrificial pits in Sanxingdui 三星堆, Sichuan, in 1986 fuelled interest in the region. On the other hand, the modernisation of Yunnan's infrastructure, especially the construction of railways and motorways to connect the province to the rest of the country, although not the only factor at play, undoubtedly had a role in the expansion of archaeological excavations in the province in the past decades. Notwithstanding the rescue nature of most of these archaeological campaigns, Yunnan has become the focus of academic interest for topics such as early migrations across Asia and interactions between the early Chinese states and local polities, just to name a few.[7] Interest in early subsistence practices has developed alongside the chronological reconstruction of the cultural developments of the area.[8] Given the rich local environmental diversity within Yunnan and broader Southwest China, questions of past plants dispersal, ecological adaptation and uses are essential for fully understanding the socio-economic development of this region from antiquity to today.

Today, most of the areas with human occupation in Yunnan are frost-free, and this is hugely beneficial for agriculture. Despite the widespread belief that the karstic nature of Yunnan makes it unsuitable for agriculture,[9] plant production in the province has seen a continuous increase in the last decades. In 2023, Yunnan was the third Chinese province for fruit exports, and the fourth for vegetable products exports.[10] According to statistics provided by the Chinese National Bureau of Statistics (*Guojia Tongjiju* 国家统计局),

5 Yunnan is barely included in the seminal work by K.C. Chang (Zhang Guangzhi 張光直; 1931-2001) *The Archaeology of Ancient China* (1986), where the province is mentioned only in relation to early hominid sites (e.g., the Yuanmou Man). The province is not included at all in the edited volume *A Companion to Chinese archaeology* (Underhill 2013). Yunnan is mentioned in relations to bronze production and its long-distance trade in *The Archaeology of China* by L. Liu and X.C. Chen (2012, 249-50, Ch. 10) and *The Archaeology of Early China* by G. Shelach-Lavi (2015, 246-57, 331-6). At time of writing of this book, only two English language monographs have been published about prehistorical and early historical Yunnan to date: *The Ancient Highlands of Southwest China* (Yao 2016); *Ancient China and the Yue* (Brindley 2015).

6 Through his work in the prehistory and early history of frontier regions in Southwest China, Tong Enzhen 童恩正 (1935-1997) played an important role in highlighting the existence of local cultures in Southwest China before the Han's influence on the region, which in turn resulted in an increased recognition of local contributions and multi-regionalism in the formation of early Chinese Civilisation (Chang 1986; Falkenhausen 1995). His work is often cited as laying the basis for the current flourishing of archaeological work in these areas in the last two decades (see Hein 2014).

7 See, for example, Yang et al. 2023; Wu et al. 2019; Wang J. 2018; Yao 2016; Allard 1998.

8 See d'Alpoim Guedes 2011; 2013; d'Alpoim Guedes et al. 2015; Li et al. 2016; Dal Martello 2022.

9 According to Walker (1986), only 6% of Yunnan (the area comprised of small basins and valleys) would have been originally suitable for agriculture.

10 Statements from the Belt and Road Portal, Xinhua News Agency. `https://eng.yidaiyilu.gov.cn/p/0ROJV61F.html`.

the "total sown area of farm crops" in Yunnan was 5,890,000 ha in 2004; by 2022 it had increased to 7,130,000 ha, of which 746,930 ha of land were occupied by tree orchards (NBS 2024). This indicates that today about 20% of Yunnan territory is occupied by some level of agricultural practices.[11] Until the early 2000s, rice was one of the most cultivated cereal grains across the province, but since 2010 maize production has surpassed that of rice.[12] Before this shift, state records attest that below 1,000 m asl, abundant water availability derived from rivers, lakes, and precipitations allowed up to three crop harvests per year, often of irrigated rice (Zhao 1986; 1994, 38).[13] These regions have been historically occupied by the Dai ethnic group (Bray 1984, 21). Above 1,000 m asl, rice was cultivated in the summer, followed by wheat in the winter. Finally, above 2,400 m asl, in the western and southern border areas of the province, one crop was produced per year (Zhao 1994, 38). Here, there is a long history of slash and burn agriculture, which historically has been practiced by Drung, Jingpo, Dai, Bouyei (*Buyi* 布依), Va, Nu, Miao 苗, De'ang, Yao 瑶, Yi 彝, Hani, Lahu, and Jino groups (Bray 1984, 21; Shirasaka 1995; Yin 2001). This type of agricultural regime (also known as swidden or shifting agriculture)[14] is practiced in hilly areas and uses fire to remove the vegetation cover and to naturally fertilise the soil. After the vegetation is cleared, dryland crops are planted; after harvest the land is left to fallow for several years so to recover the lost soil nutrients, and fields are moved to another patch of land, which is cleared through fire before sowing. According to ethnographic surveys undertaken by anthropologist Yin Shaoting 尹绍亭 between 1983 and 1990, it was estimated that until the first half of the twentieth century, slash and burn practices were the dominant agricultural system in Yunnan (Yin 2001; 2015).[15] By the time of Yin's study in the 1980s, such cultivation system, although still reported as present, was nested in the mountains along the western and southernmost limits of the province borders. Its progressive decline was due to the mechanisation of agriculture and the general industrial development post 1949 (Yin 2001, 86-7). Today slash and burn agriculture is found almost exclusively in Xishuangbanna, in southern Yunnan (Yin 2015).[16]

11 This corresponds to a total agricultural production of 2,857,920 billion tons in vegetables and 1,957,960 billion tons in grain crops in 2022, compared to 1,509,500 billion tons in grain crops and 855,140 million tons in vegetables in 2004 (NBS 2024).

12 Today total maize production in tons is more than twice as much that of rice.

13 The National Bureau of Statistics divides rice production according to seasons and cropping practices in early rice, middle season rice, single cropping late rice, and double cropping late rice, further indicating how the peculiar environmental and climatic conditions of the province allow a rich, almost year-round rice production.

14 In Chinese slash and burn agriculture is indicated as *daogeng huozhong* 刀耕火种 (tilled with knife planted with fire). Historical texts until the Song Dynasty (960-1297 CE, then uncommon) used the term *shetian* 畲田 (field cultivated by first setting fire to it; Yin 2001).

15 Beyond Yunnan, slash and burn agriculture was also still practiced in Hainan and in southern Guizhou (Yin 2015).

16 It is worth pointing out that local ethnic groups still practicing slash and burn agriculture in the 1970s and 1980s were largely blamed for forest degradation and pushed to adopt other types of 'improved' (less 'primitive') agriculture (Yin 2015, 123). This, together with population growth, the adoption of mono-culture plantations, and the implementation of state agricultural policies (for example the 2003 Sloping Land Conversion Program in northwest Yunnan) have altogether caused a progressive decline or completely ended slash and burn practices (see Guo et al. 2002; Gros 2014).

Although scholars hypothesise that the earliest agricultural systems were similar to slash and burn practices, information on the establishment of early agricultural systems in the region is scarce. In the last two decades, the direct recovery of ancient plant remains from archaeological sites through the increased application of flotation (see Ch. 2) has resulted in a wealth of data that puts us in a unique position to reconstruct the origin and development of agricultural systems in China, based on direct evidence from archaeological sites. This book reviews the available archaeological and archaeobotanical evidence related to the transition to an agricultural life in Yunnan and explores questions of how agriculture emerged and developed in the region. Covering the period from the first sedentary villages to the Han conquest of the Dian Kingdom (third millennium BCE to early first millennium CE), this book also explores the local evolution of farming in the broader context of external connections and local adaptations. What role did migrations play in the establishment of farming systems in Yunnan? And was Yunnan itself the origin for further spreads of agriculture to the surrounding regions, such as mainland Southeast Asia, as it has been inferred by some linguistics reconstructions? By analysing crops cultivation and uses, and comparing findings from Yunnan with those from broader Southwest China and mainland Southeast Asia, this monograph addresses the question of early human migrations in and out of Yunnan, and how these impacted the evolution of the region's first agricultural societies, ultimately laying the basis for the flourishing agricultural production we see in the province today.

In chapter 1, I present methodological approaches to the study of early agriculture, this includes a review of the history of archaeobotanical research in China in the context of the larger archaeological research trends in the country. Chapter 2 provides a synthesis of both early and more recent theories on the origin of agriculture in China, with special emphasis on early domestication hypotheses and recent archaeological developments that either corroborated or confuted those hypotheses; this includes theories linked with the farming/language dispersal in relation to Yunnan. This chapter ends with a synthesis of current knowledge on the spread of cereal crops domesticated elsewhere to China, as these crops contributed to the diversification of local agricultural production, including in Yunnan. In chapter 3, the ancient climate of Yunnan is reconstructed through examination of paleo-proxies from the region. This provides an environmental context through which situate the emergence of a settled, agricultural lifestyle in prehistoric Yunnan. Chapter 4 provides information on currently known sites in Yunnan with available archaeobotanical evidence to date. Data from stable isotopes is also included as this is a methodology that is increasingly being undertaken in China to explore dietary composition of ancient people and animals. Isotopes studies provide an additional line of evidence through which compare and reconstruct ancient people's diet. I use the available evidence to trace the history of agricultural practices from emergence to intensification in Yunnan. Special focus is placed on the area known as *Sanjiang* 三江 in Chinese (often referred to as the Three Rivers area), where the Yangzi, Mekong, and Salween rivers converge, creating a hub for connections between East, South and Southeast Asia. In chapter 5, reconstructed trajectories to agriculture in Yunnan are compared with those of its neighbouring regions, including broader Southwest China and mainland Southeast Asia, where agriculture is often hypothesised to derive from Yunnan. Through this, I trace possible routes of cultural connections and migrations across broader East and Southeast Asia as evidenced by the reconstructed archaeological and archaeobotanical framework.

The aim of this book is to understand how the development of a productive subsistence based on the cultivation of domesticated plants impacted the evolution of prehistorical and early historical societies in Asia at both the local and regional levels. This work will be relevant for scholars working in this region and more broadly to researchers interested in the topic of ancient agricultural production, as well as those interested in cultural and economic exchange and connections in prehistoric times. More broadly, this book provides a glimpse into how prehistoric people in Yunnan lived, and how they interacted with a landscape that today has been heavily changed by millennia of agricultural practices.

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1 Studying Humans-Plants Interactions: Methods in Archaeobotany

Summary 1.1 Introduction. – 1.2 Archaeobotanical Research in China. – 1.2.1 Chance Plant Finds and the Theme of the Origins. – 1.2.2 Flotation and the Beginning of Archaeobotany. – 1.2.3 Chinese Archaeobotany in the Twenty-First Century. – 1.2.3.1 The Establishment of Archaeobotanical Laboratories and the Expansion of Archaeobotanical Practice. – 1.2.3.2 The Standardisation of Archaeobotanical Practice in Chinese Archaeological Research. – 1.2.3.3 Decentralisation, Internationalisation and Shifts in Research. – 1.3 A Note on Archaeological Excavations and Flotation Studies in Yunnan.

1.1 Introduction

Archaeobotany studies the relationship between people and the environment in the past through the analysis of ancient plant remains from archaeological sites (Fuller, Lucas 2014). Archaeobotanists aim to explore all aspects of people-plants interaction. Popular topics in archaeobotanical research include (the list is non-exhaustive)

- investigating the domestication pathways of plant species, both from the biological point of view and the social and cultural developments occurring in societies after the transition to an agricultural economy;
- tracing the dispersal of domesticated plant species outside their native region; reconstructing ancient vegetation and its management;
- plant production for use as fuel and manufacture;
- understanding past social organisation in the production and exploitation of natural resources;
- food production and consumption, including past meal preparation technologies and diets;
- cuisine traditions as basis for social and cultural identities.

According to their size, archaeobotanical remains are grouped into two main categories: macro- and micro-remains. Macro-botanical remains

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indicate seeds, nutshells, fruit stones, wood and wood charcoal fragments.[1] These usually preserve by charring through contact with fire. Other common preservation pathways are waterlogging, when organic remains are sealed in anaerobic conditions, for example through submersion in water, and dessication, happening, where the absence of water restricts the growth of fungal, bacterial and other harmful organisms and resulting in good preservation of organic remains. Finally, ancient plants can also be preserved via mineralisation, which occurs through contact with calcium phosphate ($Ca_3(PO_4)^2$), for example from urine in sewage and latrines. Macro-botanical remains are mostly recovered through flotation, a method further explained below. Micro-botanical remains include phytoliths (silica cells deposited in the soil by the plant during its life cycle), pollen grains, and starches (Pearsall 2015; Fuller, Lucas 2014). Increasingly, other types of evidence are studied in archaeobotanical research, including isotopes, lipids and molecular biomarkers retrieved from organic residues, bones and charred seeds, and more recently paleo-soils (Pearsall 2015). The collection of micro-botanical remains requires a lengthy laboratory procedure, for example for phytoliths, it includes pre-treatment, centrifuging and washing of the soil to extract the micro-material to study. In this book I focus on macro-botanical remains, and therefore the collection and research history of micro-botanical remains is not reviewed here. Readers are referred to Henry (2020) for an introduction to micro-remains in archaeological research, Rosen (1999) and Piperno (2006) for phytoliths; Fiorentino et al. (2015) and Fernandez and Jaouen (2017) for a summary on recent applications of isotope analyses in archaeobotanical research. Readers are further referred to Dal Martello et al. (forthcoming) for an overview of the study of these materials in Chinese Archaeobotany.

To recover macro-botanical remains from archaeological sites, archaeobotanists employ a method called flotation. This methodology was first employed in archaeological contexts in the early 1950s at Tularosa Cave and Higgins Flat pueblo in New Mexico, United States, by Hugh Carson Cutler (1912-1998), who later visited Stuart Streuver (1931-2022) during the Lowillva Project, at the Apple Creek site in Lower Illinois River Valley, and demonstrated the technique, persuading him to undertake it during excavation (Browman 1999; Streuver 1968). The process developed by Culter and published by Streuver was subsequently applied, slightly modified, at the prehistoric site of Ali Kosh in the Deh Luran Plain, in Iran (Helbaek 1969). The methodology was simple and inexpensive, requiring only a container, a sieve or net with small size mesh, and some water. Today, guidelines for archaeological excavations by the Chinese State Administration of Cultural Heritage (*Guojia Wenwuju* 国家文物局; in the past referred to as State Bureau of Cultural Relics) recommend a sieve of 0.2-0.5 mm mesh size (Guojia 2009). Such a small mesh size ensures even the smallest plant remains are recovered. The excavated soil is placed in the container, water is slowly added to it and the soil is gently stirred to allow any organic remains to float to the surface thanks to their lighter weight and more porous density compared to soil. The soil deposits at the bottom of the bucket, while the float is collected on the sieve and poured into a cloth. The sample is labelled, tied securely, and let dry in the shade.

1 The study of charcoal fragments is also referred to as anthracology (*mutanxue* 木炭学/*mutan fenxi* 木炭分析).

Once dried, each sample is processed in a laboratory employing a low-power, binocular microscope; plant remains are extracted, identified, and counted.[2] As highlighted by Streuver (1968, 353), this methodology counteracts the tendency to select for larger remains and it drastically increases the quantity of material retrieved, as it allows the recovery of smaller remains which would otherwise not be clearly visible or retrievable during excavation by sieving only. This was further emphasised by the contrast in the number of remains retrieved before and after the use of flotation at Ali Kosh, with excavators eloquently stating that, while

> according to the 1961 report, plant remains were scarce at Ali Kosh. Nothing could be farther from the truth. The mound is filled with seeds from top to bottom; all that was 'scarce' in 1961 was our ability to find them, and when we added the 'flotation' technique in 1963 we recovered a stratified series of samples totalling 40,000 seeds. (Hole et al. 1969, 24)

A mechanised process of flotation was developed shortly after, with the use of several tanks and a pump (e.g., Limp 1974) and usually referred to as machine flotation. This allows for a quicker and more efficient processing of the soils compared to manual (or bucket) flotation. An early type of flotation machine was developed between the 1960s and the 1970s by Eric S. Higgs (1908-1976), founder of the Cambridge Palaeoeconomy School at Cambridge University in the United Kingdom. Higgs's Palaeoeconomy Research Group popularised flotation across archaeological excavations in Europe and the Mediterranean region.[3] This early type of flotation machine was further developed by the Shell Mound Archaeological Project working in the Green River Area in Kentucky, United States (Watson 1976). 'SMAP-type' flotation machines are today the most used ones worldwide, including in China.

1.2 Archaeobotanical Research in China

1.2.1 Chance Plant Finds and the Theme of the Origins

Until the 1980s, the recovery of plant remains at archaeological sites in China depended upon accidental discovery of high enough quantity and/or large enough plant remains that were visible with the naked eye during excavation (Liu et al. 2008, 8). The identification was then delegated to botanists or agronomists. Some notable examples of such finds include possible foxtail millet grains (described as *su* 粟 – *Setaria italica* in the original report), and alleged cabbage or mustard seeds (*baicai* 白菜 or *jiecai* 芥菜)[4] from two pottery vessels found in a pit at Banpo 半坡, Xi'an, Shaanxi (Zhongguo 1963; Zhao 1983). In 1960, rice remains were reported from Zhujiaju 朱家咀, Hubei (Hubei, Wang 1964). In 1973-74, an impressive quantity of rice husks, rice

2 Although Streuver also described and employed chemical flotation in the lab to further separate charred plant remains from small bones, this type of chemical separation is no longer employed by archaeobotanists today.

3 For early examples of flotation use see Stewart, Robertson 1973; Renfrew 1973; Jarman et al. 1972; Higgs 1972; French 1971.

4 Scholars now prefer to refer to this find with a more generic 'vegetable' seeds (see Zhuang 2020, 616).

grains and acorns were found in pits at Hemudu 河姆渡, Zhejiang (An 1980; You 1976). In 1976-78, during the excavation of the Cishan 磁山 site in Hebei Province, possible foxtail millet grains (referred as *su* 粟 – *Setaria italica*) were found in over 80 storage pits (Sun, Liu, Chen 1981; An 1980, 37; Tong 1984). Here, heaps of 'decayed' small round seeds were found at a depth of between 0.3-2 m (and in few cases deeper than 2 m), which, however, turned into dust shortly after exposure to air (today this find is contested, see § 2.2.3.2.2). Charred remains of possible walnuts, hazelnuts and hackberries were also found in some of the pits (Sun, Liu, Chen 1981). Beyond direct finds of plant remains, the presence of plants at archaeological sites was also attested by grain impressions on ceramic sherds, for example rice grains were identified from ceramic impressions on sherds unearthed at the Yangshao 仰韶 site and at the Yangshao culture site of Xiawanggang 下王岗, in Xichuan, Henan (An 1980, 41; Henan et al. 1999).

Plant remains recovered from archaeological sites were always interpreted as evidence for local cultivation and therefore representing settled agricultural populations. In the absence of plant remains, tools recovered during excavations were used to reconstruct possible agricultural practices. For example, harvesting was inferred through the presence of knives and sickles; spades, shovels and hoes were seen as evidence of land clearance and ploughing, and grinding stones were interpreted as cereal grain processing tools. Their retrieval, therefore, indirectly attested agricultural practices (Zhuang 2020). These early finds were central for the theorisation of a local origin of agriculture in ancient China, through the hypothesised domestication of millet in the North and rice in the broader South,[5] although scholars disagreed on the exact region for rice domestication (see § 2.2.1).

The reconstruction of the origin of agriculture was part of a broader effort by Chinese archaeologists to prove that Chinese civilisation had an indigenous origin, in response to early claims of a Western diffusion. The diffusionist theory was first proposed by Johan Gunnar Andersson (1874-1960) after finding painted ceramics at Yangshao sites in Northwest China. According to Andersson, Yangshao painted ceramics were similar to those found for example at Anau Culture sites in Turkmenistan, or at Trypillia/Tripolje Sites in modern Ukraine.[6] Until last century, Chinese scholars adopted the Marxist unilinear social evolution model as the primary interpretative framework for archaeological material.[7] The Marxist social evolution paradigm was first linked with archaeological evidence by Guo Moruo (郭沫若 1892-1978) in his 1930 book *Zhongguo Gudai Shehui Yanjiu* 中國古代社會研究 (Research on Ancient Chinese Society).[8] The Marxist paradigm stated that ancient societies were initially 'primitive', mobile tribes hunting wild animals and gathering wild plants who evolved into settled agriculturalists, and then transitioned into slavery, feudalism, capitalism and communism in a linear progression. Not only was there a strict dichotomy between mobile

5 Ho 1969; An 1980; Yan 1982a; 1982b.

6 An 1980; on this topic see also Chang 1964; Falkenhausen 1993; Xu 1999. About the Anau Culture see Kircho 2020; on Trypillia Culture see Müller, Rassman, Videiko 2016; Shatilo 2021.

7 Chang 1977a; 1999; Cheng 1965; Yang 1999; Lu 2002.

8 This book was highly influential in the Chinese Academic community and the theoretical paradigm illustrated by Guo became the dominant interpretative framework for archaeological remains after the foundation of the People's Republic of China in 1949.

hunter-gatherer tribes and settled agriculturalists, but the beginning of agriculture was considered as a necessary step for the rise of civilisation; therefore, tracing the origins of agriculture was essential to finding the roots of Chinese civilisation.

1.2.2 Flotation and the Beginning of Archaeobotany

The last two decades of the twentieth century in China were characterised by a general economic and political opening, with a renewed interest in international research. This resulted in a stream of foreign literature being translated into Chinese, presenting newly developed scientific archaeological terminology and methods to Chinese scholars, including those of archaeobotany.[9] This was met with interest especially by those archaeologists investigating the prehistorical period, who had focused on reconstructing the origins of agriculture. The increased interest in early agriculture is exemplified by the foundation of two academic journals entirely devoted to the topic: *Nongye Kaogu* 农业考古 (Agricultural Archaeology), and *Gujin Nongye* 古今农业 (Ancient and Modern Agriculture) founded in 1981 and 1988, respectively (Liu, Fuller, Jones 2015, 313). With regard to the study of macro-botanical remains, four articles are considered seminal for the development of archaeobotany in the country. In 1986, Huang Qixu 黄其煦, an archaeologist from the today Institute of Archaeology at the Chinese Academy of Social Sciences (*Zhongguo Shehui Kexueyuan Kaogu Yanjiusuo* 中国社会科学院考古研究所, henceforth IA-CASS) published in *Gujin Nongye* the article *Kaogu Fajuezhong Huishou Zhiwu Yicun de Fangfa zhi Yi – Paomo Fuxuanfa* 考古发掘中回收植物遗存的方法之——泡沫浮选法 (Flotation: a method for the recovery of plant remains in archaeological excavations), where he described the flotation methodology. In 1989, archaeologist Xiong Haitang 熊海堂 (1951-1994) witnessed archaeologists at Nagoya University, Japan, using a SMAP-type machine to undertake flotation and the same year he published an article in *Nongye Kaogu* describing machine flotation (Xiong 1989). These two articles mark the official start of archaeobotany in the country. In 1992, archaeobotanist Zhao Zhijun 赵志军 described archaeobotanical theoretical principles, field work collection methods and laboratory procedures for macro- and micro-botanical remains, highlighting the need for systematic collection methods in the article *Zhiwu Kaoguxue Gaishu* 植物考古学概述 (Archaeobotany: an overview; Zhao 1992). Zhao's article was particularly important to the field as it was the first to use the term 'archaeobotany' (*zhiwu kaoguxue* 植物考古学; 'plant archaeology', now usually abbreviated as *zhiwu kaogu* 植物考古) **[fig. 2]** instead of the previous 'agricultural archaeology' (*nongye kaogu* 农业考古). *Zhiwu kaogu* became the standard term for referring to the analysis of ancient plant remains from archaeological contexts from that point onward. A few years later, archaeologist Wu Yaoli 吴耀利, who would later become the head of the Prehistoric Archaeology Department at IA-CASS, published the article *Shuifuxuan zai Woguo Kaoguxue Fajuezhong de Yingyong* 水浮选在我国考古学发掘中的应用 (The use of flotation in archaeological excavations in China) and conducted the first known flotation study by a Chinese scholar

9 See Huang 1982, 1986; Jiang 1994a; 1994b; Jiang, Wang 1994; Jin 1999.

in the country during the 1992 excavation of the Lilou 李楼 site, in Henan Province (Wu 1994; Wu, Chen 1994a; 1994b). In this occasion, Wu built three square-shaped sieves each measuring ca. 40 cm in length and width and 6/7 cm in height. Each sieve was fitted with mesh of 1 mm, 1.5 mm, and 2 mm, respectively. Wu noted that through flotation he was able to recover material previously not retrieved, including charcoal fragments, small grains and husks, and rice grains (Wu 1994, 365). Before Wu, Gary Crawford, professor of Archaeobotany at the University of Toronto, Canada, had conducted (bucket) flotation on soil excavated from a house at the Baijinbao 白金宝 site, Heilongjiang, in 1986. Crawford had taught the flotation methodology to Leng Jian 冷健, a team member of the Sino-American project *Investigations into Early Shang Civilization*, led by K.C. Chang (Zhang Guangzhi 張光直; 1931-2001), professor of Chinese archaeology at Harvard University. Leng conducted flotation at several sites in Henan over the course of the project, including at Mazhuang 马庄 (excavated in late 1994), Panmiao 潘庙 (excavated in early 1994), and Shantaisi 山台寺 (excavated in 1995-97). At these sites she found wild and domesticated grasses, possibly millets, and small beans (Murowchick, Cohen 2001). The *Early Shang Civilization Project* didn't just contribute to the development of archaeobotany, but it was also among the first international collaborative projects allowed in China after 1949.[10] In 1999, Anne Underhill, professor of Chinese archaeology at Yale University (then at the Field Museum in Chicago), conducted flotation at the site of Liangchengzhen 两城镇, in Shandong (Crawford et al. 2005). In the early 2000s, Shandong University (*Shandong Daxue* 山东大学) hosted Crawford as Liqing Fellow in Social Sciences, and his stay there contributed to the establishment of Shandong University archaeobotany laboratory (see below). Although the methodologies and sampling strategies used in the above studies were not standardised, they were seminal in the establishment of archaeobotanical laboratories and expansion of the discipline in the following decade. It is important to note, however, that until the 2000s, pollen and phytolith studies were initially more widespread than that of macro-botanical remains, a trend not dissimilar to that attested elsewhere in the world (Pearsall 2015, 4-5).[11] Quaternary paleoecologists were analysing phytolith to investigate rice domestication[12] and pollen to reconstruct ancient vegetation and climate (e.g., Lu, Wang 1989; Wang et al. 1992). Among them Zhou Kunshu 周昆叔, based at the Institute of Geology (now Institute of Geology and Geophysics) of the Chinese Academy of Sciences (IGG-CAS – *Zhongguo Kexueyuan Dizhi yu Diqiu Wuli Yanjiusuo* 中国科学院地质与地球物理研究所), was among the first scholars in China to apply pollen analyses to archaeological contexts (e.g., Zhou 1963; Zhou, Yan, Xie 1975; Zhou, Hu 1988) and became among the most vocal promoters of environmental studies in archaeological research (e.g., Zhou 1993, 2002). Micro-botanical studies would develop alongside macro-botanical research in the following decades and continue to remain an important aspect of archaeobotanical research in China today (Dal Martello et al. forthcoming).

10 In 1991 the ban on international teams working in archaeological excavations in China was lifted, enabling diverse and fruitful collaborations between foreign and Chinese institutions. K.C. Chang, although Chinese by birth, was based at Harvard at the time and his Shang's origin project was able to start thanks to the lift of this ban; Yang 1999).

11 For early studies of pollen grains in China see Ho 1969, 7 fn. 12.

12 Jiang 1994; Gu 1994; Zheng et al. 1994, 1999; Jin 1999, Jin et al. 1999.

1.2.3 Chinese Archaeobotany in the Twenty-First Century

1.2.3.1 The Establishment of Archaeobotanical Laboratories and the Expansion of Archaeobotanical Practice

Archaeobotanical research saw a steady increase from the early 2000s **[figs 2-3]**. After training under the mentorship of leading figures in the field; D.M. Pearsall at Missouri University for his MA, and D.R. Piperno at the Smithsonian Tropical Research Institute for his PhD, Zhao Zhijun returned to China in 1999 and was hired at the IA-CASS. There, he established the first known archaeobotanical laboratory in the country in the Archaeological Sciences Centre (*Keji Kaogu Zhongxin* 科技考古中心) at the IA-CASS and was at the forefront of the popularisation of flotation in the successive decades. In the 2000s, he published numerous articles on archaeobotanical theoretical principles and practical methods (e.g., Zhao 2001; 2003b; 2004a) and summaries on the contribution of archaeobotany to researching early agriculture and the rise of civilisation (e.g., Zhao 2005a; 2005b). He was also among the first to conduct flotation at archaeological sites in Southwest China, including at Mopandi 磨盘地 and Shifodong 石佛洞 in Yunnan, and Yingpanshan 营盘山 in Sichuan (Zhao, Chen 2011).

Shortly after, another archaeobotany laboratory was established at Shangdong University at the (since 2016) Joint International Research Laboratory of Environmental and Social Archaeology (*Huanjing yu Shehui Kaogu Guoji Hezuo Lianhe Shiyanshi* 环境与社会考古国际合作联合实验室), itself nestled within the Eastern Archaeology Research Centre – *Shangdong Daxue Dongfang Kaogu Yanjiu Zhongxin* 山东大学东方考古研究中心). The laboratory is led by Professor of Archaeology Jin Guiyun 靳桂云, a history graduate with a PhD in Quaternary Geology from the IGG-CASS. This laboratory is one of the few in China today that has amassed a modern reference collection that includes comparative modern pollen, phytoliths and macro-botanical remains and equipment for the analysis of all three (Jin, Wang 2006).

In 2008, Professor of Neolithic Archaeology Qin Ling 秦岭 established the Archaeobotany Laboratory at the School of Archaeology and Museology of Peking University (*Beijing Daxue Kaogu Wenbo Xueyuan* 北京大学考古文博学院). Peking University had established a joint research centre with University College London (UCL, UK), named International Centre for Chinese Heritage and Archaeology (ICCHA –*Zhongguo Wenhua Yichan Baohu yu Kaoguxue Yanjiu Guoji Zhongxin* 中国文化遗产保护与考古学研究国际中心). ICCHA aimed at fostering collaborative international research on Chinese archaeology and sponsored scholarly exchange between the two universities. Through ICCHA, in 2004-05 Qin visited UCL to study archaeobotany, and in 2008 Dorian Q. Fuller (professor of Archaeobotany at UCL) went to Peking University to teach a course on the subject. After the establishment of the laboratory, Qin started instructing classes on archaeobotany, both at the undergraduate and graduate levels. Today Peking University is also building an impressive modern reference collection focussing on East Asian plant species (Fuller, pers. comm. 2024).

In the first decade of the twenty-first century, the expansion of archaeobotanical practice was further marked by the publication of two reference books that continue to be used in archaeobotanical training courses today:

- Liu Changjiang 刘长江; Jin Guiyun 金桂云; Kong Zhaochen 孔昭宸(2008). *Zhiwu Kaogu – Zhongzi Guoshi Yanjiu* 植物考古 – 种子果实研究 (Archaeobotany – Research on Seeds and Fruits). Beijing: Science Press.
- Zhao Zhijun 赵志军 (2010a). *Zhiwu Kaoguxue ~ Lilun, Fangfa he Shijian* 植物考古学~理论、方法和实践 (Palaeoethnobotany: Theory, Methods, and Practice). Beijing: Science Press.

These two books cover fieldwork sampling strategies, collection methods, and laboratory techniques while also providing identification keys to the main plant genera and taxa in China.

The establishment of laboratories led to the institutionalisation of archaeobotany as a distinct discipline within archaeological university programs. Trained specialists then went on to work at provincial institutes or establish new laboratories at other universities, thus expanding the teaching and practice of archaeobotany nationwide. Whereas only a handful of scholars were involved in archaeobotany in the early 2000s, today more than 20 universities offer archaeobotanical training, and over 70 specialists are employed at universities, research institutes and museums (Zhao 2022; Dal Martello et al. forthcoming, tab. 1).

1.2.3.2 The Standardisation of Archaeobotanical Practice in Chinese Archaeological Research

After the introduction of archaeobotanical flotation, its application was largely dependent on the interests of the individual archaeologists and specifically tied to the reconstruction of the origins of civilisation. This changed in 2009 when the State Bureau of Cultural Relics (now State Administration for Cultural Heritage) published an updated edition of the *Tianye Kaogu Gongzuo Guicheng* 田野考古工作规程 (Field Archaeology Work Protocol) (Guojia 2009). The first edition was published in 1984 (Wenwuju 1984), and a few years earlier, in 1982, the *Zhonghua Renmin Gongheguo Wenwu Baohufa* 中华人民共和国文物保护法 (People's Republic of China National Legislation for the Protection of Cultural Heritage) was promulgated (last updated in 2017). The two regulated archaeological excavations and the preservation of the national cultural heritage. Their publication is seen as a significant step by the national government in developing a unified approach to archaeological research and advancing the archaeological sciences within Chinese archaeology as a whole. In this regard, the *Field Archaeology Work Protocol* regulated all practical aspects of archaeological field work, providing detailed protocols for conducting archaeological survey and excavation, post-excavation processing and cataloguing of finds (Guojia 2009). The 2009 update included mandating the collection of environmental remains, including archaeobotanical material (21-5). According to the guidelines, each archaeobotanical sample should derive from the flotation of at least 20 l of bulk soil (or any further 5 l increments) and the flot should be collected using a 0.2-0.5 mm mesh sieve. Although these norms are not consistently implemented, there has been a marked increase in published archaeobotanical literature after 2009 compared to previous decades **[figs 2-3]**. Flotation studies, for example, increased from being conducted at only 30 sites by 2005 (equalling to about

5,000 litres of floated soil) to over 70 sites (and over 7,000 litres of floated soil) by 2011 (see Zhao 2005a; 2011). This trend continues today.

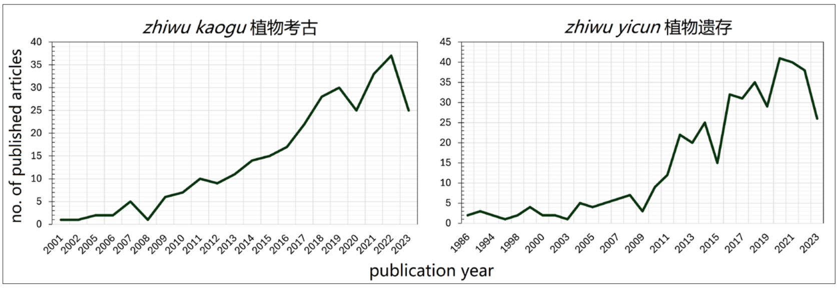

Figure 2 Graphs illustrating publication trends for the terms *zhiwu kaogu* 植物考古 (archaeobotany) and *zhiwu yicun* 植物遗存 (archaeobotanical remains) in Chinese academic publications (articles in journals, Master's theses and PhD dissertations); data from China National Knowledge Infrastructure (Zhongguo Zhiwang 中国知网, `https://cnki.net/index/`)

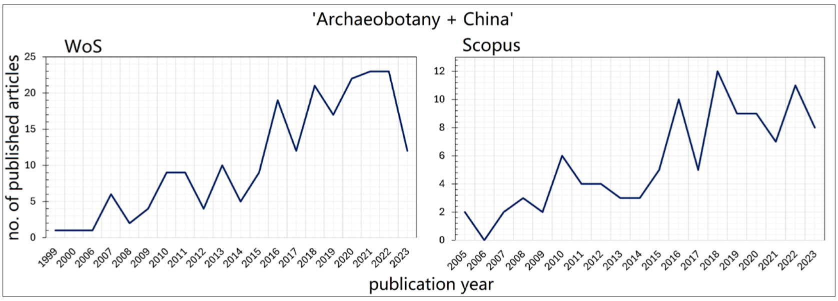

Figure 3 Graphs illustrating publication trends for terms 'archaeobotany' + 'China' in Web of Science (WoS, available at `https://www.webofscience.com/wos/woscc/basic-search`) and Scopus (available at `https://www.scopus.com/search/form.uri?display=basic#basic`), reflecting occurrences in English language publications

Qin Ling and other professors at the School of Archaeology and Museology at Peking University were involved in the updating of the *Field Archaeology Work Protocol*. In June 2009, in conjunction with its publication, Peking University hosted a large training program participated by over 600 archaeologists from provincial archaeological institutes around the country (Flad, Chen 2013). This helped introduce the new protocol and promote a standardised and unified approach to archaeological fieldwork. Peking University continues to train archaeologists employed at the provincial institutes during their yearly field school and the increase attested in publications **[figs 2-3]** may be partly attributed to these training efforts.

In 2012, IA-CASS hosted the first national archaeobotany conference, *Zhongguo Zhiwu Kaogu Xueshu Jiaoliu Yantaohui* 中国植物考古学术交流研讨会 (the Academic Exchange and Seminar on Chinese Archaeobotany), which has since been held almost annually. In 2014, during a conference on rice domestication and the spread of rice agriculture, a national archaeobotanical committee was established as a subsection of the Society for Chinese archaeology (*Zhiwu Kaogu Zhuanye Weiyuanhui* 植物考古专业委员会).[13] Since then, archaeobotanical workshops and symposia are frequently held, highlighting the growth and expansion of archaeobotanical research, both geographically and thematically. These include, for example:

- *Dao de Zhiwu Kaoguxue——Qianyan yu Fansi Xueshu Shalong Huiyi* 稻的植物考古学——前沿与反思学术沙龙会议 (International Workshop: Current Frontiers in the Archaeobotany of Rice), held at Peking University in August 2016;[14]
- Q*ingzang Gaoyuan ji Zhoubian Diqu Zhiwukaogu Guoji Xueshu Yanyaohui* 青藏高原及周边地区植物考古国际学术研讨会 (International Conference on the Archaeobotany of Tibet and the surrounding areas), held at Northwest University, Xi'an, in December 2019;[15]
- *Jiangnan Gudai Zhiwu yu Shehui——Zhiwukaogu Guoji Xueshu Duihua* 江南古代植物与社会——植物考古国际学术对话 (Ancient Plants and Society South of the Yangzi River – International Symposium on Archaeobotany), held at Hangzhou in November 2022.[16]

1.2.3.3 Decentralisation, Internationalisation and Shifts in Research

Between the 1950s and the 1980s, archaeological research was mostly conducted at the national level by either universities or the IA-CASS. At the local level, the government set up cultural relics management committees and museums to oversee archaeological excavations. After the Cultural Revolution (1966-76), these local institutions became units within the local Provincial Institutes of Cultural Relics and Archaeology (*Sheng Wenwu Kaogu Yanjiusuo* 省文物考古研究所, often abbr. *Kaogusuo* 考古所), and have since operated independently from parent museums. By 1990, except for Tibet, all provinces had their own provincial institute for cultural relics and archaeology (Falkenhausen 1995) and some larger provinces also established further institutes at their capital cities, such as the Chengdu Institute for Cultural Relics and Archaeology, which exists alongside the Sichuan one (Flad, Chen 2013, 51). The foundation of provincial institutes was an important shift toward a more decentralised approach to archaeological excavations, planning, and research, as national teams have since needed excavation permits from the institutes to conduct archaeological research in each province (Falkenhausen 1995). After decades of focus in the Central Plains as sole relevant area for the rise of Chinese civilisation, archaeological research now conducted in 'peripheral' areas showed the existence of local ancient cultures, which in turn increased work undertaken in these areas and highlighted the contributions they made to the formation of early Chinese

13 *Daozuo Nongye Qiyuan yu Chuanbo Xueshu Yantaohui ji Zhongguo Kaoguxuehui Zhiwukaogu Zhuanye Weiyuanhui Chengji Dahui* 稻作农业起源与传播学术研讨会暨中国考古学会植物考古专业委员会成立大会 http://www.soaa.zju.edu.cn/wwkg/2011/0922/c44601a1935130/page.htm.

14 *International Workshop Programme: Current Frontiers in the Archaeobotany of Rice:* https://www.ucl.ac.uk/chinese-heritage-archaeology/international-workshop-programme-current-frontiers-archaeobotany-rice.

15 For the conference program see http://www.silkroads.org.cn/portal.php?mod=view&aid=23109.

16 *Ancient Plants and Society South of the Yangzi River – International Symposium on Archaeobotany.* http://www.soaa.zju.edu.cn/2022/1125/c34190a2690957/page.htm.

civilisation.[17] The push for the modernisation of the national infrastructure has led to archaeological excavations being conducted in all provinces and across all time periods resulting in a great expansion of flotation studies, which are now routinely applied during archaeological excavations.

This has led to the expansion of research topics which now include food production, cooking technologies and cuisine identities (e.g., Ritchey et al. 2021; Hastorf 2016; Rowlands, Fuller 2009), and the role of plants and their spread in long-distance migrations and contact (e.g., Stevens et al. 2016; Long et al. 2018; Dodson et al. 2013). Most importantly this has led to the broadening of archaeobotanical research in historical periods.[18] This has allowed for the expansion of archaeobotanical research beyond the realm of the 'five grains' (*wugu* 五穀/五谷, indicating broomcorn and foxtail millet, wheat/barley, (soy)bean, and rice or hemp; see fn. 9 in Ch. 2) and the general focus of archaeobotanical research on staple crops at the expense of other plant categories (Zhao 2009; Zhong 2022). This resulted in a new understanding of the relevance minor crops in past subsistence.[19]

In the last few years, Chinese teams started working in areas outside China's borders, in part due to the political and economic relationships fostered by the Belt and Road Initiative (BRI, *Yidai Yilu* 一帶一路 'One Belt One Road'). As a result, Chinese-led archaeobotanical research has moved into new regions, investigating topics such as the role of long-distance exchange in local subsistence strategies, with a focus on the role of ancient Silk Road routes across Central Asia (Huo 2019; Lu et al. 2016). Chinese-led archaeological excavations are now conducted in some Central Asian countries, for example in Uzbekistan (Chen et al. 2020; Wang J. et al. 2023; Zhou 2024). This has finally taken Chinese archaeobotany in the global research arena, possibly marking the beginning of a golden age of Chinese archaeobotanical studies.

1.3 A Note on Archaeological Excavations and Flotation Studies in Yunnan

In 1920s and 1930s, the Geological Society of China (*Zhongguo Dizhi Xuehui* 中國地質學會) led by Ding Wenjiang 丁文江 (1887-1936; Xia 1960; Ho 1969) conducted several surveys in Yunnan and broader South China with the aim of uncovering prehistorical and early hominid sites in the province. In 1973 the first archaeological training class was undertaken at the site of Dadunzi 大墩子 (Dai 2021), but before the turn of the twenty-first century there was no reported systematic archaeobotanical study done in Yunnan. Discussions about early agriculture derived from chance finds of plant remains, mostly rice grains (either husks or whole grains), or grain impressions on ceramic

17 e.g., Chang 1986; Falkenhausen 1995; Hein 2014; Shelach-Lavi 2009; Sun, Hein forthcoming; Zhang forthcoming.

18 See work done in Xinjiang on Tang Dynasty period (618-907 CE) religious and military sites (e.g., Nong 2024; Yao Y.F. et al. 2020).

19 These include buckwheat (d'Alpoim Guedes et al. 2013a; Hunt, Shang, Jones 2017; Hyslop, d'Alpoim Guedes 2021; Wei 2019; Kryzanska et al. 2021; Tang et al. 2021); peach (Zheng, Crawford, Chen 2014; Dal Martello et al. 2023a); hemp (Dal Martello et al. 2023b; Liu et al. 2022; Long et al. 2016; Sun 2016); osmanthus and foxnut (Tang et al. 2022), and *Chenopodium* (Yang et al. 2009; d'Alpoim Guedes 2013; Gao 2021; Xue et al. 2022; Song et al. 2021).

sherds. Rice grains were reported from (listed in order of excavation) Dadunzi (Kan 1977; 1978); Baiyangcun 白羊村 (Yunnan 1981); Nanbiqiao 南碧桥 (Kan 1983); Xinguang 新光 (Yunnan 2002) and Yingpanshan 营盘山 (Xiao 2006). Rice grain impressions on ceramic sherds were reported from an unspecified site on the eastern shore of the Dian Lake (Huang, Zhao 1959); Shizhaishan 石寨山 (Sun 1956) and Toujushan 头咀山 (Ge 1978). Some of these sites have since been re-excavated and systematic flotation undertaken (see § 4.3). In 2001, Zhao Zhijun floated a sample from Mopandi 磨盘地 (Zhao 2003a) and in 2003 one from Shifodong 石佛洞 (Zhao 2010b). In 2007-08, the first systematic archaeobotanical study was undertaken during the third excavation season of Haimenkou 海门口, in northwest Yunnan (Xue et al. 2022). This marked a flourishing period for archaeobotanical research in the province, with flotation sampling and phytoliths collection during excavation routinely incorporated into all archaeological excavations across Yunnan (Li Xiaorui, pers. comm. April 2018), in line with trends seen for other provinces.

People and Plants in Ancient Southwest China
3,000 Years of Agriculture in Yunnan from the First Villages to the Han Conquest
Rita Dal Martello

2 Origins and Spread of Agriculture in China

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2.1 Introduction

Searching for the origins of agriculture was an important topic of Chinese archaeology even before the introduction of archaeobotanical practice in the country (see Ch. 1). The transition to food production is considered one of the most fundamental moments in the making of human civilisation. The domestication of plants, strictly linked with the transition from food gathering to food producing, has been among the most popular topics of archaeobotanical research in the last century. This transition was described as the 'Neolithic Revolution', happening rapidly and in one core area (the

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Fertile Crescent),[1] from where it had diffused and spread to the rest of the world (e.g., Childe 1962; Diamond, Bellwood 2003). Today this view has shifted in favour of the transition to agriculture being a gradual, long and protracted process. Plants most likely needed millennia to evolve from their wild progenitors into their domesticated forms, and different local species were independently domesticated in multiple areas around the world.[2] The accumulated archaeobotanical evidence has showed that cereals were cultivated for millennia before they were domesticated[3] and most scholars agree that their domestication was the result of selective pressures acted through cultivation practices.[4] Scholars have also moved away from the concept of domestication happening in a core, defined area and diffusing to the surrounding regions (also referred to as monocentric view)[5] in favour of a multi-regional (poly- or multi-centric) approach. This multi-centric model outlines that plant species were domesticated following their cultivation across multiple sites within a region.[6] Finally, productive economies are seen as nuanced, with increased evidence that semi-sedentary or even mobile populations also practiced some level of plant production in the past (Spengler et al. 2021). This chapter reviews early theories about the origins of agriculture in China with a focus on those plant species that hold relevance for prehistorical and early historical Southwest China, especially Yunnan. Botanical aspects, including growing requirements, are also examined to offer an environmental and ecological framework for understanding the cultural and social development of local societies. To help readers navigate this topic, I provide definitions of key terms used in relation to early agricultural research **[tab. 1]**.

1 Southwest Asia today has the earliest attested evidence of wild plant harvesting and processing, for example from Ohalo II, where wild plant collection is presumed to start 23,000 years ago (e.g., Snir et al. 2015; Maeda et al. 2016; Weide et al. 2018) and domesticated plant remains are documented at several sites in the region dating to about 10,000 years ago onward (e.g., Willcox 2012; Tanno, Willcox 2006, 2012; Arranz-Otaegui et al. 2016).

2 See Larson et al. 2014 for an overview of some of the main centres of domestication in Eurasia; other recent works on the topic include Fuller et al. 2014, 2016; Allaby et al. 2017; Allaby et al. 2022; Fuller, Denham, Allaby 2023.

3 Fuller 2007; Purugganan, Fuller 2009; 2011; Purugganan 2019.

4 Helbaek 1960; Harlan 1975; Harris 1989; Stevens, Fuller 2024.

5 The core-area hypothesis was put forward in the context of the beginning of agriculture in Southwest Asia, where scholars initially suggested that agriculture started in a 'golden triangle' where all of the 'eight founder crops' were brought into cultivation at the same time (e.g., Lev-Yadun, Gopher, Abo 2000; Kozlowski, Aurenche, 2005). The most recent research has brought into questions both the core-area and the founder crops concepts (i.e. Fuller, Willcox, Allaby 2011a; 2011b; Arranz-Otaegui, Roe 2023).

6 Fuller, Willcox, Allaby 2011a; 2011b; see also Asouti 2013; Larson et al. 2014; Boogard et al. 2017.

Table 1 List of key terms used in plant domestication studies (Fuller, Denham 2022, 182)

Term	Definition	References
Domestication	"A coevolutionary process that arises from a mutualism, in which one species (the domesticator) constructs an environment where it actively manages both the survival and reproduction of another species (the domesticate) in order to provide the former with resources and/or services".	Purugannan 2022, 664
Cultivation	Set of activities involved in the production of plant resources; can include: - Tilling - Sowing - Weeding - Manuring - Harvesting - Threshing - Winnowing	Fuller et al. 2014
Agriculture	A specific production economy of a society, characterised by reliance on the cultivation of (usually, but not exclusively, domesticated) plant species as the primary mode of subsistence. Agricultural societies are typically sedentary, but semi-mobile societies may engage in seasonal food production.	Stevens, Fuller 2017
Domestication traits (domestication syndrome)	Characteristics that differentiate a plant species from it wild ancestors. For cereal and legumes these can include: - Loss of natural seed shattering - Loss of seed dormancy - Increase of seed size - Thinning and lightening of the seed coat These morphological, morphometrical and life cycle changes are driven by specific genes which change under selective pressure exerted by recurring human behaviours (such as cultivation). These are influenced by competing pressures, environmental conditions, and gene inheritance mode in plants.	Fuller, Allaby 2009; Purugganan, Fuller 2009; Brown et al. 2009; Allaby 2014
Landrace	"A dynamic population(s) of a cultivated plant that has historical origin, distinct identity and lacks formal crop improvement, as well as often being genetically diverse, locally adapted and associated with traditional farming systems".	Villa et al. 2005
Mono-centric domestication	"Domestication occurred in the Near East, in a 'core area/golden triangle' where the whole package of eight 'founder crops' were brought into cultivation at the same time. From here, cultivation of these species spread, and if the same wild species was brought into cultivation elsewhere it was under the influence of the earlier traditions of cultivation in this core region".	Fuller, Willcox, Allaby 2011a, 618 (see also Fuller, Willcox, Allaby 2011b)
	"Domestication is a 'discovery' driven by human conceptualization of the domesticated as distinct from the wild".	Fuller, Denham 2022, 182
(Poly)/ Multi-centric domestication	Parallel processes of early plant cultivation emerging independently in multiple areas within a region that lead to the domestication of that plant species.	Fuller, Willcox, Allaby 2011a; 2011b

2.2 Early Debates on the Origins of Agriculture in China

2.2.1 The Theorisation of Agriculture Before the Study of Archaeological Plant Remains

Given the scarcity of ancient plant remains before the development of archaeobotany, most early theories relied on ancient textual evidence. A seminal work for this was *The Origin of Cultivated Plants in Southeast Asia* by Li Huilin 李惠林 (1911-2002; Li 1970).[7] Li was a Harvard PhD graduate, who taught Biology and Botany at several institutions both in China and the United States, including at Suzhou University, the National Taiwan University, and University of Pennsylvania. Li also chaired the editorial committee of the *Flora of Taiwan* (1975-79). In *The Origins of Cultivated Plants in Southeast Asia*, Li called 'Southeast Asia' the vast region comprising the Gobi Desert, North China, the Korean Peninsula, modern continental China to the southern Tibetan Plateau, modern mainland and insular Southeast Asia **[fig. 4]**. Li based his hypotheses in large part on the agricultural treatise *Qimin Yaoshu* 齊民要術 (Essential Arts for the People), attributed to Jia Sixie 賈思勰, an official of the Northern Wei Dynasty (sixth century CE). The treatise was possibly completed around 533-544 CE. In 1979, Li published the translation and commentary of an earlier botanical treatise, *Nan-fang ts'ao-mu chuang* 南方草木狀 (Plants of the Southern Regions), a written text dating to 304 CE and attributed to botanist Ji Han 嵇含 (263-307 CE).[8] In this translation-commentary Li further expanded his hypotheses, especially in relation to Belt 3 (1979) **[fig. 4]**. Li's publications summarise well the state of early agriculture and plant domestication research in this region at the time, as well as setting the scene for subsequent research until a more widespread implementation of archaeobotanical methods allowed for a review of his hypotheses. Li had divided East Asia into four main belts **[fig. 4]** and listed which plants species were domesticated in each of these four areas, on the basis of historical accounts and modern ethnobotanical and phytogeographical information **[tab. 2]**. Belt 1 included the area from the Yellow River Basin northward; a region with Loess soil and a cold and temperate climate, homeland of millet, soybean, cabbage and other vegetables, hemp and several fruit trees, including peaches, apricots, apples and pears (Li 1970, 9). Belt 2 indicated the area south from the Qinling Mountains to the current borders of mainland China, with a strong emphasis on the Yangzi River Basin. Compared to Belt 1, a warmer and wetter climate characterised this region. Here, people domesticated tea, many vegetables including Chinese kale and scallion, *Citrus* fruits (sweet orange, mandarin orange, kumquat, wampee) and some aquatic root crops such as water chestnut and lotus roots, but many plant were introduced from Belt 1. Belt 3 indicated modern mainland Southeast Asia, with the exclusion of the Malay

7 An earlier version was first published in Chinese; Li, Huilin 李惠林 (1966). *Tung-nan-ya tsai-p'ei chich-wu chic ch'i-yuan* 東南亜栽培植物之起源 (Origins of the cultivated plants in South and East Asia). Hong Kong: Chinese University of Hong Kong 香港: 香港中文大學出版. This version, however, is not easily accessible; therefore, through this book I refer to the 1970 edition.

8 Li had titled this work *A Fourth Century Flora of Southeast Asia*, keeping in line with the regional divisions of his earlier work. The text is now usually referred to with the more accurate translation of *Plants of the Southern Regions* (Li 1979).

Peninsula. Here there are year-long mild temperatures and great abundance of water thanks to seasonal monsoons.

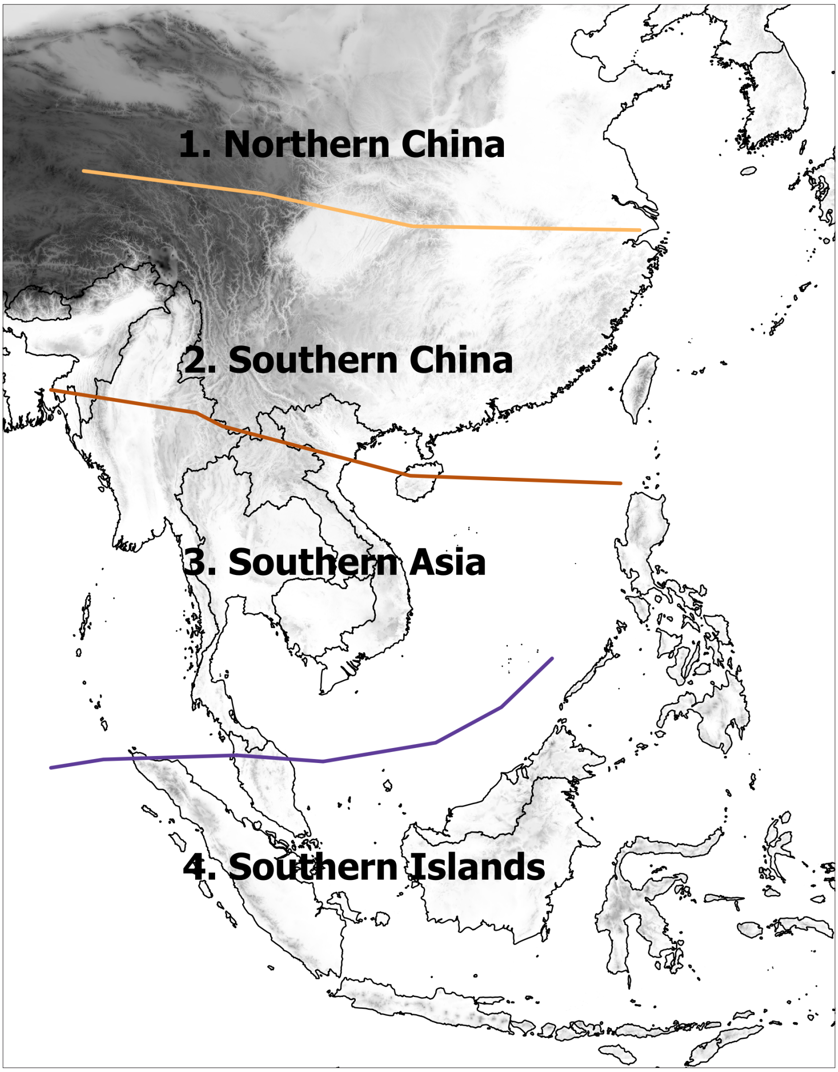

Figure 4 Map showing latitudinal belts of domesticated plants in 'Southeast Asia', according to divisions proposed by Li 1970. Redrawn from Li 1970 (fig. 1). Made by the Author with QGIS 3.28.5. Firenze, Natural Earth and Earth Resources Observation and Science (EROS) Digital Elevation basemap, U.S. Geological Survey

According to Li, rice originated here (Belt 3 was also the main region expanded upon in Li's 1979 commentary of Ji Han's botanical treatise) **[fig. 5]**. It is curious to note that Li stated that there was no archaeological evidence in support for this hypothesis, but given the importance of rice in modern agriculture, it must have originated here

> Although this view is not substantiated by archaeological evidence, the extreme importance of rice cultivation on the economy of this region is obvious. (Li 1970, 12)

Li theorised that rice was almost the only component of the native subsistence of this latitudinal belt, with ancient people still relying heavily on other types of resources or external influences (Li 1979). Finally, Belt 4, comprising of modern-day Malay Peninsula and insular Southeast Asia, was the homeland of tropical fruits and relied on the northern belts for other types of crops. Modern-day distribution of wild population is not necessarily a true reflection of the original distribution of a plant species (Fuller 2011a); therefore, the analysis of ancient plant remains from archaeological sites provides the best evidence for discussing the domestication of plant species in the past. Appendix 1 provides an updated list of plant species originally listed in Li's work and their currently known region of origin, based on the accumulated archaeological and archaeobotanical evidence.

Table 2 Main plant species and their latitudinal belt of origin according to Li (1970). The table was adapted from Chang 1986 (80). Please note that North China, South China/Southeast Asia are meant by the definition given in Li (1970), and do not correspond to modern regional divisions; see text for details. See Appendix 1 for a full list of plant species listed in Li's publication and their currently accepted region of origin, as evidenced by recent archaeological and archaeobotanical work

	North China	**South China/Southeast Asia**
Cereals	Broomcorn millet Foxtail millet	Rice Job's tear
Legumes	Soybean	Red beans
Vegetables	Garlic Mallow Knotweed Welsh Onion Chinese Cabbage	Amaranth White gourd Luffa Water spinach Lily Manchurian waterrice
Fruit trees	Peach Chinese plum Apricot Hawthorn Persimmon Chinese jujube	Oranges Kumquat Loquat Litchi Longan Chinese olive
Roots/tubers	Chinese artichoke	Chinese yam Taro Greater Yam Yam
Fiber crops	Hemp	Ramie Chinese jute
Other industrial crops	Mulberry Varnish tree	Tea oil Tung oil tree
Beverages		Tea

K.C. Chang in the fourth (and last) edition of his publication *The Archaeology of Ancient China* noted

> to understand and demonstrate the transformation into agricultural life in China, the archaeologists will have to investigate in detail the faunal and floral changes that took place in the several millennia before and after the beginning of the Holocene. A beginning has been made in the studies of domesticated pigs and dogs and their wild ancestors in China,

> but botanical studies toward and understanding of the cultivation of native grasses, roots and tubers have not yet begun. (Chang 1986, 79)

This sentence summarises well the fact that, until the introduction of archaeobotanical methods at the end of the 1980s, plant finds from archaeological sites in China were rather sporadic; K.C. Chang himself refers to the work by Li (1970) in his book. The scarcity of archaeobotanical evidence hindered the understanding of the beginning of agriculture in the country, despite it being a major topic of interest especially among prehistorical archaeologists who sought archaeological evidence to support theories derived from mythological[9] and historical records.

Grain impressions on ceramic sherds were among the first type of archaeological evidence used to theorise about the origins of agriculture in China. One often cited example is that of possible rice grain impressions from the Yangshao site, in Henan, found during its 1929 excavation (Ho 1977). Andersson, who excavated the site at that time, proposed that 'Rainy Southern Asia'[10] was the centre for rice domestication (Andersson 1934; Li 1970; Ho 1977). In these early decades of archaeological research, plant presence at a site was taken as indication of local cultivation, regardless of the quantity and type of context where the plant remains were retrieved and, most importantly, whether the plant growing requirements were in line with the ancient climate of the time of occupation of the site. Chance finds of large quantities of millet remains such as those from Cishan (Handan, Handan 1977; Hebei, Handan 1981) and rice remains such as those from Hemudu (Zhejiang, Zhejiang 1978; Hemudu 1980; see § 1.2.1) gave support to a dual view of early agriculture in China, based on millet in the north and rice in the south (e.g., Yan 2000) **[fig. 6]**. This view was initially postulated based on early textual evidence, such as that in the *Shijing* 詩經 (Classic of Odes, dated to the Zhou Dynasty, ca. 850 BCE), which contained descriptions of botanical varieties of ca. 150 plants, including indications of their cultivation practices and uses (Ho 1969; 1975). Scholars suggested that millet and rice farming were originally divided along the boundary of the Qinling Mountains and Huaihe River (Yan 1987; 2000; Zhao 2011). Millet was domesticated by Yangshao farmers in the Yellow River Valley. Ho initially postulated that thanks to the richness of loess soil, there was no need to practice fallow (Ho 1969),[11] however, he later suggested that agriculture followed a four-year cycle; land would be clear from pre-existing vegetation in the first year, cultivated for two successive years, and left to fallow on the fourth year (Ho 1975, 49-54). It was thus hypothesised that the earliest agricultural systems

9 The most well-known myth on the origin of agriculture in China is about Shennong 神農 (the Divine Farmer), a legendary king who invented the plough (Sterckx 2018) and taught his subjects to sow 'ancient five grains' (*wugu* 五穀), for which he is also sometimes referred to as the *Wugu Xiandi* 五穀仙帝 (the Divine Emperor of the Five Grains); see records in the *Shiji* 史記 (The Grand Scribe's Records) by Sima Qian 司馬遷 146-86 BCE; Ch'ien, Nienhauser 1994-2019). According to Bray (1984, 432), the five grains usually include rice (*dao* 稻), broomcorn millet (*shu* 黍), foxtail millet (*su* 粟; in ancient text millet is also referred to with the generic term *ji* 稷), wheat/barley (*mai* 麥), and (soy)beans (*shu* 菽). In some texts hemp (*ma* 麻) is indicated instead of rice, such as in the *Liji* 禮記 (The Classic of Rites; Legge 1885). These five grains are sometimes still referred as the basis of traditional Chinese agriculture (see for example He et al. 2022c, 2).

10 'Rainy Southern Asia' in opposition to 'Dry Central Asia'.

11 Recent research has demonstrated that loess soil does indeed have high fertility potential when well-watered, which would reduce fallow needs (Stevens, Zhuang, Fuller 2024).

were similar to modern slash and burn practices, with people clearing a patch of vegetation with fire, cultivating the cleared land for one or two years and then moving to another patch of land, which would be cleared with fire and cultivated while the previously cultivated land was left to fallow. This was based upon scrutiny of Zhou Dynasty (1046-246 BCE) textual sources and Shang Dynasty (1250-1046 BCE) oracle bone inscriptions[12] which indicated that the land left to fallow was used for hunting (Peng 1989). Mythological accounts gave great importance to millet, indicating that Lord Millet (*Houji* 后稷) was the legendary divine ancestor of the Zhou clan's kings (Smith 1957; cf. Legge 1861-72). Finds of ancient millet grains such as that from Cishan thus gave support to the fact that millet was indeed the staple crop that sustained the formation of the earliest Chinese States (Zhao 2011).

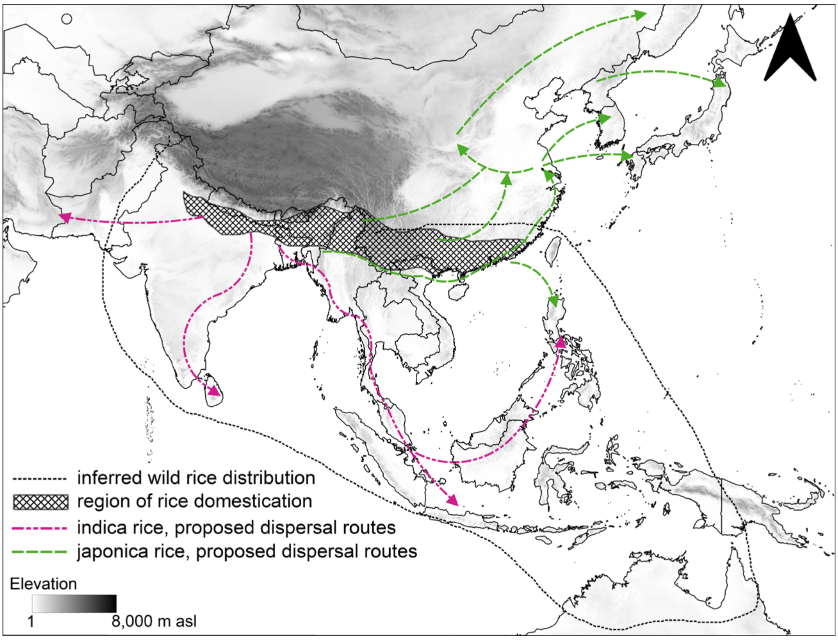

Figure 5 Map showing inferred wild rice distribution, proposed region of rice domestication and hypothesised spread routes according to early theories of rice domestication and dispersal. Redrawn from Li 1970. Made by the Author with QGIS 3.28.5-Firenze, Natural Earth and EROS Digital Elevation basemap, U.S. Geological Survey

Observation of modern centres of wild plant diversity was a common approach to individuate possible plant domestication centres, a method adopted and popularised by Vavilov in the early twentieth century (Vavilov 1951), itself developed on conclusions put forth in the late nineteenth century by De Candolle (1885). This was particularly relevant in the early theorisation of rice domestication. Among the first theories it was proposed that rice was domesticated somewhere between Northeast India, Southwest China, upper Myanmar, northern Thailand, Laos, and north Vietnam (Rozheviz 1931; Ramiah 1937). The discovery of extant wild rice populations in modern

12 Inscriptions indicating plants, especially cereals, such as possible cultivated rice, wheat, barley, millets, and hemp were identified from Shang oracle bones recovered from archaeological sites in Henan (Ho 1969; Lu 1999).

Guangdong, Guangxi, and Yunnan during the surveys conducted by the Chinese Geological Society in the 1920s and 1930s (Xia 1960; Ho 1969, 23) gave prominence to the view that rice was domesticated somewhere in the Yunnan-Nepal belt, from where it spread north and eastward, either through the Yangzi River or along a coastal route from modern Vietnam to the Yangzi Delta **[fig. 5]**. This was substantiated by the higher concentration of wild rice varieties in Yunnan compared to other areas in the region, where at least 3,000 rice varieties were documented at altitudes ranging from 40 to 2,600 m asl (Chen 1989, 90). Several scholars suggested this indicated rice was most likely domesticated there.[13] This view was further elaborated upon by scholars studying the Austroasiatic languages, most of which supported a rice origin in the region (see § 2.2.1.1). Ancient rice findings gave further support to this theory, including the silicified rice grains that were found at Baiyangcun, northwest Yunnan, during the 1972 excavation (Yunnan 1981).[14] Recent archaeobotanical research across China coupled with direct dating of ancient rice seeds has disproved this theory (see § 2.3.1.2). For Yunnan, the current earliest domesticated cereal remains date to several millennia later than those from the mid- and lower Yangzi Basin (Dal Martello et al. 2018; Ma et al. 2024; see Ch. 4).

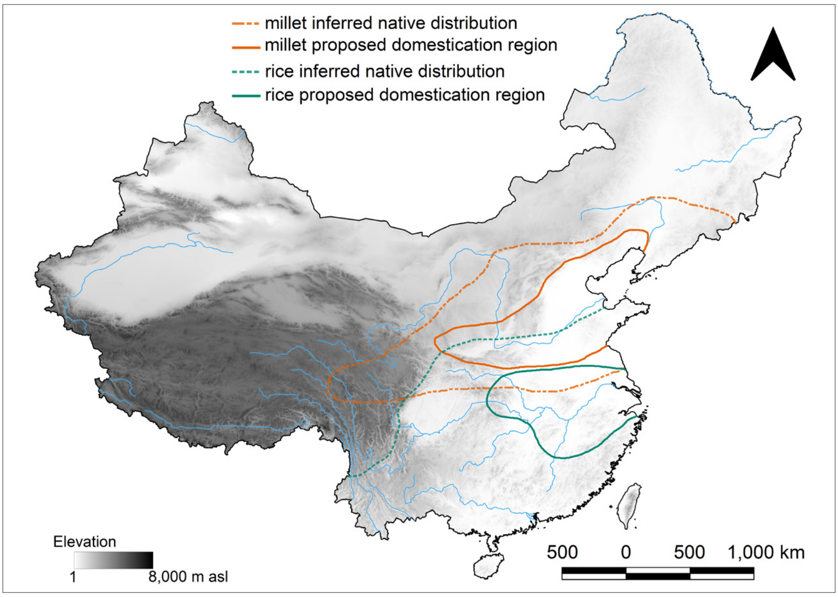

Figure 6 Centres of domestication and inferred native distributions of rice and millet according to early theories of agricultural origin in China. Based on Yan 2000 (fig. 1). Made by the Author with QGIS 3.28.5. Firenze, Natural Earth and EROS Digital Elevation basemap, U.S. Geological Survey

13 See for example Chatteerjee 1951; Chang 1964; Li 1970; Liu 1975; Chang, Bunting 1976; Wang 1977; Li 1981; 1984; Dubu 1982; Xu 1998.

14 The Baiyangcun rice later gained prominence in the context of the farming/language dispersal hypothesis which linked the domestication and spread of rice to proto-Austroasiatic speakers, whose homeland was possibly Yunnan and from where rice spread outward (e.g., Bellwood 1995; Higham 1996a, 1996b; Benedict 1999; Higham 2004; Sagart 2008; Van Driem 2012). This view was supported by some scholars until quite recently and only the increased application of archaeobotanical methods has finally confuted it (see Ch. 4).

Based on rice finds from archaeological sites in the lower Yangzi (see § 1.2.1), other scholars suggested that rice was domesticated in the Yangzi River Basin or possibly further south. Finally, some scholars suggested that rice was domesticated by millet farmers as they migrated south and found that millet cultivation was less successful than in the north (e.g., Barrau 1966; Ho 1969; Chang 1970).

This dualistic component of early Chinese agriculture **[fig. 6]**, albeit with nuances, is still generally considered accurate and has been substantiated by successive archaeological and archaeobotanical work (see below). Scholars, however, have moved away from a monolithic view of an individual centre of domestication, in favour of a cluster area or mosaic view of domestication of plant species (e.g., Stevens et al. 2020), a shift in archaeobotanical research that reflects general trends towards multi-centric approaches in archaeological research worldwide.

2.2.1.1 Linguistics and the Domesticators of Rice

An important theory related to the beginning of rice agriculture in China, which proposed Yunnan as a probable centre of domestication, arose following comparative and historical linguistic studies on Austroasiatic languages. Today, this is one of five major language phyla that exist in East Asia, the others being Sino-Tibetan (referred by some scholars as Trans-Himalayan), Tai-Kadai (also known as Kra-Dai), Hmong-Mien (previously referred to as Miao-Yao), and Austronesian (see Sagart 2022; Enfield 2021 for recent overviews on these language families). The aim of linguistics studies is to reconstruct language phylogeny by tracing similarities and shared innovations in vocabulary, often examining terms related to animals, plants, food, and agricultural activities. As a result, such studies attempt to individuate the ancient homeland and dispersal routes of those language families. Geographical origins of language families are often identified where the greatest modern diversity of those languages is attested today.[15] Within Archaeology, linguistics reconstructions gained prominence in past discussions on ancient plant domestication in the framework of the language/farming dispersal hypothesis. This theory links the dispersal of major world language families to the development of agriculture, based on the assumption that demographic expansions (and, consequently, the spread of languages) are driven by the increased availability of food surpluses derived by stable agricultural production.[16] Scholars postulate that the demographic growth, driven by food surpluses, would have placed pressures on available resources (as per Rindos 1980; 1984), pushing part of the population outward in search of new arable lands, while at the same time displacing pre-existing hunter-gatherer

15 Some scholars have recently raised questions about the suitability of this method, highlighting for example that, although modern Sino-Tibetan languages today have the highest level of diversity in Nepal-Northeast India-Myanmar (see Blench, Post 2014), however, scholars agree that they originate from the Yellow River Basin (see Sagart et al. 2019; Wu, Bodt, Tresoldi 2022; Jacques, Stevens 2024).

16 See Renfrew 1992, 1996; Bellwood 1996; 2001; 2005; 2006; Bellwood, Renfrew 2003.

populations (Ammerman, Cavalli-Sforza 1971).[17] According to proponents of the farming/language dispersal hypothesis, in tracing the homeland of language phyla, we can individuate where plants were domesticated. Noting that Austroasiatic languages today have the greatest diversity in vocabulary for rice and related cultivation activities compared to other East Asian languages,[18] numerous scholars suggested that rice was domesticated among ancient Austroasiatic speakers. These languages today are most prevalent in continental Southeast Asia, extending from Northeast India (where the Munda languages sub-group is found) to Malaysia, although their distribution is highly fragmented. The other major Austroasiatic subfamily is Mon-Khmer, occupying fragmented territories in mainland Southeast Asia and Yunnan. There is yet no consensus among scholars about the original homeland of Austroasiatic languages, but Yunnan has often been suggested as the possible homeland for this language phylum.

Some scholars postulated that rice was domesticated among Austroasiatic speakers in the region where modern Munda languages are distributed (southern Yunnan-Myanmar).[19] It was further suggested that the presence of different ecotypes in the region led to the domestication of different rice cultivars (*ahu*, *indica*, and *japonica*), resulting in the development of dry and wet rice cultivation systems before these dispersed west and eastward.[20] Other scholars proposed that Austroasiatic and Austronesian languages had a common ancestor, Austric, whose speakers domesticated rice, and the population growth resulting from rice cultivation drove their expansion and later divergence into what are now Austroasiatic and Austronesian languages.[21] The most likely area for the Austric homeland was individuated in the *Sanjiang* 三江 (Three Rivers, or Three Parallel Rivers) region of Yunnan, where three major Asian rivers run parallel to each other for 300 km and would have provided routes of dispersal (Blust 1996). These rivers are the Nujiang 怒江/Salween, Langcang 浪沧/Mekong, and the Jinsha 金沙 section of the Changjiang 长江/Yangzi River. Further west, the N'Mai River, a tributary of the Irrawaddy River, also runs parallel to the Three Rivers, but by being in modern Myanmar is usually not included **[fig. 13]**. This theory was favourably received among proponents of a single origin of agricultural spread from China to Southeast Asia.[22] Today, the existence of Austric has been refuted, including by proponents of the theory themselves (e.g., Blust 2013), due to the lack of shared vocabulary for rice agriculture between

17 Ethnographic studies have documented this kind of agricultural driven demic diffusion in Borneo, where native Iban swidden rice cultivators would periodically spread to neighbouring areas following demographic increase (Freeman 1970).

18 Diffloth (2005) for example illustrates eleven reconstructible Austroasiatic roots: *(kə)ɓaːʔ 'rice plant', *rəŋkoːʔ 'rice grain', *cəŋkaːm 'rice outer husk', *kəndək 'rice inner husk', *pheːʔ 'rice bran', *təmpal 'mortar', *jənreʔ 'pestle', *jəmpiər 'winnowing tray', *guːm 'to winnow', *jərmuəl 'dibbling stick' and *kəntuːʔ 'rice complement', i.e. accompanying cooked food other than rice; indicating that Austroasiatic has the high diversity in rice agriculture related terminology.

19 e.g., Sagart 2008; Sagart 2011a; 2011b; 2019; van Driem 2011; 2012; Bellwood 2011.

20 e.g., Van Driem 2017, 2012, 2011; Donegan, Stampe 2004.

21 The Austric hypothesis was originally postulated by W. Schmidt in 1906. For proponents of this theory see Diffloth 1994; Reid 1994, 1996, 1999; Blust 1996; Benedict 1999. Austronesian languages are thought to originate in modern Taiwan and from there spread to coastal China and insular Southeast Asia.

22 e.g., Higham 1996a; 1996b; 2002; 2004; Bellwood 1995.

Austroasiatic and Austroneasian languages (Sagart 2011b, 346), and Austronesian languages are thought to originate in modern Taiwan and from there spread to coastal China and insular Southeast Asia (e.g., Blust 2013). Others indicated a tropical origin of Austroasiatic languages, based on reconstructed animal species, and located this homeland in modern continental Southeast Asia (Diffloth 2005), although, at the presumed time of rice domestication, southern China also provided tropical environments (see Ch. 3). Other scholars, in fact, pointed to southern China/the middle Yangzi River as the homeland of Austroasiatic speakers (Norman, Mei 1976), often citing that the Chinese *jiang* 江, old Chinese *kˤroŋ, used to refer to the Yangzi River, is an Austroasiatic borrowing.

Finally, some scholars refuted the hypothesis of Austroasiatic being rice domesticators altogether, indicating instead that proto-Austroasiatic speakers were hunter-gatherers that lived in a tropical environment, relied on fishing, and practiced vegeculture of tubers (e.g., taro). Known as the 'Southern Riverine Hypothesis', this view postulates that proto-Austroasiatic homeland was along the Mekong Basin (described by Blench as the phylum geographical 'centre of gravity'; Blench 2015, 1). Those groups, after the adoption of rice, spread rapidly following riverine routes (Sidwell, Blench 2011; see also Heine-Geldern 1917).

Language/farming dispersal hypotheses still weigh heavily in early agricultural dispersal debates, but the assumption that wet rice cultivation was the main driver of demic diffusions has recently been challenged. Archaeological and archaeobotanical evidence demonstrate that the high yields derived from wet rice cultivation (see below) cause population packing rather than dispersing, as demonstrated by the establishment of large urban centres sustained by wet rice cultivation during the Liangzhu Culture, in the lower Yangzi region (Qin, Fuller 2019). It has been suggested that millet cultivation, or dry rice cultivation, cause demic diffusion and may have been the driver of major population dispersals (Qin, Fuller 2019; Stevens, Zhuang, Fuller 2024).

2.3 The Domestication of Rice and Millets

Ancient plant remains from archaeological sites in China have accumulated steadily in the past decades, thanks to the continued improvement and implementation of archaeobotanical methods in the country (see Ch. 1). This has allowed enormous steps forward in our understanding of past plant domestication and use in China. This section provides information on the growing requirements of each species, a summary of the evidence regarding their early cultivation, and an overview/outline of the potential areas and timing for their domestication.

2.3.1 Rice

2.3.1.1 Rice – Growing Requirements and Domestication Criteria

Rice (*dao* 稻) – *Oryza sativa* subsp. *japonica* (the rice species domesticated in China) derives from the wild progenitor *Oryza rufipogon* (Choi et al. 2017). The history of domestication of rice is complex, genetic evidence is increasingly supporting multiple wild population origins with a single domestication process, indicating that modern diversity in rice derives from later introgression of wild populations with domesticated *japonica* rice. More specifically, *indica* rice is thought to derive from the hybridisation of domesticated *japonica* with a proto-*indica* rice, itself evolved from the wild *Oryza nivara*. Archaeological evidence has shown that *O. nivara* was cultivated in the Ganges Valley around the tenth-ninth millennium BCE.[23] *Indica* rice has similar growing requirements to *japonica*, with the advantage of having a shorter growing season. Today, both varieties are cultivated, with *indica* preferred in South China, where favourable climatic conditions allow for the double cropping of the cereal (a second harvest sown in June and harvested until November; Yoshida 1981). However, since all prehistorical rice evidence identified so far in China belongs to the *japonica* type, *indica* rice is not discussed further here.[24]

Rice is a summer crop sown in conjunction with the warming of temperatures in the spring and harvested after summer, or slightly later. It has a long growing season of at least three months or more **[tab. 3]**. Depending on water management practices, rice can be divided in upland (dryland or rainfed) and lowland (wetland or irrigated) rice. Dryland rice relies solely on rainfall for its water intake, rice fields are established after clearing the forest through fire (slash and burn practice; Fuller, Weisskopf 2011), and there is no creation or maintenance of irrigation structures and therefore no surface water accumulation. Today, upland rice is cultivated in marginal hilly areas (mostly in tropical regions) where there is a minimum precipitation of 800/1,000 mm per year (Jaquot, Courtois 1987). Wetland rice is characterised by the construction of embankments, water reservoirs and other irrigation structures to allow water retention on the fields surface. Fields are either seasonally or permanently flooded. Dryland rice is less labour intensive than wetland rice, however, it also yields a much lower harvest.

23 Choi et al. 2017; Fuller 2011a; 2011b; Fuller et al. 2010; Fuller, Qin 2010.

24 For discussions on the origin of *indica* rice, readers are referred to Fuller 2011a; Choi et al. 2017; Ishikawa, Castillo, Fuller 2020; Bates 2022.

Table 3 Main growing requirements of domesticated rice. Sources: Jaquot, Courtois 1987; Yoshida 1981; Mutert, Fairhurst 2002; Maclean et al. 2002; Fuller, Weisskopf 2011; Qin, Fuller 2019

Growing requirements	Upland (rainfed) rice	Lowland (irrigated) rice
Water requirements	Rainfall higher than 800/1,000 mm	Grown in a spectrum of water systems: irrigate, flooded, fully submerged
Variety according to latitudinal region of growing	Japonica temperate	Japonica tropical
Sowing	February-May	June-July
Minimum temperature to germinate	10°C	
Optimal temperature to flower	20-35°C	
Days to maturity	120/130-150	Up to 200
Harvest	June-October	December
Yield/ Hectare	578 kg/ha ~ 1062 kg/ha (229 kg/ha)	1897 kg/ha (historical data: 1000-1300 kg/ha; Neolithic est. data: 800~900 kg/ha)
Photoperiod sensitivity (changes in day lengths)	High	Low

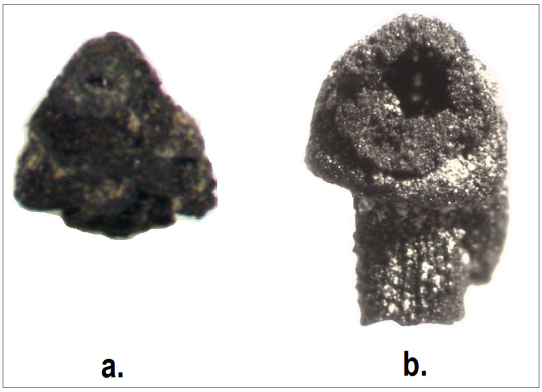

Figure 7
Rice spikelet bases from Baiyangcun, Yunnan, showing different morphology: a. wild type; b. domesticated-type. © Author

Initially, phytoliths were the widest employed method to assess the domestication status of rice. This was undertaken through the morphological and metrical study of rice husk phytoliths, specifically double peak phytoliths and fan-shaped bulliform phytoliths (Zhang, Wang 1998). Fan-shaped bulliform phytoliths are still widely employed to establish the domesticated status of the rice plant that deposited them, through the measuring of the overall size of the phytolith, the length of the fan 'handle', and the count of the scales in the scalloped margin of the fan.[25] However, not all scholars agree on the reliability of this methodology citing the still unclear processed behind the increase of facets in the scalloped margin of bulliform phytoliths produced by domesticated rice plants. Moreover, the application of this methodology to assess wild vs. domesticated rice in areas outside of China has proved unreliable. Contradictory results within China (for example the

25 See for example Wang et al. 1996; Lu et al. 2002; Huan et al. 2015; Ma et al. 2016.

presence of allegedly domesticated rice from very early periods, well before any other archaeological evidence for the exploitation of this plant) have raised further questions regarding the applicability of this methodology to investigate the domestication of rice. Interpretations derived from rice phytoliths push back rice domestication by several millennia compared to inferences made on macro-botanical remains alone. For example, rice phytoliths have been reported from limestone caves in South China at several sites along the Nanling Mountains dated by cultural association to the eleventh millennium BCE (Hung 2014). Their retrieval gave rise to the hypothesis that they represent the initial stage of rice domestication in China; however, phytoliths lack the possibility of ascertaining their antiquity via direct dating, and some scholars have pointed out that the remains from these limestone caves may represent wild rice as there is no clear indication of human collection or consumption of rice.

More reliable evidence of the early management of wild rice, leading to its domestication, is provided by charred macro-remains, as these can be directly dated through radiocarbon dating. Additionally, they can reveal changes in the spikelet morphology, which indicate whether the rice plant exhibited seed shattering or non-shattering behaviour. Non-shattering is a key trait of rice domestication, effectively making the plant dependent on humans for its successful reproduction. The examination of the spikelet base morphology is a recent development within archaeobotanical analyses,[26] which emerged following the refinement of flotation techniques and subsequent recovery of very small macro-botanical remains. Rice spikelet bases often measure just over 0.5 mm or between 0.5-0.3 mm and are thus washed out from the archaeobotanical record if the mesh size used during flotation is not small enough for their retrieval.[27]

Wild-type spikelet bases present a smooth and round scar in the abscission zone, which is mostly flat when examined from its profile angle; domesticated-type spikelet bases, instead, show a deeply ripped, rough and irregular scar in the abscission zone, which appears concave from profile **[fig. 7]**. The ripped scar in the spikelet base is an indication of a non-shattering rachis and can therefore identify domesticated rice. Other domestication traits in rice include a more erect plant growth, a compact panicle, a white grain pericarp, and an increase in grain size, especially width (Fuller 2007; Ishii et al. 2013; Ishikawa, Castillo, Fuller 2020). Archaeobotanical studies on rice domestication have also focused on grain size, another measurable trait in the archaeobotanical material (e.g., Fuller et al. 2009; 2010). These changes altogether have been estimated to account for an increase in yield per hectare of 366% compared to yields from wild rice collection (from an estimated harvest of 232 to 850 kg/ha).[28]

26 The first study of rice spikelet bases can be said to be that of G.B. Thompson in the late 1990s from archaeobotanical materials from Khok Phanom Di, Thailand (Thompson 1996; 1997). In China, early work was conducted on ancient rice remains from the lower Yangzi area (Fuller, Harvey, Qin 2006; 2007; Fuller et al. 2009).

27 Recommended mesh size for the recovery of rice spikelet bases is between 0.25-0.3 mm.

28 Qin, Fuller 2019; Fuller 2020, 94, tab. 1; Stevens, Zhuang, Fuller 2024.

2.3.1.2 Rice – Centres of Domestication: The Archaeobotanical Evidence

Numerous rice macro-botanical remains have been found in the broader Yangzi Valley, especially in the middle and lower basin. Recent work has indicated three main areas as probable centres for rice domestication **[fig. 8]**:

- the lower Yangzi Basin;
- the middle Yangzi Basin;
- the Han/Huai River Valleys (tributaries of the Yangzi).

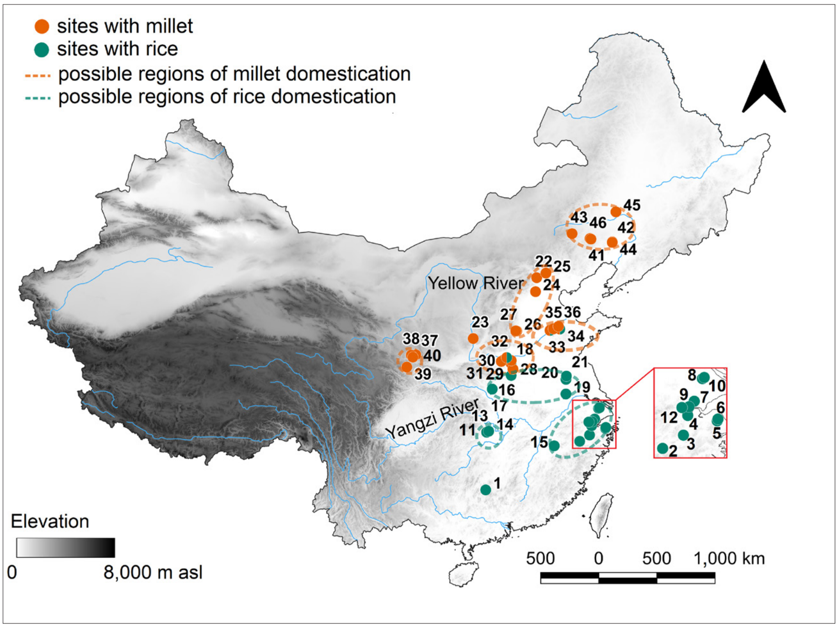

Figure 8 Sites mentioned in text in relation to rice and millet domestication in China (listed in order of first mention): 1. Yuchanyan; 2. Hehuashan: 3. Shangshan; 4. Kuahuqiao; 5. Hemudu; 6. Tianluoshan; 7. Luojiajiao; 8. Caoxieshan; 9. Maoshan; 10. Chuodun; 11. Chengtoushan; 12. Liangzhu; 13. Pengtoushan; 14. Bashidang; 15. Diaotonghuan; 16. Jiahu; 17. Baligang; 18. Peiligang; 19. Hanjing; 20. Xuenan; 21. Shunshanji; 22. Donghulin; 23. Shizitan; 24. Nanzhuangtou; 25. Zhuannan; 26. Cishan; 27. Niuwabao; 28. Dingzhuang; 29. Shawoli; 30. Wuluoxipo; 31. Fudian; 32. Zhuzhai; 33. Yuezhuang; 34. Xihe; 35. Zhangmatun; 36. Xiaojingshan; 37. Dadiwan; 38. Qin'An 1; 39. Lixian 7; 40. Huluhe; 41. Xinlonggou; 42. Jiajiagouxi; 43. Nanwanzibei; 44. Tachiyingzi; 45. Mangha; 46. Zhaobaogou. Made by the Author with QGIS 3.28.5. Firenze, Natural Earth and EROS Digital Elevation basemap, U.S. Geological Survey

At present, the lower Yangzi region has yielded the highest number of rice remains and is the most in-depth studied among the three regions. Here, the wet early to mid-Holocene environmental conditions provided a natural habitat for wild rice (see Ch. 3). Micro-botanical remains from the lower Yangzi region suggests rice exploitation might have started as early as the late ninth millennium BCE, evidenced for example by the find of rice husks and phytoliths from Yuchanyan 玉蟾岩 in Hunan (16300-13400 BCE; Zhang, Yuan 1998; Boaretto et al. 2009; Yuan 2013), and rice phytoliths from Hehuashan 荷花山 in Zhejiang (ca. 9400-5500 BCE; Qiu et al. 2019). However, conclusive evidence for cultivation associated with securely dated macro-botanical remains have been found only from sites dating to the seventh millennium BCE onward, exemplified by the site of Shangshan 上山 in Zhejiang (ca. 8000 BCE; Zhao, Jiang 2016). Here, fragmentary rice grains and rice spikelets have been reported.[29] These are today the oldest macro-botanical evidence recovered from the area. The majority of examined rice rachises from Shangshan are of wild-type, and only a few are of possible domesticated-type (Liu et al. 2007). The recovery of milling stones and acorns at both Shangshan and other Shangshan Culture sites (ca. 7000-6000 BCE) suggests an economy still heavily dependent on foraging. This view has been supported by a recent study on micro-botanical residue analysis on grinding stones from these sites, which revealed these were mostly used for processing acorns, inferring that Shangshan people were relying on the collection of acorns and wild rice for their subsistence (Wang, Jiang 2022). At these sites, high levels of rice husks in the pottery temper suggests people were collecting wild rice (widely available in the area at the time) and using it both for food and other purposes. Large ceramic vessels found at these sites could have been used to boil rice (Jiang 2013a), although no residue analysis was performed on the vessels to confirm this hypothesis. Although it may still represent wild rice, evidence from Shangshan Culture sites is important to trace the potential beginning of rice exploitation and later domestication in the area.

Other sites with evidence of rice exploitation date to the sixth millennium BCE onward, the most famous ones being the waterlogged sites of Kuahuqiao 跨湖桥, Hemudu, and Tianluoshan 田螺山.[30] The fact that clearly domesticated rice evidence, as we will see below, dates to a few millennia later is indicative of a long domestication process for this species. At Kuahuqiao (ca. 6200-5200 BCE) ancient plant remains recovered include several different acorn species of the Fagaceae family; possible water chestnut, Rosaceae fruits, and other species belonging to the Nymphaceae, Fabaceae and Cucurbitaceae families, as well as high quantities of rice grains and spikelet bases, recovered through flotation.[31] The majority of the spikelet bases were of wild-type (58% of the samples analysed by Zheng, Sun, Chen 2007), and samples also included a relatively high number of so-called immature-type spikelet bases, which are harvested before plants are completely ripe. Scholars have suggested that the presence of immature spikelet bases, and therefore the collection of rice panicles while still green, may represent an effort by the Kuahuqiao people to retain a higher number of grains before they would naturally shatter (Fuller, Harvey, Qin 2007). This repeated behaviour would apply a selective pressure to the plant and kick start the domestication process (Fuller, Harvey, Qin 2007). This view is not universally agreed upon (for alternative views see Liu et al. 2007; Pan 2008) and other scholars have suggested that different harvesting techniques and different stages of semi-shattering plants (plants not fully domesticated) may be possible reasons for the inclusion of immature panicles (Crawford 2011a). Due to excellent waterlogged preservation conditions, a thick layer (20-50 cm) of 'rice deposits' was found at Hemudu during excavation (ca. 5000-4500 BCE; Zhejiang 2003; Fuller, Harvey, Qin 2006; Fuller et al. 2009). The layer consisted of rice husks, ears, and straws, and some charred grains. According to the authors of the study, rice remains showed a mixture

29 At the same site, foxtail millet grains have been recovered dating to ca. 4500 BCE (Zhao, Jiang 2016).

30 Zhejiang, Zhejiang 1978; Zhejiang 2003; 2004; Hemudu 1980; Zheng, Sun, Chen 2007; Jiang 2013b; Sun 2013.

31 Zhejiang 2004; Fuller, Harvey, Qin 2007; Zheng, Sun, Chen 2007; Pan, Zheng, Chen 2017.

of wild and domesticated-types. Other plants recovered at Hemudu include acorns, water caltrop, bottle gourd (*Lagenaria siceraria*); mountain peaches (*Prunus davidiana*), apricots (*Armeniaca vulgaris, P. mume*); possible sour date (*Choerospondias axillaris*); foxnut (*Euryale* cf *ferox*); Job's tears (*Coix lacryma-jobi*), and Polygonaceae nutlets (Fuller, Harvey, Qin 2007). The find of such a diverse range of plant resources implicates a general economy still largely based on foraging. High quantity of rice chaff and grains were also found at Tianluoshan (ca. 5500-3500 BCE) located only 7 km from Hemudu, and Luojiajiao 羅家角 (ca. 5000 BCE; Zheng, Sun, Chen 2007). At Tianluoshan, rice is initially only a small component of the overall the archaeobotanical assemblage, which contained the same array of wild plants as those reported from Hemudu (with the addition of horse chestnuts – *Aesculus* sp.; Fuller, Harvey, Qin 2006). However, rice became more prevalent over time, indicating that people living at Tianluoshan were sedentary foragers who grew in dependence on rice over time.[32] Phytoliths studies suggest that Tianluoshan people were managing the wetland margin of wild rice fields, therefore practicing a low-level cultivation (Weisskopf et al. 2015). Here, a slightly higher proportion of domesticated-type spikelet bases has been reported compared to wild-type ones. The archaeobotanical evidence from the above sites shows a slow but steady increase in the exploitation of rice, which resulted in an increase in domesticated-type remains over time. This has been taken as evidence to illustrate the species potential domestication pathway.

Other important sites in the lower Yangzi basin include Caoxieshan 草鞋山, Maoshan 茅山 and Chuodun 绰墩, where rice fields were excavated, providing direct evidence for the crop management and early cultivation practices.[33] At Caoxieshan (ca. 4000-3800 BCE), rice is the most prevalent crop in the archaeobotanical assemblage; of note, acorns and water chestnuts have not been retrieved. Over 70% of the rice spikelet bases reported from the site have been identified as of domesticated-type, a conspicuous increase compared to earlier sites mentioned above (Fuller, Weisskopf 2011). During the 1990s excavation of the site, ovoid fields, of an area of less than 10 m^2 and about 0.2-0.5 m deep, were found dug directly on virgin soil.[34] These have been interpreted as rice paddy fields, at present the second earliest recorded evidence of this kind in China after those found at Chengtoushan 城头山 (see below). Of note, phytolith studies undertaken at the site have identified a shift to drier conditions through time (Weisskopf et al. 2015; Fuller et al. 2016). It has been argued that drier conditions might have been the initial trigger of increased grain productivity, acting on wild rice in-built stress response to drought to produce more grains instead of shoots and leaves (Fuller 2020). Scholars have also postulated that the small creeks connecting the Caoxieshan fields were a strategy to control the water flow and dry the fields at need in order to stress the plants and cause them to produce more grains (Fuller, Qin 2009; Fuller 2011a). At Maoshan (ca. 3000-2300 BCE), located about 20 km from the walled Liangzhu 良渚 site, complex rice paddy field systems were found (Zhuang,

32 Fuller, Harvey, Qin 2007; Fuller et al. 2009; Fuller, Qin 2010; Weisskopf et al. 2015.

33 Zou et al. 2000; Zhuang, Ding, French 2014; Suzhou 2011; 2012.

34 Zou et al. 2000; Fuller 2011a; Fuller, Weisskopf 2011; Fuller et al. 2009; Fuller et al. 2014; see also Qin 2012; Fuller et al. 2016.

Ding, French 2014). According to the excavation report, in the early period of Maoshan occupation (ca. 3000-2600 BCE), irregular round shaped fields ranging between 1-2 to 30-40 m^2 were found (Zheng, Chen, Ding 2014). In the later period of occupation (ca. 2600-2400 BCE), rice fields increased to about 2,000 m^2 and were connected to the river by small ditches and embankments; soil breaking cut marks were clearly visible at the margins of the embankments indicating people at Maoshan were managing the creeks and creating field boundaries. Geoarchaeological analyses of field palaeo-soils confirmed that people at Maoshan were maintaining the natural creeks across the field to cultivate the rice (Zhuang, Ding, French 2014). Wells and possibly dams located north of Liangzhu were also found during excavation, and these might have served to control the water flow or prevent floods. An intensification of rice cultivation has been inferred based on palynological evidence related to deforestation and intentional burning after 4000 BCE (He et al. 2020), which compares well with the macro-botanical evidence discussed above.

In the middle Yangzi River Basin, rice grains have been reported from Pengtoushan 彭头山, and Bashidang 八十垱 (Nasu et al. 2012; Gross, Zhao 2014), however, neither site is well dated, and the lack of rice spikelet bases makes it difficult to determine the domestication status of the rice recovered. Other plant remains retrieved from these sites include water chestnuts (*Trapa bispinosa*) and lotus (*Nelumbo nucifera*), indicating collection of wild water resources. In this region, at Chengtoushan, small rice paddy fields[35] with simple drainage structures were discovered during excavation and dated to ca. 4500 BCE (He 1999; Fuller 2011a; Qin 2012). Phytoliths from Diaotonghuan 吊桶环 have been taken as an indication of early utilisation of rice in the area (Zhao 1998), possibly pre-dating the domestication of the species to the ninth millennium BCE; however, as we have seen, scholars disagree on the reliability of this method to determine domestication status, and further evidence is needed to fully clarify the contribution of this region to rice domestication.

More recently, new data from the Han (also known as *Hanshui* 汉水 or *Hanjiang* 汉江) and Huai River (*Huaihe* 淮河) Valleys, geographically located between the Yangzi and Yellow Rivers and today both discharging into the Yangzi, suggests this region was also central for the domestication of rice.[36] Rice remains have been found at several sites belonging to the Peiligang and Yangshao Neolithic Cultures in this area.[37] Rice found at Jiahu 贾湖 (ca. 7000-6600 BCE; Henan 1999), located in Henan Province along the Upper Huai River, has been used by many as strong evidence for rice cultivation by the Yangshao people (e.g., Zhang, Wang 1998; Liu et al. 2007). Others argued that Jiahu rice remains belong to a wild variety that did not participate in the later domestication of the crop (Fuller, Harvey, Qin 2007). Flotation undertaken during the 2013 excavation revealed a high number of previously unrecorded charred rice grains and spikelet bases among other species, such as grape and wheat (Zhang J.Z. et al. 2018). According to this study, spikelet bases show an increase in domesticated-type through

35 At the time of writing this is the earliest archaeological rice field excavated so far in China.

36 Gross, Zhao 2014; Silva et al. 2015; Deng et al. 2015; Stevens, Fuller 2017; Huan et al. 2022a.

37 See Yang et al. 2016; Wang et al. 2017; 2019a; 2019b; Cheng Z.J. et al. 2022; Huan et al 2022b; Sun et al. 2022.

time, and rice is also among the most prominent species recovered. The authors of the study suggest Jiahu inhabitants relied heavily on rice exploitation and contributed to this species domestication. However, no rice grains were directly dated; wheat and foxtail grains coming from the same contexts as rice, dated by AMS radiocarbon dating, were revealed to be either modern or dating to ca. 600-500 years ago; this raises doubts about the chronology of the rice remains recovered in this occasion and any inferences made from it. Until more conclusive evidence is found, the role of rice at Jiahu remains ambiguous; rice is a minor component of the overall archaeobotanical assemblage retrieved, suggesting it occupied a minor role in the overall economy of Jiahu, where hunting and gathering were the main subsistence strategies (Zhao, Zhang 2009). The only site where rice cultivation is well attested from the same area is the site of Baligang 八里岗 (ca. 6700-1800 BCE) in the Nanyang basin, which was occupied around the same time as Jiahu (Deng et al. 2015). The archaeobotanical assemblage here is dominated by rice, which is found alongside wild plant resources, especially acorns, for the initial period of occupation. In the later periods, wild foodstuff decreases, and rice is present alongside millets (both *Setaria italica* and *Panicum miliaceum*) constituting among the first mixed farming system in China (see § 5.1). Rice remains for the whole period of occupation are mostly of domesticated-type, with wild-type remains present in negligible quantities already by ca. 6300 BCE (Deng et al. 2015). Recent archaeobotanical data from the site of Peiligang 裴李岗 (ca. 6200-5700 BCE; Li Y.Q. et al. 2020), located in northern Henan, included rice, millet, and other fruits; while the full archaeobotanical report has not been published yet, this still suggests exploitation of rice in this area by at least the sixth millennium BCE.

In the lower Huai region, rice grains have been recovered from Hanjing 韩井, Xuenan 雪南, and Shunshanji 顺山集, all belonging to the Shushanji Culture and dating to well before 6000 BCE (Nanjing, Sihong 2016). At Hanjing, what looks like paddy structures have been discovered (Zhuang et al. 2018; Qiu et al. 2022), and this suggests rice cultivation was well underway in this area by the end of the seventh millennium BCE.

Regardless of the ongoing debates on where exactly rice was domesticated, the disagreement on the best suited type of evidence to distinguish between wild and domesticated rice, scholars agree on the fact that the domestication of rice was a long and protracted process that took several millennia. Present evidence attests that the collection of wild rice started in the ninth millennium BCE, or possibly earlier, in the Yangzi Basin. This is strongly connected to an intensification in wild acorns exploitation; some scholars have suggested that the need for processing acorns to make them edible (e.g. boiling) forced people to have longer sedentary camps, which may have laid the basis for later rice agriculture (Chang 1970). Convincing evidence, including both domesticated-type rice remains and paddy-like fields, has been attested from the fifth millennium BCE onward, both in the lower and middle Yangzi region. Intensification of rice cultivation and large-scale fields have been found connected with the Liangzhu Culture from the third millennium BCE. The Han/Huai Valleys have also recently provided data of cultivated rice from about the same time. Ancient palaeoclimate in the Yangzi region was much wetter than today (see Ch. 3); this created a natural environment for wild rice, which was distributed much further north than today, and provided abundant wild rice availability to people living in the

Yangzi Basin and north from it. This allowed for experiments with wild rice gathering and exploitation for a variety of uses, but it is possibly where drier conditions emerged that rice productivity was pushed to increase, as evidenced by shifts in ecological signatures at Caoxieshan. Predominantly domesticated rice forms have been attested from the fifth millennium BCE onward, when rice began being the main source of food of people living along the Yangzi River.

2.3.2 Millet

2.3.2.1 Millet – Growing Requirements and Domestication Criteria

Two millet species are native to China: broomcorn millet (*Panicum miliaceum*, *shu* 黍) and foxtail millet (*Setaria italica*, *su* 粟). Broomcorn millet's wild ancestor has not yet been conclusively determined. Ancestral relatives of *Panicum miliaceum* subsp. *ruderale*, found today across Eurasia, have been indicated as likely candidates (Xu et al. 2019; Li L.X. et al. 2021), but a recent morphometric study on archaeological *P. miliaceum* and *P. ruderale* grains has found that these ancient *ruderale* grains are longer than the earliest *miliaceum* grains, suggesting that *P. miliaceum* var. *ruderale* may be a poor fit as a true wild ancestor of broomcorn millet (Stevens et al. 2020). Other possibilities include *Panicum repens*; however, some scholars have suggested that broomcorn millet wild progenitor might be extinct.[38] Foxtail millet derives from *Setaria viridis* (green bristlegrass).[39] Millets are warm season crops but thanks to their high level of resilience to cold and drought they are well suited to grow in a variety of environmental conditions, including harsher climates (Weber, Fuller 2008). Compared to foxtail millet, broomcorn millet has a shorter growing season, can handle water shortages better, but is not completely frost tolerant, as foxtail millet is **[tab. 4]**. Chinese millets adaptability and ability to produce grains even with as low as 200 mm rainfall make them particularly well adapted to grow in northern China and semi-arid regions. Recent experimental data has suggested that grain yields derived from the cultivation of domesticated millets increased by 1,180% (from 50.8 to 600 kg/ha) for foxtail millet and 546% (from 109.9 to 600 kg/ha) for broomcorn millets (Stevens, Zhuang, Fuller 2024).

38 Sakamoto 1987; De Wet 2000; Hunt et al. 2011; Hunt et al. 2014.

39 He et al. 2023; Jia et al. 2013; Eda et al. 2013; Le Thierry d'Ennequin et al. 2000.

Table 4 Main growing requirements of domesticated Chinese millets. Sources: Kamkar et al. 2006; Weber, Fuller 2008; Liu 2009; Saseendran et al. 2009

Growing requirements	***Panicum miliaceum***	***Setaria italica***
Water requirements	200-350 mm (Optimal range 300-350 mm)	
Minimum temperature to germinate	20°C	10°C
Optimal temperature for flowering	20-25°C	16-25°C
Frost tolerance	Some	Yes
Days to maturity	45-100	60-120
Yield/ Hectare	500-700 kg/ha (Neolithic est. 600 kg/ha)	800-900 kg/ha (Neolithic est. 600 kg/ha)

Millet grains preserve well archaeologically, but their very small size (charred grains usually range between <1-1.5 mm) has resulted in a bias against their retrieval in favour of larger grains. This was even more so before the standardisation of flotation techniques and use of a small size mesh sieve during flotation at archaeological excavations (see Ch. 1). At present, seed size and a general rounder seed shape together with changes in seeds' embryo size and shape have been used as the main attestable criteria in tracing this crop domestication, as these preserve well archaeologically (Fuller et al. 2014; Stevens et al. 2020).

2.3.2.2 Millet – Centres of Domestication: The Archaeobotanical Evidence

Recent debates about millet domestication in China have focused on a single vs. multiple domestication origin, as finds have been reported across separate areas in western and northeast China (Xu et al. 2019), as well as Europe (see Hunt et al. 2008; Motuzaite-Matuzeviciute et al. 2013; Filipović et al. 2020 for a critical review of that data). Millet grains were reported from Neolithic Age sites in Europe dating to as early as the seventh millennium BCE. This prompted hypotheses for either a local domestication (e.g., Jones 2004), or a very early spread of the crop (e.g., Hunt et al. 2008), which would have had implications on a possible date of origin in China. Direct radiocarbon dating on these millet grains revealed that they were intrusive from later periods and determined to be dated to the second millennium BCE (Motuzaite-Matuzeviciute et al. 2013; Filipović et al. 2020), therefore laying to rest claims of a separate European origin of these species. Within China, based on genetic analyses it was proposed that the centre of broomcorn millet domestication was in western China, possibly at the limit of the Loess Plateau (Hunt et al. 2018), but the uncertainty of its wild progenitor has made it difficult to fully investigate this issue. For foxtail millet, rDNA studies on modern *Setaria viridis* landraces have shown that the highest diversity within China is attested in the Yellow River Valley, making this area the likely centre for the domestication of this species (Huang et al. 2014; Wang et al. 2012). Archaeological finds of millets indeed appear in broader northern China along the Yellow and Wei River Basins at sites dating to at least the seventh millennium BCE.[40] Recent archaeobotanical data has individuated five possible regions involved in the domestication of Chinese millets **[fig. 8]**:

1. Southern Hebei (Cishan Culture sites, located in the north China plain east to the Taihang Mountains);
2. Northern Henan (Peiligang Culture sites, located mostly along the Jialu River valley to north of the Funiu Mountains);
3. West Shandong (Houli Culture sites, located in the Haidai alluvial plain north of the Taiyi Mountains);
4. Gansu (Dadiwan);
5. Manchuria (Xinglongwa Culture sites).

To date, the earliest macro-botanical evidence of presumably collected wild and possibly 'domesticated-shape' millet grains come from the site of Donghulin 东胡林, located less than 80 km from Beijing (Zhao C.H. 2006; Zhao et al. 2020). Flotation samples collected during the fourth excavation campaign at the site (between 2001 and 2006) included 14 grains of foxtail millet, one grain of broomcorn millet, and 11 grains of *Setaria viridis*. Additional macro-remains included seeds of hackberry (*Celtis bungeana*), possible wild grape (*Vitis* sp.) and a possible wild *Vigna* bean species. Foxtail millet grains from one context were directly radiocarbon dated to ca. 8240-7800 BCE, confirming antiquity of the grains and representing the oldest evidence of millet cultivation from China so far. *Setaria* starch grains have also been reported from lithic implements, further indicating exploitation of grasses at the site (Yang et al. 2012; 2015a). Other sites which have reported grasses starch grains evidence on stone tools include Shizitan 柿子滩, Nanzhuangtou 南庄头, and Zhuannian 转年 (ca. 9500-7500 BCE, Liu L.H. et al. 2013; Bestel et al. 2014; Wang C.F et al. 2012; 2015a). At Shizitan, grains of *Echinochloa* sp. and *Setaria* sp. have also been retrieved through flotation (Bestel et al. 2014); at Nanzhuangtou flotation samples included waterlogged water caltrop (*Trapa incisa*), and wild grape (*Vitis bryoniifolia*), and at Zhuannan charred remains of Manchurian walnut (*Juglans mandshurica*) were found (Yang et al. 2015a). These remains altogether attest to the range of wild plants exploited by late forager groups; finds of both macro- and micro-remains of grasses, including *Echinochloa* and *Setaria*, indicate that collection of wild millet might have started as early as the late ninth millennium BCE.

Further evidence comes from sites linked with Cishan and Peiligang Cultures, located in the Central Plains, dating to the late seventh and early sixth millennia BCE. At the site of Cishan (ca. 6000?-5000 BCE), 88 alleged underground storage pits were excavated during the 1970s archaeological campaigns (Tong 1984). According to the excavation reports, it was claimed that over 50 kg of millet grains had been retrieved from the pits,[41] however, these were too fragile to be further examined and were described as 'possibly' foxtail millet grains. This find has been questioned by later scholars, including whether the pits were indeed storage units and if millet was at all present at the site (e.g., Lu 1999; Cohen 2011; Liu,

40 He et al. 2022a; Stevens et al. 2020; Liu et al. 2019; Shelach-Lavi et al. 2019; Stevens, Fuller 2017; Crawford et al. 2016; Fuller et al. 2016; Zhao 2011; Barton et al. 2009; Lu et al. 2009a.

41 Yan 1992; Tong 1984; Handan, Handan 1977; Hebei, Handan 1981.

Chen 2012, 84). More recent investigations based on phytolith analyses on material retrieved from previously unexcavated pits at Cishan have reported the presence of both species, with possibly broomcorn millet more prevalent than foxtail millet (Lu et al. 2009a; 2009b). However, charring experiments also showed that broomcorn millet may be underestimated in carbonized macro-remains and overestimated in the phytolith assemblages but most importantly, the identification, chronology, and context of provenance of the material analyses in these more recent studies has also called into question (Zhao 2011), therefore, further research needs to ascertain the presence and status of millet at Cishan (He et al. 2022a). In this region, foxtail millet grains have also been reported from Niuwabao 牛洼堡 (ca. 6500- 5100 BCE, Liu, Jin, Kong 2008), not far from Cishan.

Broomcorn millet and comparatively lower quantities of foxtail millet as well as wild acorns have been found at the site of Peiligang (ca. 6500 BCE; Kaifeng 1978; 1979; Zhongguo 1984). Other sites belonging to the Peiligang Culture with evidence of cultivated crops include for example Dingzhuang 丁庄, Shawoli 沙窝李, Wuluoxipo 坞罗西坡, and Fudian 府店 where grains of *Setaria italica* have been reported, and from Zhuzhai 朱寨, and Zhuzhai B, where both grains of *Setaria italica* and *Panicum miliaceum* have been reported, all dating to ca. the mid-sixth millennium BCE.[42] At both Cishan and Peilingang there is widespread presence of agricultural tools such as stone adzes, spades, hoes, sickles, mortars and pestles. These have been interpreted as indicators of agricultural activities, especially sickles have been linked to cereal harvesting at the ear, and mortar and pestle to grain dehusking practices. Further sites with evidence of early millet grains have been mapped along the Sushui River Valley (flowing into the Yellow River from the north), dating to fifth millennium BCE (Song, Wang, Fuller 2019).

Among Houli Culture sites (ca. 6000 BCE), which are mostly clustered in modern Shandong Province, macro-botanical remains of millet cultivation have been found at Yuezhuang 月庄, Xihe 西河, and Zhangmatun 张马屯.[43] Additionally, at Xiaojingshan 小荆山 stable carbon isotope ($\delta^{13}C$) data on human skeletons showed that millet consumption contributed to less than 25% of the overall dietary protein intake ($\delta^{13}C$ average value −17.8‰ ± 0.3‰; Hu et al. 2008). This type of study estimates dietary contribution of C_3/C_4 plants based on stable carbon isotopes values measured in human (and animal) bone collagen and thus allows for inferences of potential dietary composition and its changes through time, especially when coupled with macro-botanical remains and a background vegetation baseline, to gain insights into the available plant resources at the time.[44]

42 Wu 1983; Song 2011; Zhu 2013; Cohen 1999; Liu, Hunt, Jones 2009; Lee et al. 2007; He et al. 2022a; Wang et al. 2017; Wang C. et al. 2018; Bestel et al. 2018.

43 Crawford et al. 2013; 2016; Jin G.Y. et al. 2014; Wang 2013; Wu et al. 2013; Wu, Jin, Wang 2015.

44 C_3 plants include rice, wheat, barley, most legumes and trees; C_4 plants include millets, sorghum, and maize. This categorisation is based on the different processes plants use to fix carbon during photosynthesis. On C_3, C_4 plants see Furbank, Taylor 1995; on the application of stable carbon isotopes to infer dietary changes in Archaeology see Parkington, Sealy, Merwe 1987; Merwe 1982; 1992; Boutton, Lynott, Bumsted 1991; Schoeninger 2014; Lightfoot, Liu, Jones 2018; Katzenberg, Waters-Rist 2019. For recent syntheses of stable isotope studies to infer human diets in China see Liu et al. 2021a; Liu, Reid 2020.

At the sites of Dadiwan 大地湾, Qin'an 1 秦安 1, Lixian (LX07) 礼县, and Huluhe 葫芦河 (ca. 6000-5000 BCE) broomcorn millets have been reported in association with stone spades.[45]

In Northeast China, millet grains (mostly broomcorn millet) have been reported from Xinglongwa Culture sites including at Xinglonggou 兴隆沟 (ca. 6200-5400 BCE; Zhao 2004b, 2011a; Qiu et al. 2023), Jiajiagou West 贾家沟西 (Fuxin 12D56), Nanwanzibei 南湾子北, and Tachiyingzi 塔尺营子 (Fuxin 12D16), dating to the late sixth millennium BCE (Shelach-Lavi et al. 2019; Sun 2021). Both foxtail millet and broomcorn millet grains have been found at Hamin Mangha 哈民忙哈 (Sun, Zhao, Ji 2016) and Zhaobaogou 赵宝沟 (Yuan, Sun 2019; Zhang, Sun 2022). At other Xinglongwa Culture sites, although millet grains were not found, the stone tool assemblages bear strong similarities with the sites mentioned above. This has been interpreted as indicative of a common cultivation technology tradition continuing into the successive millennia, until at least the fourth millennium BCE (Shelach-Lavi, Teng 2013).

Although millet grains have been recovered from numerous sites across broader northern China from the late seventh millennium BCE onward, at present there is a lack of conclusive evidence as whether this cereal was first domesticated in any of the regional areas outlined above and how possibly independent episodes contributed to the overall domestication of the crop. The available data supports that the domestication of millets happened over a protracted period of several millennia, and a case can be made on morphometric data for a continued increase in size in archaeological broomcorn millet grains from the seventh to at least the mid-fourth millennium BCE. This possibly attests that the domestication of the crop had fully happened by that time (Stevens et al. 2020; Stevens, Zhuang, Fuller 2024). A recent meta-data analysis of archaeobotanical reports of early archaeological millets has shown a shift from a predominantly broomcorn millet-based cultivation system for the sixth-fifth millennia BCE to a predominantly foxtail millet agriculture during the fourth millennium BCE (He et al. 2022a). This has been attested by the recovery of predominantly foxtail millet remains from sites in the Central Plains, including those located in the upper Yiluo River Valley (a tributary of the Yellow River; Lee et al. 2007; Zhang, Xia, Zhang 2014) and the middle and upper Ying River Valley (tributary of the Huai river flowing into Henan; see Fuller, Zhang 2007; Zhang et al. 2010). Foxtail millet was also the main staple crop during the foundation of the early Chinese states (Zhao 2011). Some scholars suggest that the predominance of broomcorn millet in the early Holocene was correlated to a drier climate, given the better adaptation of broomcorn millet to drought.[46] Others have also noted that foxtail millet is more common in eastern China, where there are wetter environmental conditions compared to interior regions, including Central Asia, where broomcorn millet is more predominant and has a bigger role for the species spread both westward and southward (Crawford et al. 2005; Lee et al. 2007; He et al. 2017). However, others have pointed out that, while during the wild collection stages *Panicum* grains would have provided greater yields than wild *Setaria* due to its higher grain weight (Stevens, Zhuang, Fuller 2024, 6, tab. 1), domesticated foxtail

45 Liu, Kong, Lang 2004; Ji 2009; Bettinger et al. 2010; Barton et al. 2009.

46 Feng, An, Wang 2006; Dodson, Dong 2016; He et al. 2022a; 2022b.

millet produces comparatively higher yields than broomcorn millet[47] due to greater changes in percentage of seed size increase and number of seeds per panicle. Greater yields derived from domesticated foxtail millet may have caused its predominance over broomcorn millet, as attested in the archaeological record from around 4300-3800 BCE (Stevens, Zhuang, Fuller 2024). In addition to macro-botanical evidence for grains, other scholars have noted an increase in the presence of stone 'harvesting knives' around the mid-fifth millennium BCE (Luo 2007). These are small implements characterised by a peculiar mostly half-moon or rectangular shape with holes in the middle. They are considered crop-reaping tools mostly used to harvest cereals at the ears (although other uses have also been attested ethnographically). These knives would be held with one hand and secured to the fingers through a rope going through the holes (these tools are in fact called by some scholars *xisheng shidao* 系绳石刀, corded stone knife; Luo, Li 2013). Such a use has been attested up to the 1990s among Miao people (Luo, Li 2013). Archaeologically they are a widespread find across East Asia (China, Korea and Japan) to northern India and Pakistan (Luo 2004). It has been suggested their use for harvesting millet would contribute to a predominance of non-shattering and enlarged panicle plants over time, thus contributing to the domestication of the plant (Stevens, Zhuang, Fuller 2024, 13). Finally, a synthesis of recent carbon isotope studies has highlighted the increasing importance of millet in human (and animal) diets in China over time and provides an additional line of evidence to investigate the timing and geography of the transition to an agricultural life in China (Liu et al. 2021a). It is worth pointing out that isotopic analyses are increasingly being undertaken at ancient sites across China and this may help complement and refine our understanding of early subsistence especially for those sites lacking plant remains.

2.4 Other Important Plants in Early Chinese Agriculture

2.4.1 Soybean – *Glycine max*

Soybean (*Glycine max*, *dadou* 大豆) today is the most cultivated legume worldwide, ranking among the top ten produced agricultural commodities in the last 30 years (FAOSTAT 2024). It is consumed for its seeds, for oil, and used in the production of other food products such as tofu (*doufu* 豆腐). Soybeans are planted in spring and sown before the end of the summer, have high-water requirements and a short growing season of less than three months **[tab. 5]**. Similarly to other legumes, soybeans are nitrogen fixing, meaning that, when cultivated, they compensate for potential losses of nitrogen in the soil, which can occur after the cultivation of cereals (Postgate 1998). For this reason, soybeans can be used as 'green manure', intercropped with other plants, usually cereals, in order to maintain soil nutrients balance (Zohary, Hopf, Weiss 2012). Interestingly, in many of the known agricultural centres in the world, cereals have been domesticated alongside legumes, which may indicate that legumes were in fact domesticated as a companion

47 During the wild collection stages *Panicum* grains would have provided greater yields than wild *Setaria*, given its higher grain weight (Stevens, Zhuang, Fuller 2024, 6, tab. 1).

crop to cereals to compensate for soil nutrients losses derived from intensive cereal cultivation (He et al. 2022c).

Table 5 Main growing requirement of soybean. Sources: Yadav, Yadav 2002

Growing requirements	***Glycine max***
Water requirements	600-800 mm
Minimum temperature to germinate	10°C
Optimal temperature for flowering	25-30°C
Photoperiod sensitivity	Yes
Days to maturity	70-90 days
Yield/ Hectare	2 t/ha (modern)

The wild progenitor of soybean is *Glycine soja*,[48] a native species that occurs across many regions in East Asia. Given its widespread occurrence across several areas in East Asia and the scarcity of early archaeological material, there are still debates about when and where exactly soybean was domesticated. Genetic analyses have proposed often contradictory results, with some studies suggesting Japan as centre of origin (e.g., Jeong et al. 2018; Takahashi et al. 2023) and others China, either in the Yellow River Valley[49] or South China, based on high diversity in modern wild populations.[50] Interestingly, a disjunct wild population of soybean has been found in Southwest China (Dong et al. 2001), but at present it is unclear whether it contributed to the domestication of the crop. Although scholars have argued for multiple origins, with centres in China, Japan and Korea (e.g., Xu et al. 2002; Kim et al. 2012), at present the single origin is the most widely accepted theory, and a centre in the Yellow River Valley is supported by both higher genetic diversity compared to other areas in China as well as archaeological finds (Li et al. 2012; Lee et al. 2011).

Soybean, like other legumes, loses natural pod dehiscence when domesticated; however, given that pods rarely preserve archaeologically,[51] there are no reliable archaeobotanical methods to assess the non-shattering ability of legume pods. The main measurable trait to assess the domestication status of archaeological soybean has been seed size (Lee et al. 2011; Fuller et al. 2014; see also Fuller, Asouti, Purugganan 2011). Seed coat thinning has also been explored as a possible measurable trait in archaeological material (Murphy et al. 2019). Data from early sites in the Yellow River Basin have a clear trend of size increase during the fourth to third millennia BCE (Lee et al. 2011; Fuller et al. 2014). Possibly wild soybean remains have been reported from Jiahu (ca. 7000-6600 BCE; Zhao, Zhang

48 Some scholars have suggested that soybean was domesticated from a *G. soja/G. max* complex that diverged from a common ancestor of these two *Glycine* species (Kim et al. 2010; Li et al. 2014).

49 The Yellow River Valley was indicated as the homeland of domesticated soybean already by Li 1970. Archaeobotanical studies and proponents of this area include Dong et al. 2023; Li et al. 2008, 2010, 2012; Liu et al. 2020.

50 Gai et al. 2000; Shimamoto et al. 2000; Dong et al. 2001; Wen et al. 2009; Guo et al. 2010.

51 A paper available in pre-print at the time of writing has reported finds of charred soybean pods together with both wild (n=290) and domesticated (n=111) soybean seeds from Wangjinglou 望京楼, in Henan, dated to ca. 1600-1400 BCE (Tang et al. 2024). The authors argue that pod dehiscence develops earlier than increase in seed size, and retrieval of remains such as those from Wangjinglou might shed new light on the domestication of soybean. The pre-print is available at Research Square: `https://doi.org/10.21203/rs.3.rs-4571188/v1`.

2009), Baligang 八里岗 (6700-6500 BCE; Deng et al. 2015), and Bancun 班村 (6000-5000 BCE; Kong, Liu, and Zhang 1999). This evidence suggests that soybean may have been domesticated in northern China around the fourth millennium BCE; however, a larger dataset will be needed to confirm whether this is the result of primary, local processes or, for example, a secondary domestication of the crop following its spread from somewhere else, for example Japan.

2.4.2 Possible Minor Crops

2.4.2.1 Buckwheat – *Fagopyrum esculentum*, *Fagopyrum tartaricum*

Buckwheat (*qiaomai* 荞麦) belongs to the Polygonaceae family and for this reason is often referred to as a 'pseudo-cereal'. Of the 18 *Fagopyrum* species known globally, two are cultivated today in temperate regions: *Fagopyrum esculentum* (common buckwheat), and *Fagopyrum tartaricum* (Tartary buckwheat). These both have a short growing season (9-12 weeks) and a degree of tolerance to drought. Although they are most often cultivated during the summer, they can be cultivated in all seasons depending on the latitudinal belt of cultivation. Common buckwheat is usually grown at lower altitudes as it has no tolerance to frost, contrary of Tartary buckwheat, which is known to withstand low temperatures. Buckwheat is regarded as a suitable crop for marginal agricultural areas where other crops cannot successfully grow. Cultivations of Tartary buckwheat have been reported from as high as 4,500 m asl in some areas of the Himalayas in modern Nepal and among Drung (Dulong) villages in northwest Yunnan, where both buckwheat species were traditionally grown (Gros 2014; Luitel et al. 2017) **[tab. 6]**. Today, the main buckwheat producing countries are Russia, China, Ukraine, and Poland (Small 2017, tab. 1), however, buckwheat cultivation has declined in the past decades, mostly due to its erratic yields (e.g., Brunori et al. 2005; Pirzadah, Rehman 2021).

Table 6 Main growing requirements of buckwheat. Sources: Kalinova, Mouldry 2003; Oplinger et al. 1989; Luitel et al. 2017

Growing requirements	*F. esculentum*	*F. tartaricum*
Water requirements	100 mm	
Minimum temperature to germinate	5/7°C	
Optimal temperature for flowering	15-26°C	
Frost tolerance	No	Some
Days to maturity	70-90	
Yield/ Hectare	900 kg/ha (modern)	

Recent genetic studies on *Fagopyrum* landraces have individuated in *Fagopyrum esculentum* ssp. *ancestralis* the wild progenitor of common buckwheat, and in *Fagopyrum tartaricum* spp. *potanini* the wild progenitor of tartary buckwheat.[52] Such studies have also shown that the highest diversity in *Fagopyrum* landraces is found in Southwest China, where there

52 Ohnishi 1991; 1998; Ohnishi, Matsuoka 1996; Fawcett et al. 2023; He et al. 2024.

are at least 16 endemic species, including both *esculentum*, *tartaricum* and their wild ancestors.[53] Of note, these are mostly localised at the crossroad of northwest Yunnan, southwest Sichuan, and eastern Tibet, in a rocky hilly area of only 250 km of radius.[54] This area has been proposed as the most likely region for the domestication of both species, although some recent linguistic studies implied that buckwheat was domesticated by East Bodish speakers of the Tibeto-Burman language family living in modern day Buthan, with domestication occurring around or after the first millennium BCE (Hyslop, d'Alpoim Guedes 2021). At present no archaeobotanical data is available to test this theory.

Archaeological evidence for buckwheat cultivation and use is limited. At present, the earliest evidence for Tartary buckwheat come from Chu-gong/Qugong 曲贡, Tibet, ca. 1400-1000 BCE (Gao et al. 2021). Archaeological seeds of common buckwheat have been reported from Xingyi 兴义 in central Yunnan, ca. 1800-1000 BCE (Ma et al. 2024) and Haimenkou, in northwestern Yunnan, ca. 1400-700 BCE (Xue et al. 2022). Seeds of buckwheat have also been reported from Zongzan 宗咱, dated by cultural association to the second-first millennia BCE (Li 2016) **[tab. 12]** and from Donghuishan 东灰山 (1600-1450 BCE; Wei 2019; Wei et al. 2020). For both species the earliest known macro-botanical remains are reported from Southwest China dating to the late second millennium BCE, which would support an origin of the crop from this region. However, a recent review of all instances of buckwheat remains, including macro-botanical remains, pollen and starch grains recovered from archaeological sites in China has highlighted that the majority of the reported remains come from both northern and southern China alike (Krzyzanska et al. 2021; Hunt, Shang, Jones 2017). This gives rise to seemingly contradicting theories regarding the domestication of the crop, with some scholars suggesting that the centre of domestication should be individuated in northern China around the fourth millennium BCE, based on pollen remains (Krzyzanska et al. 2021; Hunt, Shang, Jones 2017).

A few problems persist with this theory: the lack of unambiguous taxonomic identification, most finds are in fact reported as *Fagopyrum* sp., and the lack of possibility of direct dating of either pollen or starch grains, which doesn't allow confirmation of their antiquity. At present is not clear whether the pollen finds refer to human activity or natural depositional processes from nearby wild populations, since most of the finds reported come from off-sites locations (Hunt, Shang, Jones 2017).[55] A recent study on buckwheat pollen highlighted the difficulty of securely identifying pollen grains to species and distinguishing between wild and domesticated plants (Yao et al. 2022). The same study further highlighted an increase in pollen grains from sediments in Southwest China from the Holocene onward, suggesting that, in line with phylogenetic reconstruction and macro-botanical evidence, this region is a likely candidate for the domestication of this crop. The general lack of

53 Ohnishi 2004; Ohnishi, Yasui 1998; Chauhan et al. 2010.

54 Ohnishi, Yasui 1998; Ohnishi, Konishi 2001; Ohnishi, Tomiyoshi 2005; Konishi, Yasui, Ohnishi 2005; Konishi, Ohnishi 2007.

55 Of note, similar conflicting evidence has been reported from Europe. Here, directly dated macro-botanical remains indicate an introduction of the crop in the Middle Ages (e.g., Rösch 1998; Brown et al. 2017), but pollen-based reconstruction suggested an introduction already in the Neolithic time (e.g., Janik 2002; Jones et al. 2011; Alenius, Mökkönen, Lahelma 2012; de Klerk, Couwenberg, Joosten 2015).

archaeological buckwheat remains from early periods across East Asia could also imply depositional processes that negatively impact the preservation and recovery of buckwheat, or simply that a more intensive use of the plant developed much later compared to other species. Based on charred macro-botanical remains, such as those from Qugong and Haimenkou, buckwheat was exploited from at least the late second millennium BCE in broader Southwest China,[56] but the lack of systematic morphological and morphometrical studies on ancient buckwheat grains, but most importantly, the general lack of ancient buckwheat remains makes it challenging to reconstruct the timing and region of early human use of this plant.

2.4.2.2 Barnyard Millet – *Echinochloa* sp.

Echinochloa (*bai* 稗) is an herbaceous millet-type plant within the Poaceae family. Globally, there exists at least 50 *Echinochloa* species, some annual and some perennial, usually summer growing and regarded as the toughest invasive weedy plants in the world. *Echinochloa* plants are able to survive and adapt extremely well to a wide range of different ecological conditions, from fully submerged (e.g., *E. crus-galli* var. *oryzoides* syn. *E. oryzoides* and *E. oryzicola*, obligate weeds of rice and rice mimics) to dry settings (Michael 2001). In Eurasia two species have sometimes been cultivated for either food or fodder: *E. frumentacea* (Indian sawa/mawa millet, also called Indian barnyard millet) and *E. esculenta* (syn. *E. utilis*, Japanese barnyard millet).[57] *E. frumentacea* is thought to be derived from *E. colona*,[58] and scholars generally agree that it was domesticated in South Asia, more specifically in the Indian peninsula. Today, cultivation of *E. frumentacea* can still be found in India, Pakistan and Nepal, as well as northwestern Yunnan among the Drung people (Gros 2014; Yabuno 1962; Fischer 1934). Ethnobotanical reports from these regions state this species is most often grown inter-cropped in mixed fields with other millet-type crops, including foxtail millet and finger millet (*Eleusine coracana*; De Wet et al. 1983). *E. crus-galli* is considered the wild progenitor of *E. esculenta* (Yabuno 1962; 1987; Yamaguchi et al. 2005). *E. crus-galli* is extremely tolerant and well-adapted to harsh and varying conditions and has been reported to survive up to 40 days in flooded conditions (Maun, Barrett 1986). This ability to thrive in submerged environments makes it amongst the most common infesting weeds of irrigated rice fields in East Asia. *E. esculenta* has been grown as an alternative to rice in high elevation areas of East Asia (above 2,000 m asl; Yabuno 1987). Today, cultivations of *E. esculenta* can still be found in the Korean peninsula, in Japan, in northern and southwestern China, especially in the province of Yunnan; however, the recent development of frost-tolerant rice is slowly contributing to the decrease of barnyard millet popularity in the region.[59]

56 Gao et al. 2021; Xue et al. 2022; Weisskopf, Fuller 2014c; Boivin, Fuller, Crowther 2012.

57 *Echinochloa* has a complex taxonomic history and a high degree of morphological similarities across species, causing persistence of scholarly debates regarding taxonomic identification and nomenclature of different species (e.g., Hoste, Verloove 2022). Throughout this book I refer to the potentially cultivated *Echinochloa* species in Asia as indicated in Hoste, Verloove 2022.

58 Yabuno 1962; Yabuno 1966; Yamaguchi et al. 2005; Hoste, Verloove 2022.

59 See Ye et al. 2009; Su et al. 2010; Pereira da Cruz et al. 2013; Ma Y. et al. 2015; Li et al. 2022.

Barnyard millet has a short growing season, reaching maturity in less than two months, and moderate water requirements, surviving with as little as 350-420 mm of annual precipitation **[tab. 7]**. *E. esculenta* is better adapted to colder temperatures than *E. frumentacea*. Given *Echinochloa*'s ability to grow in a variety of environments including in harsh conditions, there has been recent scholarly interest in the plant as a potential crop for the future (Sood et al. 2015).

Table 7 Main growing requirement of cultivated *Echinochloa* species. Sources: Muldoon, Peraaon, Wheeler 1982; Padulosi et al. 2009; Rojas-Sandoval, Acevedo-Rodríguez 2018

Growing requirements	***E. frumentacea*; *E. esculenta***
Water requirements	350-720 mm (optimal range 650-720 mm)
Minimum temperature to germinate	20°C
Optimal temperature for flowering	27-36°C
Frost tolerance	Some
Days to maturity	40-60
Yield/ Hectare	400-600 kg/ha (modern)

Ancient seeds of *Echinochloa* are sometimes reported from early archeological sites in East and South Asia, most often from Japan, China, and India. Archaeobotanical finds of *Echinochloa* are most often categorised as weed; however, in cases of retrieval of high quantities, scholars have suggested possible human exploitation or even cultivation. In India, archaeologically preserved seeds of *Echinochloa* have been reported from early Harappan sites in the northwest of the country, dating to the third millennium BCE (Murphy, Fuller 2016, 346; 2017). Additional finds have been reported from first millennium BCE South India and 100 BCE Sri Lanka (Cooke, Fuller, Rajan 2005; Cooke, Fuller 2015; Murphy et al. 2018). In Japan, scholars have suggested that barnyard millet has been cultivated since at least 4,000 years ago, and archaeological seeds have been reported from southwest Hokkaido. A morphometric study on these seeds revealed a 15% increase in their size by the second millennium BCE, which could possibly indicate a domestication process, or intensive human cultivation of this species.[60] Within China, reports of ancient *Echinochloa* are scarce. Macro-botanical remains mostly come from the southwestern region, including Yunnan (see § 4.3.1). Barnyard grass phytoliths and starches have been found on stone tools from ca. 7000 BCE Shangshan, in the lower Yangzi (Yang et al. 2015b); however, this could relate to general wild resources exploitation. At present, the scarcity of archaeological remains and the lack of morphological and morphometrical studies on ancient *Echinochloa* seeds hinders the possibility of clarifying the ancient history of cultivation of this plant.

2.4.2.3 Fat Hen/Lambsquarter – *Chenopodium album*

Chenopodium (*li* 藜) is a genus in the Amaranthaceae family (Chenopodioideae subfamily) of about 150-250 annual and perennial species, of which only *C. quinoa, C. pallidicaule*, *C. berlanderi* subsp. *nuttalliae*, and *C. album* have

60 Crawford 2011b; Takase 2010; Crawford 2006; 1983.

economic value today (e.g., Risi, Galwey 1984). These are cultivated as leafy vegetable or grain crop (Joshi 1991). Among these, only *C. album* is native to most of Eurasia and northern Africa (the others being native to the American continent).[61] Today, *Chenopodium album* is cultivated in regions of East and South Asia but is otherwise considered a rather invasive dryland weed. Thanks to its high level of drought tolerance, it adapts well to harsh environmental conditions, surviving in arid and semi-arid regions. It is also known to survive at very high altitudes **[tab. 8]**, although it does not have frost-tolerance (Williams 1963).

Table 8 Main growing requirement of *Chenopodium album*. Sources: Williams 1963; Partrap 1985a

Growing requirements	*Chenopodium album*
Water requirements	400-1200 mm
Minimum temperature to germinate	10-15°C
Optimal temperature for flowering	15-20°C
Frost tolerance	None
Days to maturity	120
Yield/ Hectare	50 mil. seeds/ha
Photoperiod sensitivity	Yes

Ethnobotanical surveys in the late 1970s documented winter cultivations of *C. album* in small communities living in remote and isolated villages in the southern Himalayan region at altitudes as high as 3,650 m asl.[62] In northeastern India, *Chenopodium* seeds are used to make bread, gruel, and fermented beverages (Nesbitt 2005, 59). The Lu-k'ai tribe in highland Taiwan is known to collect and consume C*. album* both as greens and grain (Fogg 1983). In China, recent ethnobotanical surveys investigating modern wild plant exploitation have documented widespread collection of *C. album* for greens among Tibetan villages in southern Gansu, western Sichuan and southern Tibet, and among the Drung people in northwest Yunnan.[63] While Tibetan and Drung people participating in the study live in remote mountain villages and the collection of *C. album* may be motivated by the need of supplementing the diet with fresh vegetables, *C. album* has also been recorded as collected by ethnic Han farmers of maize, wheat and potatoes residing in mountain villages in southwestern Shaanxi. These farmers encourage the natural growth of the plant around their homestead by not applying herbicide on them (Kang et al. 2013). This suggests a widespread knowledge of the potential nutritional value of the plant and use in Chinese cuisine.

There are currently no known domestication studies focusing on *Chenopodium album* from archaeological material in Eurasia.[64] *C. quinoa*,

61 Gremillion 2014 provides a review of the American chenops, including a botanical overview of the plant, a review of the archaeological evidence with discussion on domestication and current uses of the species in the American continent.

62 Partap, Kapoor 1985a; 1985b; 1987; Partap, Joshi, Galwey 1998; Singh, Thomas 1978; Partap 1999.

63 Malaisse et al. 2012; Boesi 2014; Kang Y.X. et al. 2014; Kang J. et al. 2016; Cheng Z. et al. 2022.

64 The available studies discussing the evolution of the Eurasian *Chenopodium* species focus on the cytological and phylogenetic aspects of the species, for a summary see Ohri 2015.

which is considered an American relative to *C. album*, has been investigated more in depth and it is assumed that *C. album* would develop similar domestication traits; these include a more compact inflorescence, loss of natural seed shattering, a progressive thinning, lightning and smoothing of the seed coat and an increase in seed size (Gremillion 2014; Bruno 2006; see also Smith 1992 for studies on *Chenopodium berlanderi* in northeastern Americas).

Archaeological seeds of *C. album* are widely reported in archaeobotanical studies in China at sites dating as early as the seventh to the fifth millennia BCE onward,[65] and in India at sites dating to the Harappan Rojdi period (2500-1700 BCE; Weber 1989). In Europe *Chenopodium* grains have been reported from numerous prehistoric sites dating to between the sixth to fifth millennia BCE (Bakels 1979) and in a ceramic vessel found inside a house at the pre-Roman site of Gordin Hede in Denmark (Helbæk 1954). Ingested *Chenopodium* seeds were also recovered in the stomach of several 'peat bog bodies', such as the Tollund Man and the Grabaulle Man (ca. 400 BCE-400 CE; Helbæk 1959; 1960; 1961). The retrieval of seeds inside stomachs is a strong indication that the plant was consumed as food and that *Chenopodium* might have contributed to a greater extent to past diets that we assume today. However, the lack of morphological and morphometrical studies on ancient remains greatly limits our understanding of this plant in the past. Archaeobotanical reports rarely include morphometric or morphological data on archaeological *Chenopodium* grains, and the species is interpreted as possibly consumed only when retrieved in extremely high quantity or unambiguous food/ingested contexts such as those mentioned above from Europe.

2.4.3 Selected Fruits

2.4.3.1 Peach and Apricot – *Prunus persica* and *Prunus armeniaca*

Peach (*Prunus persica*, syn. *Amygdalus persica*, *tao* 桃) and apricot (*Prunus armeniaca,* syn. *Armeniaca vulgaris*, *xing* 杏)[66] are two Chinese native species within the Rosaceae family, Prunoideae subfamily, Prunus clade. Members of this clade (which count more than 400 species) include important economic fruits such as plums (*Prunus domestica* ssp.), Japanese plums (*P. salicina*), cherry plums (*P. cerasifera*), sloes (*P. spinosa*) and cherries (*P. cerasus*). Their evolutionary history is still somewhat poorly understood due to their high level of hydridisation, close morphological similarities, and wide range of phenotypic diversity, resulting in several, sometimes contradicting, taxonomic systems.[67] Archaeologically, the high degree of

65 Yang et al. 2009; Gao 2021; Xue et al. 2022; Song et al. 2021.

66 In the Flora of China (FoC) peach and apricot are referred to by the old nomenclature *Amygdalus persica* and *Armeniaca vulgaris*; this is sometimes still used in many Chinese publications. The Flora has been completely digitised and can be consulted at `http://www.efloras.org/flora_page.aspx?flora_id=2`.

67 For a summary of recent proposed taxonomic systems see Shi et al. 2013, fig. 1; for classifications proposed on the combination of archaeological and modern materials, with a focus on Europe, see Körber-Grohne 1996; for a review on recent archaeological finds of peach, plums, and apricot and their routes of dispersal across Eurasia, see Dal Martello et al. 2023a.

morphological similarity among *Prunus* stones creates some ambiguity in species-level identification. As a result, in the archaeobotanical literature, many *Prunus* remains, especially when fragmented, are often identified only to the genus level (Dal Martello et al. 2023a). This may also result in misidentification of wild with domesticated species, further complicating the issue of tracing these fruits domestication trajectories.[68] Peaches and apricots are perennial, deciduous fruit trees that are now widely distributed in temperate regions across the world. When sown from seeds, they start producing fruits usually after three to five years of growth, with flowering and fruiting seasons in March-April and August-September, respectively (Bassi, Monet 2003). Some scholars have suggested that the management of fruit trees arose later than the cultivation of herbaceous perennials (such as cereals and legumes), due to the intrinsic, multi-year perspective required to obtain fruits. It has been inferred that such perspective only developed with urbanism and the establishment of land ownership and reliable exchange networks.[69] Establishing a domestication pathway for peach and apricot has been challenging, since the wild ancestors are yet unknown, possibly extinct (Lu, Bartholomew 2003; Yazbek, Oh 2013). An increase of the fleshy part of the fruit and sugar content differentiates domestic from wild species; however, this is almost impossible to trace archaeologically, since only the stones preserve. Fuller has recently suggested that an elongation of the fruit stone might be indicative of the domestication process (Fuller 2018); however, further studies are needed to confirm this.

Peach was thought to originate in Persia,[70] but recent phylogenetic analysis and archaeological evidence both point to a Chinese origin. The oldest stone peach fossils have been found in a pre-hominid context in Yunnan, dating to ca. 2.6 million years ago. These Pliocene stones were close in morphology and size to modern stones. This would indicate that the initial selection of this fruit was possibly driven by primates, which acted on stone size, and later human selection acted on varietal differentiation and fruit size (Su et al. 2015). Some wild peach varieties are documented in north China, and early Chinese texts have referred to this region as the centre of origin for this fruit (Keng 1973). At present early archaeological remains have been reported from South China only, especially from sites in the lower Yangzi basin. The oldest securely dated fossilised peach stones from archaeological sites come from storage pits at Kuahuqiao and Tianluoshan, dating to ca. 6000-5500 BCE, with some later examples from the Liangzhu Culture sites of Bianjiashan 卞家山, Maoshan, and Qianshanyang 钱山漾, dating to ca. 3300-2300 BCE. Morphometrical analyses on these revealed that Liangzhu Culture peach stones show a substantial increase in overall stone size compared to the Kuahuqiao and Tianluoshan remains (Zheng, Crawford, Chen 2014). This is in line with phylogenetic reconstructions indicating a division from a wild species in China around four thousand years ago (Cao et al. 2014). Outside of the lower Yangzi Basin, peach finds have been reported from Chengtoushan and Nanjiaokou 南交口 dating

68 See, for example, Wu et al. 2025 for a critical discussion on peach species.

69 Fuller, Stevens 2019; Janick 2005; Zohary, Hopf, Weiss 2012; Gross, Olsen 2010.

70 A Persian origin is suggested also in the scientific name, derived from Greek *malon persikon* and Latin *malum persicum*, translated in 'Persian apple'. This is how the fruit was referred to by ancient Greek and Roman writers (Dal Martello et al. 2023a), a classification later adopted by nineteenth century botanists (e.g., Faust, Timon 1995).

to around 4200-3700 BCE which may indicate peach dispersed with rice (Jacques, Stevens 2024). Although some reports of peach presence in Korea date to as early as the fourth millennium BCE, a revaluation of the current evidence suggests caution since the chronology of those finds is unclear (Dal Martello et al. 2023a, 22).

Apricot's origin was placed by ancient Greco-Roman writers in the Caucasus, possibly the Fergana region in modern Uzbekistan.[71] Wild apricot populations today have been documented from eastern China to the Tianshan Mountains, and while some scholars still argue for a separate centre of domestication/diversification of apricots in the Fergana region (giving rise to European lineages; see Bourguiba et al. 2020; Decroocq et al. 2016), recent studies have instead suggested that it originated in China (Jacques, Stevens 2024; Fuller, Stevens 2019; Zheng, Crawford, Chen 2014). Here, archaeological remains currently predate those from Central Asia (Dal Martello et al. 2023a). Early apricot finds include those from Kuahuqiao, Jiahu, Jiajiagou West and Tachiyingzi in Liaoning Province (Shelach-Lavi et al. 2019), all dating to the fourth millennium BCE. A recent study summarising archaeological, archaeobotanical and linguistic data thus proposed a single domestication centre in China around 4000 BCE, after which the fruit dispersed westwards with millets and rice, and subsequently separated and went feral in Central Asia around 1000 BCE, and from there later dispersed to Europe (which would explain the more recent genetic split of European apricot lineages; see Jacques, Stevens 2024).

2.4.4 Agriculture Beyond Cereals: a Note on the Hypothesised Tropical Tuber-Based Agriculture in Southern China

Beyond the centre for millet domestication in North China, and the centre for rice domestication in the middle-lower Yangzi region (§ 2.3.1) **[fig. 6]**, some scholars have proposed an additional centre of agricultural origin in the Pearl River Valley of southern China, spanning Guangxi and Guangdong provinces, based on evidence suggesting the possible cultivation of vegetatively propagated plants (Zhao 2006; 2011).[72] Here, recent archaeobotanical investigations at cave and shell midden sites dating between ca. 8000-3000 BCE have retrieved remains of lotus roots (*Nelumbo nucifera*), taro (*Colocasia esculenta*), yam (*Dioscorea* spp.), sago-type palms (Aracaceae, *Caryota* sp.), and banana (*Musa* sp.), among other plants.[73] These have been identified based on phytoliths or starches, and based on this evidence some scholars have suggested that plants such as palms, roots, rhizomes, corms, and tubers may have been cultivated in this region before the introduction of cereal agriculture (ca. pre 2800 BCE). This view, however, is not widely accepted as the retrieval of such remains is not

71 See for example Dioscorides *De Materia Medica*, where apricot is named *mailon/armeniacon* (Osbaldestone, Wood 2000), and Pliny the Elder *Naturalis Historia* and Columella *De Re Rustica,* where apricot is referred to as *pomum armeniacum/armeniaca arbor* (Rackham 1938-63; Harrison 1941-55). Similarly to peach, the Latin classification adopted in the nineteenth century reflected the view of a Caucasian origin (Dal Martello et al. 2023a).

72 This theory has originally developed on previous hypothesis proposed by Li 1970.

73 Zhongguo et al. 2003; Wan 2013; Yang et al. 2013; 2017; Zhang Y.K. et al. 2020; 2021; 2024; Zhang 2022a; Wang W. et al. 2024.

direct evidence that these were cultivated, but rather of their presence in the landscape. The collection of such resources in the wild is widely undertaken in tropical and subtropical regions around the world, and at present there are no morphological or genetic studies trying to understand whether remains from the above sites represent collection in the wild or cultivation. Debates about the extent of exploitation of these resources persist (Denham, Zhang, Barron 2018). These studies, however, clearly demonstrate groups of foraging communities inhabiting this region before the spread of cereal-based agriculture to the area and lay the basis for understanding the relationship between incoming farmers and pre-existing local populations in future studies.[74]

2.5 Non-Native Crops

2.5.1 Barley – *Hordeum vulgare* and Wheat – *Triticum aestivum*

Barley (*Hordeum vulgare*) and wheat (*Triticum* ssp.) are two cereals that originate in Southwest Asia and were introduced and successfully adopted into Chinese agriculture. Of the two, wheat is today extremely prevalent worldwide, ranking among the top three cultivated cereals in the world (after maize and rice; FAOSTAT 2024). Today there exists two seasonal (a winter and a spring) varieties of these crops; growing requirements differentiate based on seasonal variety rather than species, and water requirements are unchanged across species and varieties **[tab. 9]**. Winter varieties are sturdier, cold tolerant and need vernalisation (undergoing a period of frost when buried underground) in order to later germinate. Given this requirement, winter varieties take a much longer period between sowing and harvest compared to the spring varieties. Both crops have been domesticated as winter cereals, since this was the rainy season in their domestication homeland. The timing and place of evolution of spring varieties is still not fully understood. Early Chinese textual sources dating to the first millennium BCE describe different sowing times depending on the regions of China where the plants were cultivated. This led some scholars to suggest seasonal varieties had developed by at least the first millennium BCE, most likely in conjunction with the introduction of the species to the Tibetan Plateau, where the harsh winter conditions would not have allowed their cultivation (Liu et al. 2017; see Ch. 5).

74 Studies focused on hunter-gatherers' specific subsistence and the transition to agriculture in South China include Zhang, Hung 2012; Deng et al. 2020; Wang, Jiang 2022.

Table 9 Comparing main growing requirements for winter and spring varieties of wheat (*T. aestivum*) and barley (*H. vulgare*). Sources: FAO 2024; Klepper et al. 1998

Growing requirements	Winter variety	Spring variety
Water requirements	450-650 mm	
Sowing	September-October	March-April
Minimum temperature to germinate	–7°C	4°C
Optimal temperature to flower	10-12°C	15-20°C (min. 12°C)
Days to maturity	180-250	100-130
Harvest	April-May	June-July
Yield/ Hectare	6-9t/ha (modern)	
Photoperiod sensitivity (changes in day lengths)	High	Low
Vernalisation required	Yes	No
Tolerance to frost	High (–20°C)	None

In the 1980s, after finds of wild barley populations in Tibet, some scholars suggested the plant was (also) domesticated on the Tibetan Plateau (e.g., Xu 1982; Ma et al. 1987). Recent genetic studies have demonstrated that genetic similarity between modern cultivated and wild barley on the Plateau derives from gene flow that occurred after the introduction of the domesticated plant from Southwest Asia to the Plateau, instead of a local domestication (e.g., Yang et al. 2008), but some scholars suggest this instead indicates a polyphyletic origin of the cultivated crop (Dai et al. 2012; 2014; Ren et al. 2013). The broader consensus is that barley was domesticated in Southwest Asia from *Hordeum vulgare* ssp. *spontaneum*.[75] At present, earliest conclusive evidence for domesticated barley has been reported from ninth millennium BCE with an increase in remains from the eighth millennium BCE onward (see Arranz-Otaegui, Roe 2023 for a recent review of the accumulated evidence). Domesticated barley differentiates from its wild progenitor by having a brittle (non-shattering) rachis, reduced seed dormancy, vernalisation, photoperiod sensitivity, and a general increase in seed size.

Several wheat species have been domesticated; these include einkorn (*Triticum monococcum*) and emmer (*T. turgidum* subsp. *dicoccum*, sometimes still referred to as *T. dicoccum* in the archaeobotanical literature), which chronologically are the first to be domesticated around the eighth/seventh millennium BCE in southwest Asia (Zohary, Hopf, Weiss 2012). Durum wheat (*T. turgidum* subsp. *durum*, sometimes referred to as macaroni wheat) evolved in Southwest Asia from emmer (Feldman, Kislev 2007). Bread wheat (*T. aestivum*) evolved from the hybridisation of durum wheat with the wild goatgrass *Aegilops tauschii* (Dvorak et al. 2012), although the exact region where it underwent this evolution is still unclear. Remains have been reported from modern day Turkey and Syria dating to around 6600-5800 BCE (Willcox 1996; Nesbitt, Caligari, Brandham 2001; Nesbitt 2002), and shortly after from southern Central Asia. Both durum and bread wheat are free-threshing (or naked) wheat species, meaning that they evolved a softer glume which detaches from the ripe grain with much more ease than in the hulled/threshing species and varieties, such as einkorn and

75 Relevant literature is too numerous to fully cite here, readers are referred to Harlan, Zohary 1966; Zohary 1999; Allaby 2015; Arranz-Otaegui et al. 2016; Wang Y.L. et al. 2019; Arranz-Otaegui, Roe 2023.

emmer. Naked varieties are considered more desirable as they require less processing after harvest, thus reducing considerably work; however, by not having the protective barrier offered by the glumes, they are more prone to pests and diseases. According to present evidence only free-threshing wheat has ever been reported from early archaeological sites in China. Similarly to barley, with domestication wheat evolves a non-shattering rachis, reduced seed dormancy, and a general increase in seed size; for free-threshing varieties there is also a softening of the glumes, which considerably reduces grain processing times after harvest, but have the disadvantage of being more susceptible to pests. Barley also evolved naked varieties, which may have initially emerged in Southwest Asia by the Late Pre-Pottery Neolithic period (ca. 7000-6000 BCE; Fuller, Weisskopf 2020; Komatsuda et al. 2007). A recent study suggested that naked barley in Tibet may have evolved independently from that in Southwest Asia (Tang et al. 2025).

2.5.2 The Question of The Routes and Timing of Dispersal of Wheat and Barley to China

In China, reports of wheat and barley grains have been documented from archaeological sites in China dating to at least the third millennium BCE (e.g., Stevens et al. 2016; Deng et al. 2020; Zhou et al. 2020). How the two species dispersed to China has been a central topic in Chinese archaeological research for decades. Several routes have been proposed, including a northern route through the Inner Asian Mountain Corridor into Xinjiang, from where it possibly reached Central China either through the Hexi corridor or via Mongolia through Northeast China (e.g., Long et al. 2018), and a southern route along the southern Himalayan Mountains (e.g., Lister et al. 2018). Others have suggested the species might have dispersed individually via separate routes, based on the apparent absence of barley where early finds of wheat are documented **[figs 9-10]**.[76] According to proponents of the northern route, both species were transported by Central Asian pastoralists, which were using wheat and barley to supplement their diets (Betts 2019). In 2020, seeds of naked barley and free-threshing wheat were reported from Tongtian 通天 Cave, in the Altai Mountains of modern Xinjiang, and have been directly dated to ca. 3200 BCE and 3000 BCE, respectively (Zhou et al. 2020). At present, these are the earliest occurrence of both species in China **[figs 9-10]**.

76 For the northern route see Kuzmina 2008; Frachetti et al. 2010; Dodson et al. 2013; Betts, Jia, Dodson 2014; Stevens et al. 2016; Long et al. 2018; Dong et al. 2017; Betts 2019; Zhou et al. 2020. For the southern route see Vishnu-Mittre 1972; Knörzer 2000; Liu et al. 2017; 2019; Lister et al. 2018. For separate routes see Flad et al. 2010; Liu et al. 2017; Deng et al. 2020.

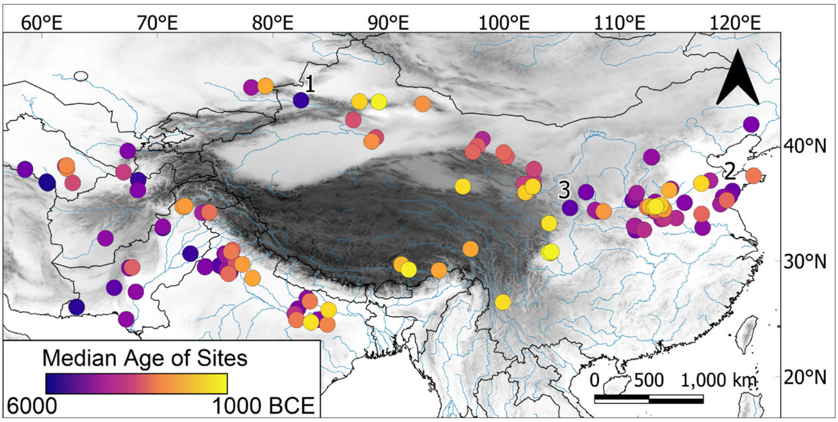

Figure 9 Sites with evidence of wheat before the second millennium BCE, plotted chronologically based on median age of occupation (see Appendix 2). Sites mentioned in text: 1. Tongtian cave; 2. Zhaojiazhuang; 3. Xishanping. Made by the Author with QGIS 3.28.5-Firenze, Natural Earth and EROS Digital Elevation basemap, U.S. Geological Survey

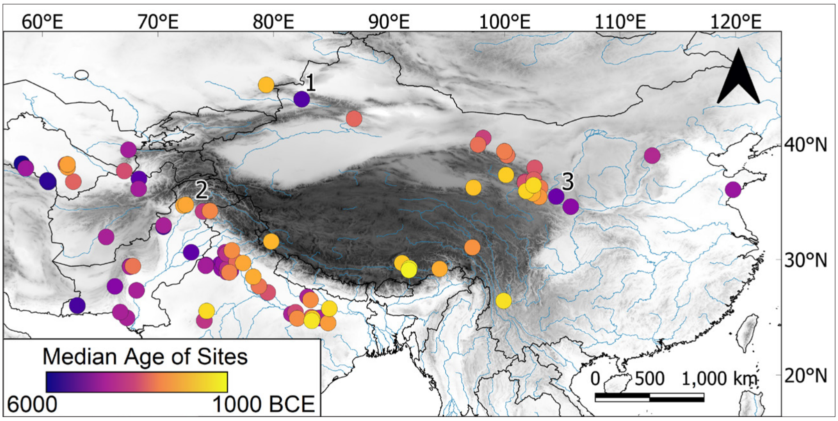

Figure 10 Sites with evidence of barley before the second millennium BCE, plotted chronologically based on median age of occupation (see Appendix 2). Sites mentioned in text: 1. Tongtian cave; 2. Kanispur; 3. Xishanping (AMS dating on rice grains). Made by the Author with QGIS 3.28.5-Firenze, Natural Earth and EROS Digital Elevation basemap, U.S. Geological Survey

Proponents of the southern and/or of separate routes for wheat and barley put forth their hypotheses on the basis of modern barley landraces genetic studies, and the direct dating of barley grains from Kanispur, in Kashmir (c. 2400-2200 BCE),[77] which, however, is still later than the recently reported grains from Tongtian cave. Although some earlier finds suggested the introduction of wheat into Central China dated to the fourth millennium BCE or possibly earlier, recent direct radiocarbon dating of these grains revealed they were intrusive from later phases (Deng et al. 2020). This raises doubts on building chronology of dispersal based on dating by cultural association rather than the direct dating of grains. At present the earliest attested evidence for wheat in the Central Plains date to no earlier than the late third millennium BCE, but even so seed numbers are low. A slight increase is seen only after ca. 1000 BCE, although the crop remained of minor importance until after the Han Dynasty (ca. early first millennium CE, see Deng et al. 2020). Within eastern China, the earliest directly dated wheat grain come from Zhaojiazhuang 赵家庄 and Dinggong in Shandong around 2200-1980 BCE, with some earlier grains dated by association to ca. 2400 BCE, which could indicate trade and exchange with agro-pastoral groups in the north (Jin et al. 2011a; Long et al. 2018). Figures 9 and 10 illustrates finds of wheat and barley across Central, South and East Asia from before the end of the second millennium BCE, with indication of the earliest directly dated evidence for the species in China.[78] It is worth noting that there still exist very large geographical gaps and, as evident from the recent report from Tongtian cave, new finds continuously refine and change these theories, thus only future research will be able to determine precise routes of dispersal of these crops to China. After their introduction to China, wheat seems to take a more prominent role than barley in the ancient agricultural practices of the Central Plains. Barley becomes predominant on the Tibetan Plateau, where other crops have much more difficulty growing (see Ch. 5).

77 Pokharia et al. 2018; Liu et al. 2017; Lister et al. 2018 fig. 10 site 2; Zeng et al. 2015.

78 Sites are mapped chronologically using the median date of the accepted chronology for each site, note that not all wheat and barley remains have been directly dated, and most of the sites have been dated by association or radiocarbon dating on other material. See Appendix 2.

People and Plants in Ancient Southwest China
3,000 Years of Agriculture in Yunnan from the First Villages to the Han Conquest
Rita Dal Martello

3 Climate and Environment in Prehistoric Yunnan

Summary 3.1 Modern Yunnan Landforms, Vegetation and Climate. – 3.2 Palaeoenvironmental Reconstruction of Ancient Yunnan Climate and Flora.

3.1 Modern Yunnan Landforms, Vegetation and Climate

Yunnan is the furthest southwestern Chinese province within mainland China (N 21.9-29.15; E 97.39-106.12) **[fig. 11]**. It has an area of over 394,000 km^2, which equates to only 4.1% of modern Chinese territory, however, Yunnan has the highest natural biodiversity compared to all other provinces in the country. It is estimated that 49% of all native seed plant species present in China come from Yunnan (14,822 out of 30,270, of which many are endemic to Yunnan; Tang 2015, 30).[1] Yunnan is also considered one of the most diverse places globally (it is included in the 25 biodiversity hotspots outlined in Myers et al. 2000; see also Walkers 1986). The reason for this richness and diversity is closely related to its peculiarly rugged topography **[fig. 12]**. Sitting at the eastern end of the Himalayas and the southeastern corner of the Tibetan Plateau, Yunnan Province is enclosed by the Hengduan Mt. range (*Hengduan shanmai* 横断山脉) on the northwest (N 22-32.05; E 97-103),[2] which highest peak, Gonggashan 贡嘎山 (situated in Sichuan), reaches 7,556 m asl. The highest Yunnan peak of the Hengduan

1 Cf. Wu 1977-2006; Zhongguo 1998; López-Pujol, Zhang, Ge 2006.

2 The Hengduan Mt. are a series of ranges that go parallelly north-south across the border where Tibet, Sichuan and Yunnan provinces meet (extending into Qinghai). They represent the eastern-southernmost section of the Himalayas. The Chinese name means ‘traverse cutting mountains’, perfectly describing the crossed intersected direction of the Hengduan Mt. ranges against the usual east-west direction of mountain ranges in Eastern Asia.

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belongs to the Meili Snow Mt. range (*Meili xueshan* 梅里雪山) and is known as Kawagebo/Kawagarbo Mt. (also spelled Khawa Karpo, *Kawagebo shan* 卡瓦格博山) with 6,740 m asl. The Hengduan end on the Jade Dragon Snow Mt. massif (*Yulong xueshan* 玉龙雪山), which highest peak is at 5,596 m asl.[3] In eastern Yunnan, the Yungui Plateau sits east of the Ailao Mt. range (*Ailao shan* 哀牢山; N 23.49, E 101.33); the Yungui Plateau itself has an average altitude comprised between 1,500-3,000 m asl, but its highest peak is Jiaozi Snow Mt. (*Jiaozi xueshan* 轿子雪山) at 4,344 m asl, situated within the Gongwang Mt. range (*Gongwang shan* 拱王山) of the Plateau. The highest peak of the Ailao Mt. range is Damoyan Mt. (*Damoyan shan* 大磨岩山) with 3,166 m asl. Mountains and highlands constitute the majority of Yunnan territory (94%), with average altitudes decreasing progressively as one descend north to south, from over 6,000 m asl at the Meili Mt. in the Hengduan, to only 76.4 m asl at the intersection of the Nanxi River (*Nanxihe* 南溪河) with the Red River (*Honghe* 红河), in Hekou County (*Hekou yaozu zizhixian* 河口瑶族自治县) at the border with Vietnam (Zhou 1985) **[fig. 12]**.

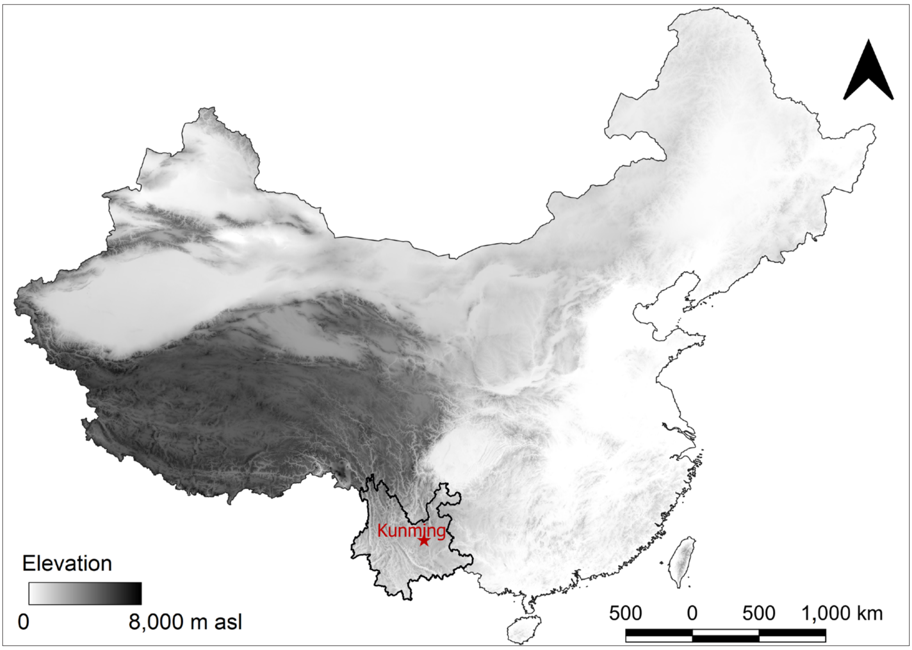

Figure 11 Location of Yunnan in relation to modern mainland China. Made by the Author with QGIS 3.28.5-Firenze, Natural Earth and EROS Center Digital Elevation basemap, U.S. Geological Survey

3 The highest peak of the Jade Dragon Massif is Shanzidou 扇子陡.

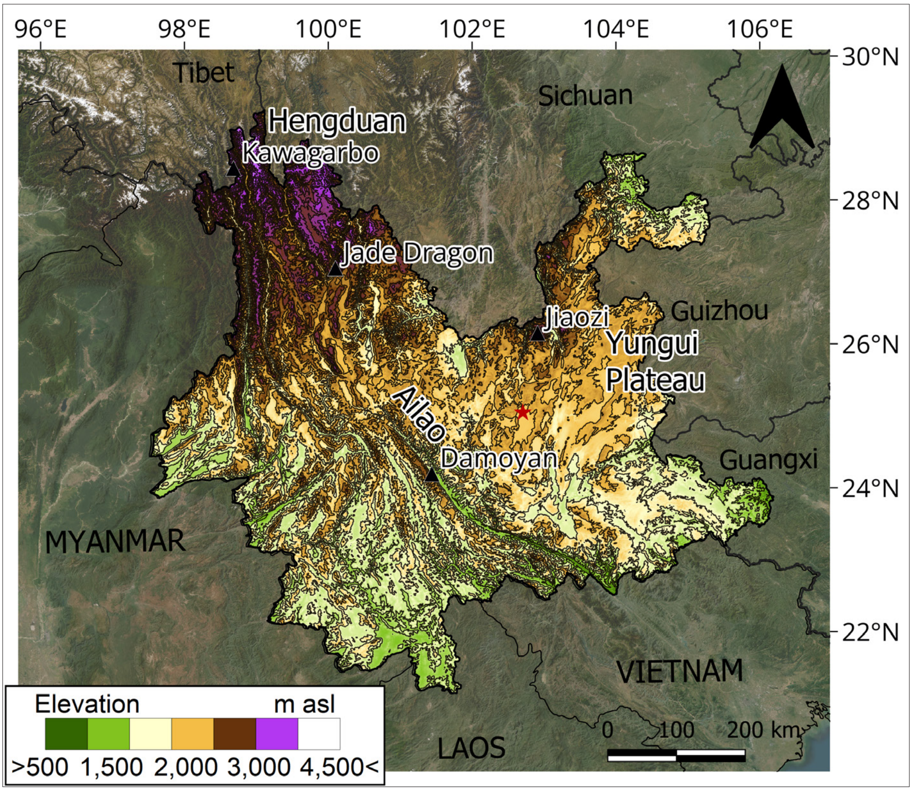

Figure 12 A topographic map of Yunnan showing altitudes lines at every 500 m. Peaks mentioned in text: Kawagarbo (6,740 m), Jade Dragon Snow Mt. (5,596 m), Jiaozi Snow Mt. (4,344 m), Damoyan (3,166 m). The red star indicates Kunming. Made by the Author with QGIS 3.28.5-Firenze, Natural Earth, ESRI and EROS Digital Elevation basemap, U.S. Geological Survey

Yunnan mountains are crisscrossed by a complex river network, which creates deep river valleys within the mountain ranges. Three major Asian rivers originate on the Tibetan Plateau and then run through the province; the Salween (*Nujiang* 怒江), Mekong (*Lancangjiang* 澜沧江), and the upper branch of the Yangzi (*Changjiang* 长江) known as *Jinshajiang* 金沙江 in Chinese. These run parallel at less than 100 km of distance to each other in northwest Yunnan, and for this reason this area is known as the Three Rivers area, or the three parallel rivers area from the Chinese *Sanjiang* 三江 (three rivers; see also § 2.2.1.1). The Red and Pearl (*Zhujiang* 珠江) Rivers originate in Yunnan and from there flow into Vietnam and Guangxi, respectively. In addition to rivers, numerous lakes (more than 40 recorded) provide plenty of water resources to the province, the largest one include the Dian Lake (*Dianchi* 滇池; 312 km^2), near Kunming and the Erhai 洱海 Lake (250 km^2), near Dali 大理 **[fig. 13]**.

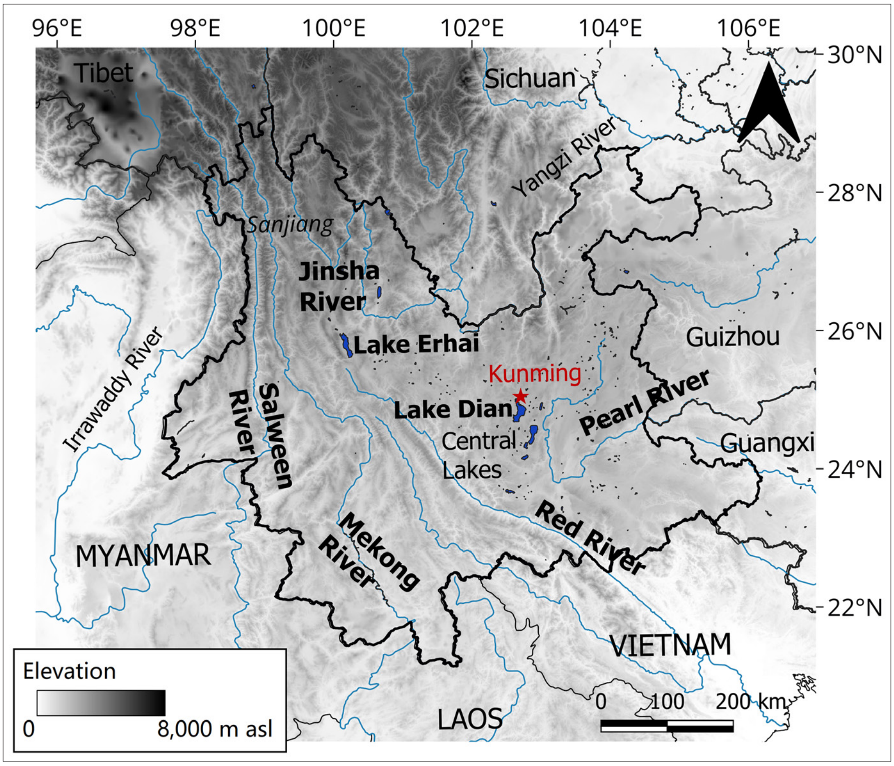

Figure 13 Main rivers and lakes in Yunnan. Made by author with QGIS 3.28.5 Firenze, Natural Earth Basemap

Ecologically, Yunnan sits between temperate East Asia and tropical Southeast Asia, acting *de facto* as a transitional belt between the two regions (Tang 2015). Modern Yunnan climate is humid, subtropical and tropical in the very far south (such as Xishuangbanna 西双版纳) **[figs 14-15]**. Today Yunnan is characterised by short, dry winters and long, warm and humid summers (Kottek et al. 2006). The Indian (or Southwest) Summer monsoon, the East Asian (of Pacific) Summer Monsoon, and the East Asian winter monsoon all reach into Yunnan and altogether create clearly demarcated wet and dry seasons and allow for a longer rainy season than that attested in the northern area of the East Asian continent. In Yunnan this is from May to October, when up to 90% of the annual precipitation occurs (Zhao 1994). However, the effects of the monsoons are also mitigated by the numerous mountain ranges in the province. In the northwest, the Hengduan Mt. range stops the cold Siberian winds during winter, allowing for milder temperatures year-round; the Ailao lessens the Indian Monsoon and creates a northwestern wet-southeastern dry divide in the province; this benefits interior areas by creating suitable conditions for truly subtropical climate and vegetation (Tang 2015). Annual precipitation varies greatly across the province, averaging 1,500 mm in the southern lowlands and around 600-800 in the northern highlands (see Tang 2015; Zhao 1986) **[fig. 14]**. Of note, river valleys today present a savanna-like vegetation and are generally drier than the rest of the province. Precipitation in the valleys varies between 600-900 mm annually, being higher in the south-central Yunnan, valleys here are hot-dry, and decreasing as we go north, where valleys are warm-dry, and temperate-dry at the limit with Tibet and Sichuan (Tang 2015, 166 fig. 6.1). Temperatures follow the altitudinal gradient, with around 10°C degrees difference in mean annual temperature north to south, but being generally mild year-round.[4] For example, in southern Yunnan the mean temperature in January is 12-16°C, and in July it is 22-26°C. **[fig. 15]**. Since Southwest China was never covered by unified ice sheets, many relict species have found refuge in this region, including presumed extinct in the wild *Ginkgo biloba* trees (Tang 2015).

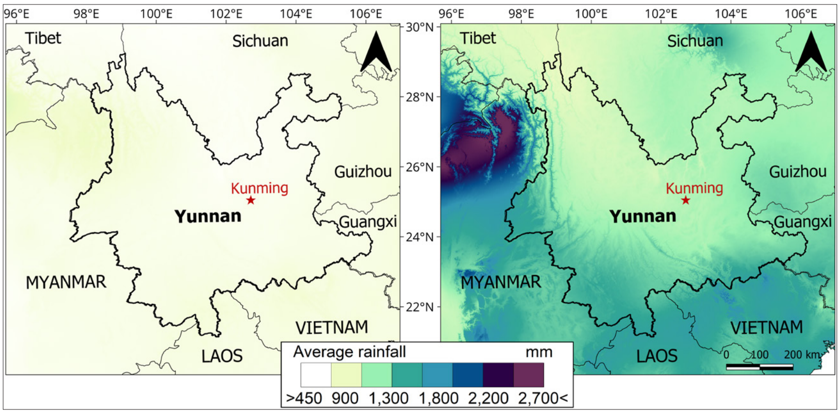

Figure 14 Modern (1970-2000) average precipitation in Yunnan, shown in cumulative value from November to April (dry season, left) and May to October (rainy season, right). Made by the Author with QGIS 3.28.5-Firenze, Natural Earth basemap; precipitation data from WorldClim v2 (Fick, Hijmans 2017)

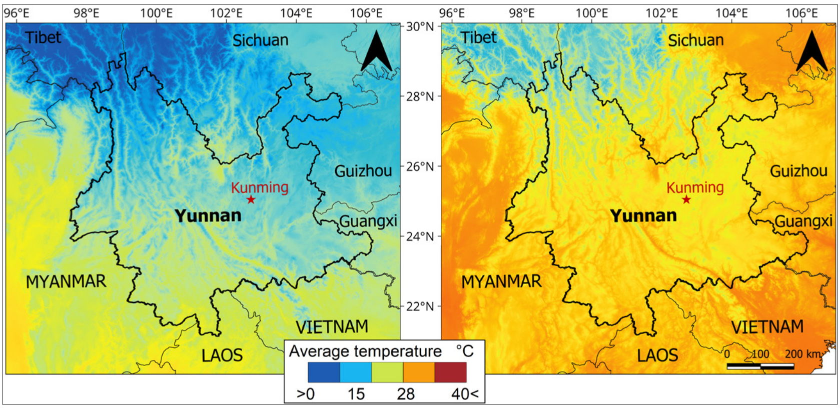

Figure 15 Modern (1970-2000) average temperatures in Yunnan in January (left) and July (right). Made by the Author with QGIS 3.28.5-Firenze, Natural Earth basemap; temperature data from WorldClim v2 (Fick, Hijmans 2017)

The Yunnan landscape is defined by a strong 'biogeographical vertical zonation' (Zhao 1986; Guo, Long 1998), indicating that climate and floristic vegetation patterns are strictly correlated to the elevation. Broadly speaking this means that Yunnan's vegetation can be divided into sequential belts

4 Kunming, the capital city of Yunnan, is in fact also known as the 'city of eternal spring' (*chuncheng* 春城). Here, January average temperature is 8-10°C, and in July it is 19-22°C.

according to the specific elevation, transitioning from alpine, subalpine, temperate, subtropical, and tropical belts. Above 4,500 m asl there is perennial snow, and alpine scrub meadows characterise elevations between 3,800-4,500 m asl. Below that, several forest regions are present according to elevation and area **[tab. 10]**.

Table 10 Original evergreen broad-leaved forest regions in Yunnan (after Tang 2015; Shen et al. 2006)

Forest Type	Dominant species	Altitudes	Annual rainfall	Distribution
Fir forest	*Abies forrestii* *Larix potaninii* *Pseudotsuga forestii* *Cephalotaxus fortune* *Taxus chinensis* *Taxus wallichiana* *Taiwania cryptomeriodoides* *Taiwania flousiana* *Pinus excelsa* *Tsuga yunnanensis* *Tsuga dumosa*	3,100-3,800 m asl	-	Northwest Yunnan
Mid-montane moist and mossy evergreen broad-leaved forest	*Cyclobalanopsis lamellosa* *Cyclobalanopsis oxyodon* *Cyclobalanopsis myrsinifolia* *Lithocarpus variolosus* *Lithocarpus hancei* *Lithocarpus pachyphyllus* *Lithocarpus xylocarpus* *Lithocarpus echinotholus* *Castanopsis echidnocarpa* *Castanopsis wattii* *Castanopsis remotidenticulata* Further species: *Machilus longipedicellata* *Machilus viridis* *Cinnamomum iners* *Phoebe faberi* *Schima khasiana* *Schima argentea* *Schima villosa* *Manglietia gongshanensis* *Manglietia insignis* *Alcimandra cathcartii*	(1,600) 1,800-2,500 (2,800) m asl	1,700-3,700 mm	All of the provinces apart from central Yunnan
Subtropical semi-humid evergreen broad-leaved forest	*Castanopsis orthacantha* *Cyclobalanopsis glaucoides* *Cyclobalanopsis delavayi* *Lithocarpus dealbatus*	(1,500) 1,900-2,400 m asl	1,100-1,700 mm	Central, south-central, eastern Yunnan

Forest Type	Dominant species	Altitudes	Annual rainfall	Distribution
Monsoon evergreen broad-leaved forest	*Castanopsis hystrix* *Castanopsis fleuryi* *Castanopsis calathiformis* *Lithocarpus truncatus* *Lithocarpus polystachyus* *Lithocarpus fenestratus* *Trigonobalanus doichangensis* *Cyclobalanopsis augustinii* *Cyclobalanopsis kerrii* *Cryptocarya calcicole* *Cryptocarya densiflora* *Beilschmiedia yunnanensis* *Schima wallichii* *Anneslea fragrans*	(800)1,000-1,800 m asl	>1,600 mm	Northwest, southern Yunnan
Montane mossy dwarf evergreen broad-leaved forest	Ericaceae Dwarf Fagaceae Vacciniaceae Rosaceae Aceraceae	Summits	-	Southern Yunnan
Tropical monsoon evergreen broad-leaved forest	*Hopea haimonensis* *Hopea mollissima* *Dypterocarpus tokinensis* *Dypterocarpus pilosus* *Myristica cagayanensis* *Myristica sinnarum*	800-1,000 m asl	900-1,200 mm	-

In addition to the species listed in the table, further species recorded include several dry-climate adapted sclerophyllous (hard-leaves) evergreen *Quercus* found at high altitudes[5] and in hot-dry valleys.

The whole province is generally described as originally having been covered by subtropical evergreen broad-leaved forest. Original[6] forests have decreased drastically in the last 90 years, due to the continuous expansion of cropland and pastures into Yunnan, and original species are now relegated in remote montane (alpine and subalpine) areas, natural reserves, temples, or generally inaccessible places. It is estimated that only 10% of modern Yunnan presents its original vegetation cover (Lin, Qiao, Walker 1986). Today there is a high documented presence of warm, temperate coniferous trees, including *Pinus* and *Ketelleria* species, which have substituted the original forests and are indicative of human disturbance of the landscape. At lower altitudes (>1,800 m asl), trees such as *Cunninghamia lanceolata, Cryptomeria japonica* var. *sinensis, Pinus yunnanensis, Pinus armandii, Alnus nepalensis* and *Eucalyptus smithii* are a strong indication of human disturbance to the original vegetation. Mixed conifer woodlands are also reported between 2,800-3,200 m asl, where *P. yunnanensis* is the most

5 For example, *Q. aquifolioides, Q. fimbriata, Q. guyavifolia* and *Q. monimotricha* are endemic to the Hengduan region (Tang 2015).

6 Here, 'original' vegetation refers to forest cover that stabilised at the beginning of the Holocene and created the basis of modern vegetation composition before any human intervention. For an overview of the development of Yunnan vegetation before the Pleistocene era, see Zhu, Tan 2022; Ding et al. 2020.

common species documented today. Strands of *Tsuga* are instead present in areas little impacted by human activity **[fig. 16]**.

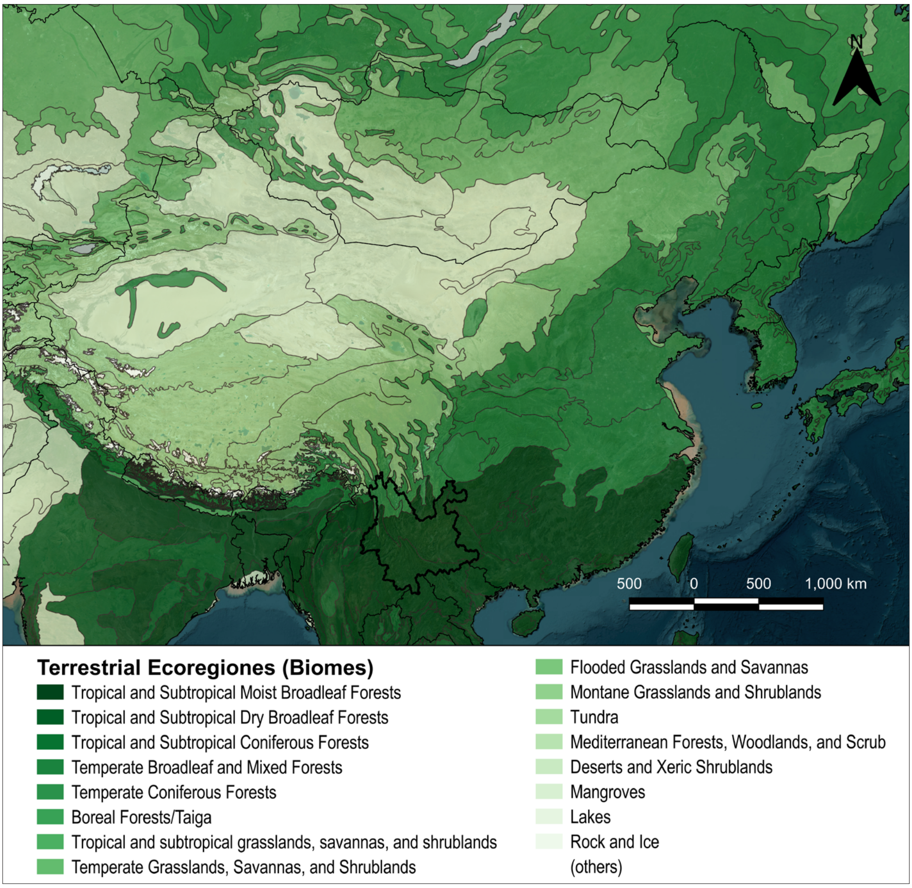

Figure 16 Modern biome regions in Yunnan seen in Asian context. Yunnan Province is highlighted in black. Ecoregions[7] as defined by the Terrestrial Ecoregions of the World (TEOW) map by the World Wildlife Fund (WWF; Olson et al. 2001). Made by the Author with QGIS 3.28.5-Firenze, ESRI and TEOW basemaps

7 According to TEOW categories, the subalpine conifer forests of the Hengduan Mt. and the alpine conifer and mixed forests of the Nujiang-Langcang Gorge belong to Biome 5 (temperate coniferous forests); the subtropical evergreen forests of Yunnan belong to Biome 1 (tropical and subtropical moist broadleaf forests). Full definitions are available at `https://www.worldwildlife.org/publications/terrestrial-ecoregions-of-the-world`.

3.2 Palaeoenvironmental Reconstruction of Ancient Yunnan Climate and Flora

Studies on pollen data retrieved from lake sediment cores in Yunnan have provided an almost uninterrupted record for the palaeoclimate of the province;[8] these, in conjunction with data from cave speleothems,[9] have allowed the reconstruction of climatic phases, including monsoon intensity, and vegetation cover during different earth geologic eras in Yunnan.

During the late Pleistocene (ca. 15000 to 10500 BCE), the Yunnan climate was generally colder than today, and the winter monsoon intensity was much stronger than that of the summer monsoon. Throughout the province, the dominant forest cover was composed of conifers, and many species that are now confined at higher altitudes were present at least 500 m below their current altitudinal limit. Climate and vegetation changes at the transition from the Pleistocene to the end of the Holocene climatic optimum transformed Yunnan from a subtropical dry/semi-dry forested region characterised by warm-rainy winter and hot-dry summer to a subtropical evergreen broad-leaved forested region with dry winters and rainy summer.

From about ten thousand years ago, after the transition to the Holocene, climate fluctuated and underwent almost five millennia of warm and wet climate, a period known as the climatic optimum, or Holocene thermal maximum. During this period, temperatures were higher by at least 2-3°C degrees, and it is estimated that precipitation was 20-40% higher than present-day. This caused an inversion of rain period seasonality compared to the previous period, winters became dry and summers rainy. The summer monsoon intensity reached its peak during this period. The increased precipitation is attested, for example, by increased water level at the Erhai Lake (Shen et al. 2006; Sun et al. 1986), and rainfall estimate reconstruction from lake sediment core pollen records from Xingyun and Qilu Lakes (Chen F.H. et al. 2014; Chen X.M. et al. 2014; Hillman et al. 2017), and Yilong Lake (Yuan et al. 2021). The warmer and wetter climate caused a retreat of the conifer forests to above 2,800 m asl, and an expansion of the evergreen broad-leaved forests, especially of *Cyclobalanopsis*, *Lithocarpus*, and *Castanopsis* species, including to the area north of present-day Dian Lake, near Kunming. Altitudinal differentiation and current vegetation belts and altitudinal limits for species became gradually defined. For example, between ca. 6000-4000 BCE, subtropical evergreen forests became dominant in the lowlands, and montane humid evergreen forests became prevalent in the highlands. Subtropical and tropical vegetation during the sixth to the third millennia BCE extended to north of the Yangzi Basin (Yu et al. 1998, 2000; Fuller, Qin 2010) **[fig. 17]**.

8 Walker 1986; Sun et al. 1986; Yu et al. 1990; Fang 1991; Brenner et al. 1991; Long et al. 1991; Hodell et al. 1999; Yu et al. 2000; Zheng et al. 2002; Yang. et al. 2005; Shen et al. 2005; 2006; Dearing et al. 2008; Jones et al. 2012; Chen X.M. et al. 2014; 2022; Chen F.H. et al. 2014; Hillman et al. 2017; 2021; Xiao et al. 2017; 2020; Zhang E. et al. 2017; Yuan et al. 2021; Zhao et al. 2021b; Wu D. et al. 2023.

9 For example, speleothems from Dongge cave, located ca. 750 km from Erhai Lake in northwestern Yunnan are particularly useful as proxy for Yunnan paleoclimate reconstruction (Dykoski et al. 2005). For a review of cave speleothem records from broader China see Zhang et al. 2011. More recently, leaf wax isotope studies have started to be undertaken and contribute to palaeoclimate reconstruction (e.g., Zhang et al. 2021a).

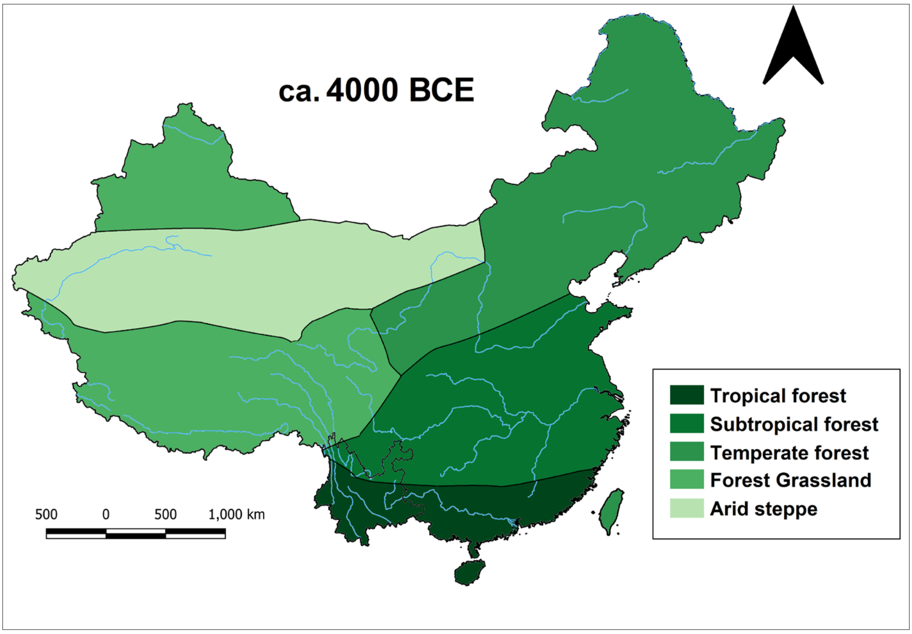

Figure 17 Map showing a schematic reconstruction of Chinese vegetation, dating to ca. 4000 BCE, with illustration of main rivers and modern Yunnan borders (redrawn from Li, Chen 2012, 31, fig. 2.4). Made by the Author with QGIS 3.28.5-Firenze, Natural Earth basemap

It has been suggested that this warmer and wetter climate greatly contributed to the expansion of Neolithic Cultures and especially provided suitable environmental conditions for the domestication of rice and millet during the sixth and fifth millennia BCE (Fuller, Qin 2010; see § 2.3). The similar tropical vegetation and environmental conditions present both where rice was domesticated and in Yunnan, would have not created a barrier for the crop spread to Southwest China at this time.

In Yunnan, the Holocene thermal maximum ended around the fourth millennium BCE. Since then until about the end of the first millennium BCE, the monsoon density decreased, and temperatures cooled; a possible sharp drop event is documented around 1500 BCE (Dykoski et al. 2005). This caused a decline of *Cyclobalanopsis*, *Castanopsis*, and *Tsuga* species and a retreat of the tropical forest to its modern limits (Shen et al. 2005). More generally it is in these millennia that current vegetation belts definitively stabilised (Wrinkler, Wang 1993). *Pinus*, Poaceae, Chenopodiaceae and *Artemisia* taxa show a drastic increase during these millennia, indicating a more open landscape. This could have been linked to an expansion of wetlands, shallow lake phases, or even clearing of the forest through fire (Shen et al. 2005; 2006; Cao et al. 2024). These species are also considered 'disturbance taxa', meaning they are indication of human activities and their impact on the vegetation. An increase in *Pinus* is usually interpreted as the result of forest clearance through fire and therefore possibly linked with removing the vegetation cover to bring in new land for agriculture (Dearing et al. 2008). This has led some authors to push back anthropogenic driven environmental change in northwest Yunnan to as early as ca. 5500 BCE, possibly even ca. 7000 BCE (Dearing et al. 2008). However, no archaeological evidence in support of this hypothesis has been uncovered yet.

Compositional analyses of lake sediments from Dian Lake have also shown that between the third millennium BCE and the first millennium CE lake levels fluctuated and were characterised by a series of frequent flood-shallow lake phases. This allowed human settlement of the lake shores and a more extensive exploitation of lacustrine resources during the Dian Kingdom (Yan, Wünnemann, Jiang 2020). Lake Fuxian, south from Dian Lake shows a thinning of the vegetation density after the third millennium BCE, with a big deforestation event in the mid-first millennium BCE, when forests were replaced by grasslands, wetlands and cultivated vegetation (Wang M. et al. 2024). In the same area, charcoal and pollen records indicate significant human impact on the natural vegetation only starting from the mid-first millennium BCE (Xiao et al. 2020; Hillman et al. 2021). Historical documents attest the development of intensive water irrigation systems in the Dian Basin from at least 16 CE (Yao et al. 2015). Some scholars have suggested that whereas temperature fluctuations in Yunnan during the early and mid-Holocene would have created unsuitable conditions for agriculture, the decreased humidity and retreat of the forest cover from fourth to first millennia BCE would have instead provided suitable conditions for the development of agricultural systems (Wu D. et al. 2023).

4 Local Perspectives: Archaeobotanical Studies in Yunnan

4.1 Prehistorical Sites in Yunnan: An Introduction

A recent publication has indicated Yunnan, Tibet, and Xinjiang are the provinces in China with the lowest reported prehistorical archaeological site density (quantified to less than 1:1,000 km^2; see Guojia 2001 in Hosner et al. 2016). This analysis was based on data compiled in the *Zhongguo Wenwu Dituji* 中国文物地图集 (Atlas of Chinese Cultural Relics), a series published by the Chinese Bureau of Cultural Relics between 1989 and 2014, which provides maps of known archaeological sites in each Chinese province at the time of publication. Hosner et al. (2016) note that provinces with fertile loess soils and good water resources, such as Shandong and Shaanxi, have among the highest reported site density (45:1,000 km^2 and 30:1,000 km^2, respectively). The authors of the study attribute these differences to the contrasting topographic features of the regions. Although the rugged landscape of Yunnan and Tibet, along with the arid environment of Xinjiang, may have limited prehistoric occupation, it is also important to consider that the shorter history of archaeological research in these provinces could have contributed to the lower number of known sites at the time of the Atlas publication. In addition to this, archaeological research in China historically focused on Shandong and Shaanxi, while excavations

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in other provinces like Yunnan have been primarily driven by rescue campaigns related to infrastructure projects, such as the construction of motorways and railways. When taking this into account, the differences in prehistorical site density are not surprising. However, the data presented in Hosner et al. (2016) has discrepancies with that listed in the Atlas; it considers a lower number of sites than those reported in the Atlas (279 vs. 546) and groups together substantially different sites in a single category of 'undistinguished Neolithic cultures'. Pleistocene early hominid sites, such as the *Homo erectus* Yuanmou man (*Yuanmouren* 元谋人), dating to ca. 1,700,000 years ago (Zhu et al. 2008), are grouped with sites dating from the ninth millennium BCE, which represent *H. sapiens* hunter-gatherer groups. These are also combined with sites that were re-dated to the Bronze Age before the publication of the study (for example Yeshishan 野石山 and Qinghuadong 清华洞, dated to ca. 1300-900 BCE; Liu, Sun 2009; Min et al. 2013). Although the Atlas classifies sites according to their chronology (Palaeolithic, Neolithic, and Bronze Age)[1] and provides information on whether these were settlements or cemeteries, many of the reported sites are 'locations with evidence of' lithics or bronze artefacts (*shiqi/qingtong chutu dian* 石器/青铜出土点). Archaeological research undertaken in the two decades since the publication of the Atlas has refined the chronology of known prehistoric sites in Yunnan. This prompts caution when making direct inferences from the data compiled in the Atlas without examination of the most recent archaeological findings in the region (Dal Martello 2022).

4.2 Before Sedentism: Evidence of Plant Use in Early Holocene Yunnan

An overview of the origins of agricultural practices would be incomplete without mentioning the time period that preceded them, often referred to as the Palaeolithic Age (*Jiushiqi Shidai* 旧石器时代), indicating the period prior to the Neolithic Age (*Xinshiqi Shidai* 新石器时代). In Chinese archaeology this classification is adapted from categories developed in the nineteenth century in European Prehistoric Archaeology, originating from the Three-Age System – a theory commonly attributed to Christian Jürgensen Thomsen (1788-1865; see Rodden 1981; Trigger 2006, 121-9). Thomsen theorised a Stone, Bronze, and Iron Age on the basis of raw material changes in prehistoric artefacts from the then Danish Museum of Northern Antiquities (now Danish National Museum). John Lubbocks (Lord Avebury; 1834-1913) in his book *Pre-historic Times* (1865), further elaborated upon Thomsen's classification by dividing the Stone Age into the Palaeolithic (or Archaeolithics, meaning Old Stone) Age and the Neolithic (New Stone) Age, each characterised by distinct lithic tool production technology – usually describes as chipped vs. ground or polished (see Trigger 2006, 147-8).

1 Sites listed in the Atlas include Palaeolithic (n=27), Neolithic (n=314) and Bronze Age sites (n=205; see Guojia 2001, 54-5).

Simplifying, in current Chinese archaeological literature[2] Palaeolithic sites indicate seasonal campsites, caves or open air sites, which are characterised by flaked/chipped stone tools and/or microblades, absence of domesticated plants or animals and generally absence of pottery remains (with some exceptions).[3] Neolithic sites indicate settled villages (and cemeteries) with evidence for domesticated plants and animals, intensive production of pottery, but no metal artefacts (Yan 2008). Broadly speaking, in China sites dated to ca. 20000-6500 BCE are classified as Palaeolithic sites; sites dating to 6500-2000 BCE are considered Neolithic sites (Liu, Chen 2012). However, this chronology has been established based on archaeological data from the Central Plains. With the expansion of archaeological research in other regions, chronological variations in local development have become increasingly evident. Recognising the limitations of these terms but acknowledging their widespread use in Chinese archaeological reports, I refer to Palaeolithic and Neolithic sites in line with published conventions in Chinese literature. More specifically, I use the term Palaeolithic to refer to pre-agricultural sites. To avoid confusion, all sites mentioned in text will also be presented with their absolute chronology at first mention.

2 Although some scholars have raised questions about the usefulness and suitability of applying such categories to classify Chinese material, this classification is widely employed in both Chinese and English language academic literature on Chinese archaeology. For example, Liu and Chen (2012) monograph *The Archaeology of China* has the subheading *From the Paleolithic to the Early Bronze Age*; the first volume of an important publication series by the Institute of Archaeology of the Chinese Academy of Social Sciences summarising archaeological data in China is titled *Zhongguo Kaoguxue: Xinshiqi Shidai Juan* 中国考古学: 新石器时代卷 (Chinese Archaeology-Neolithic Archaeology; Zhongguo 2010). It is standard practice to title archaeological excavation reports with indication of Palaeolithic/ Neolithic/ Bronze Age before the site name, a quick search of the terms on CNKI (Chinese Network Knowledge Infrastructure, a search engine for academic publications in China) gives numerous yearly reports titled that way: `https://cnki.net/index/`.

3 Ceramic production was considered strictly linked with sedentism and as such seen as a foundational element of the so-called Neolithic Age. This view was challenged after the discovery of several sites in South China with evidence of ceramic technology before any attested sedentism and/or presence of domesticated plants (see, for example, Xianrendong 仙人洞, Yuchanyan 玉蟾岩, and Zengpiyan 甑皮岩; Wu et al. 2012; Boaretto et al. 2009; Yuan 2013). Some scholars proposed that pottery in South China emerged along with collecting and cooking wild rice (e.g., Higham, Lu 1998; Liu 2008). This view was supported by the retrieval of rice phytoliths at these sites; however, the reliability of the identification and the provenance of the remains has been questioned. Other scholars have suggested that ceramic containers were more generally used to store and cook (boil) food from local foraged resources to increase digestibility. For example, nuts need a soaking period to remove toxins (Lu 1999, 124; Pearson 2005; Fuller, Castillo 2016). Meat from freshwater gastropod shells is also more easily extracted through cooking, and finds of crushed shells at sites without pottery, as opposed to whole shells at sites with pottery seem to support this view (Lu 2010, 2012).

Table 11 Radiocarbon dated Palaeolithic sites in Yunnan with indication of chronology, lithic industry, faunal, and floral remains if available. Lithic tools categories after Huan et al. 2024. See Figure 18 for location of sites

Site	Chronology	Lithic tools	Faunal remains	Floral species	References
Xiaodong cave 硝洞 (Discovered 1981 Exc. 2008, 2015)	43-24 k y BP Oldest site with Hoabinian tools to date	Hoabinian complex; (Ridge-hammer percussions)	*Rhinoceros sinensis, Selenarctos thibetanus, Macaca* sp., *Cervus unicolor*, *Muntiacus* sp., *Bos gaurus, Hystrix brachyuran yunnanensis*	-	Ji et al. 2016a; Zhang 2016
Yushuiping cave 玉水坪 (Discovered 1984 Exc. 1988, 2005)	38-17 k y BP	Core-flake tools; Cobbles	*Rhinoceros* sp., *Cervus* sp., Bovidae, *Leprus* sp., *Ursus* sp.	-	Yunnan, Nujiang, Lanping 2020
Longtanshan 龙潭山 (Discovered 1975 Exc. 1982)	31-29 k y BP	Core-flake tools	*Rhinoceros sinensis,* Bovidae, *Cervus* sp., *Sus* sp.	-	Hu 1977; Qiu, Zhang, Hu 1985
Laohu cave 老虎 (Discovered 1987 Exc. 2005)	30-18 k y BP	Cobbles; Core-flake tools	Unspecified	-	Zhu, Ji 2010
Dedan cave (Discovered 1950s Exc. 2018-22)	(35-)18 k y BP	Hoabinian complex	Unspecified	-	Wu et al. 2022a
Naminan cave 娜咪囡 (Discovered 1997 Exc. 1997-8, 2010-11)	20-10 k y BP	Cobbles; Core-flake tools	Unspecified invertebrate and vertebrate animals, including fish, amphibians, and mammals	Phytoliths: Palm, Panicinae, Eragrostioideae, Arundiaceae/ Bambusoide	Ruan 2021; Zhang, Wang, Gao 2022
Maludong (Red deer cave)[4] 马鹿洞 (Exc. 1989, 2008-11)	18-13 k y BP	Cobbles; Core-flake tools	Large mammals, *Macaca* sp., *Axis yunnanensis*	-	Curnoe et al. 2015; Ji et al. 2016b; Zhang et al. 2022b

4 Despite earlier claims of hominid fossils showing a mixture of archaic and modern features, genomic analyses indicate that human bones from Maludong are anatomically modern humans.

Site	Chronology	Lithic tools	Faunal remains	Floral species	References
Fodongdi cave 佛洞地 (Exc. 2016-17)	18-13 k y BP	Hoabinian complex; Core-flake tools; Microliths; (Ridge-hammer percussions)	Fish: *Cyprinus, Ctenopharyngodon, Barbodes, Carassius;* Amphibians: *Anura, Cynops*; Reptiles: Testudoformes, Lacertiformes, Serpentiformes; Small and large mammals: Erinaceidae, Chiroptera, *Macaca, Semnopithecus,* Hystricida, Rhizomyidae, Sciuridae, Cricetinae, *Castor;* Felidae, Canidae, *Meles, Porcula,* Cervidae, Bovinae, Caprinae, Birds and invertebrates	Pollen: *Pinus, Dendrocalamus, Aphanamixis, Gleditsia, Gigantochloa, Cyclocarya paliurus, Dipterocarpus, Cyclobalanopsis, Ailanthus, Toona, Cyclobalanopsis, Quercus, Phoenix, Celtis, Juglans, Cerasus, Bromus, Plantago, Vitis*	Gao et al. 2023; Huan et al. 2024
Zhangkoudong cave 张口洞 (Discovered 1989 Exc. 1990; 2003)[5]	14.9-9.8 k y BP	Core-flake tools (Ridge-hammer percussions)	Boars, rhinos, deer, dogs	-	Hu 1995; Gao 2004
Tangzigou 塘子沟 (open air site) (Discovered 1987 Exc. 2003, 2006)	10-8 k y BP	Cobbles; Core-flake tools; microliths	Small cervids, large cervids, bovids, micromammals: Murids, Rhizomyids, Scuirids, Hystricids	-	Jin et al. 2012; Zhou et al. 2020; Zhu et al. 2020
Dabanqiao cave 大板桥 (Discovered 1989 Exc. 1989)	10-8 k y BP	Microliths; Core-flake tools	Gastropoda: *Margaya* ssp. Fish, Birds, Mammals: *Rattus* sp., *Vulpes vulpes, Aonyx cinerea, Felis bengalensis, Panthera* sp., *Sus* sp., *Muntiacus reevesis, Cervus* sp., Bovinae	-	Yang 1993

5 Gao 2004 mentions plant remains but no formal report has been published.

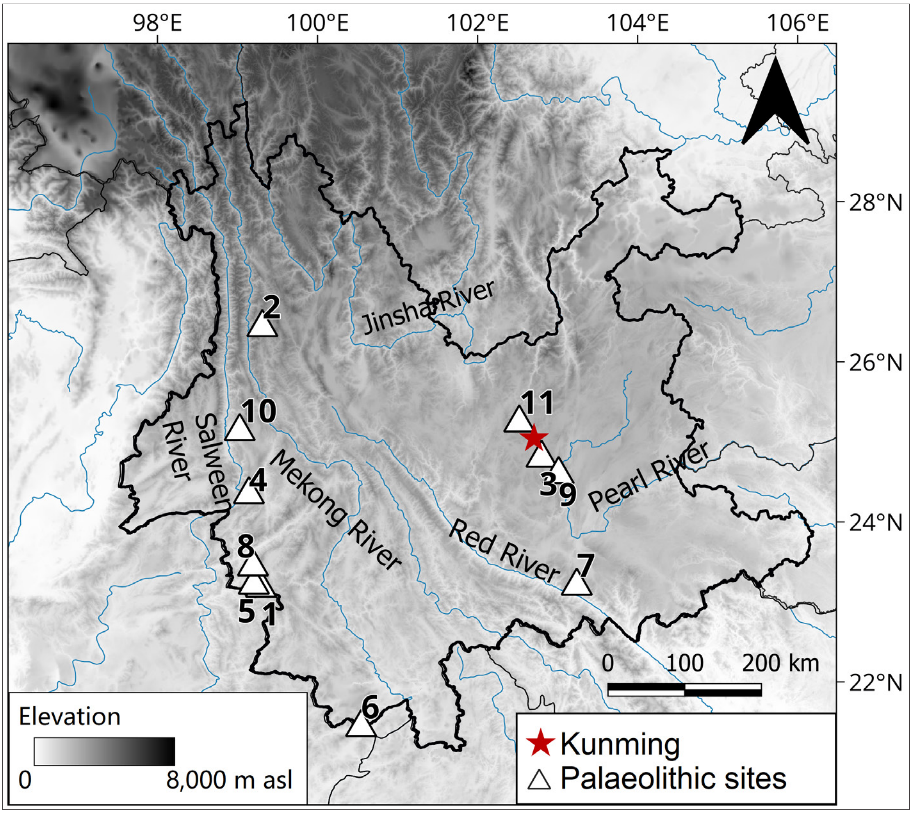

Figure 18 Palaeolithic sites mentioned in text: 1. Xiaodong; 2. Yushuiping; 3. Longtanshan; 4. Laohu; 5. Dedan; 6. Naminan; 7. Maludong; 8. Fodongdi; 9. Zhangkoudong; 10. Tangzigou; 11. Dabanqiao. Made by the Author with QGIS 3.28.5-Firenze, Natural Earth and EROS Digital Elevation basemap, U.S. Geological Survey

Of the 27 Palaeolithic sites listed in the Atlas, 17 had been excavated by the time of its publication and several new sites have been discovered or systematically investigated since.[6] Most sites dating to the late Pleistocene and early Holocene in Yunnan (ca. 40,000-8,000 years ago) are cave sites located close to water reservoirs. At present, eleven sites have been dated through radiocarbon dating methods and provide a chronological framework for the occupation of Yunnan during this period **[fig. 18] [tab. 11]**. This shows anatomically modern humans inhabiting Yunnan as early as 43,000 years ago, as evidenced by *Homo sapiens* remains from Xiaodong 硝洞 (Ji et al. 2016a). Palaeolithic research in Yunnan places greater emphasis on the study of human remains or lithic tools production technology; while animal resources are sometimes found and reported, almost no information is available on the plant species that may have been exploited for food by these groups. An exception to this is the pollen study undertaken at Fodongdi 佛洞地 (Gao et al. 2023; Huan et al. 2024), and the phytolith study at Naminan 娜咪囡 (Ruan 2021; Zhang, Wang, Gao 2022). These studies help reconstruct the environment during the occupation of the sites; however, they don't provide

6 See Ji, Ma 2005; Qi, Dong 2006; Li 2015; Ji et al. 2016a; 2016b; Wu et al. 2022a; 2022b; Gao et al. 2023; Huan et al. 2024; Zhang et al. 2024.

indication on whether people exploited these floral resources. Plant use at these Palaeolithic sites is inferred through the analysis of the lithic toolkit **[tab. 11]**. Hoabinhian tools are reported at sites located along the Mekong Basin, spanning across Yunnan and present-day mainland Southeast Asia. In Yunnan, Hoabinhian tools have been reported from Xiaodong (Ji et al. 2016a; Zhou et al. 2024), Dedan (Wu et al. 2022a), and Fodongdi (Gao al. 2023).[7] The discovery of Hoabinhian tools at Xiaodong has provided new support for the theory of a Hoabinhian homeland in present-day Yunnan (a theory known as 'Chinese Hoabinhian Homeland'; see Van Heekeren 1972; Wu et al. 2022; Zeitoun, Forestier, Nakbunlung 2008), or, at the very least, suggests a much broader distribution of Hoabinhian-like tool-producing groups in Southwest China than previously hypothesised.[8] The Hoabinhian technocomplex typically includes unifacial flaked tools and large cores ('sumatraliths') that have been suggested to be correlated to clearing tropical (and sub-tropical) forest vegetation (e.g., Gorman 1971). Based on this, scholars have inferred people living in these humid tropical forests practiced a broad-spectrum subsistence.[9] According to palaeoenvironmental reconstructions, many areas of Yunnan up to 2,000 m asl in elevation were dominated by plant taxa that produced edible acorns (i.e. *Cyclobalanopsis, Castanopsis, Lithocarpus*; see Ch. 3). These provide highly nutritious food that could easily serve as starchy staples for hunter-gatherer groups. Of note, according to the authors of the systematic subsistence study done at Tangzigou 塘子沟, one of the few known open-air sites dated to this period in Yunnan, people were not under resource stress (Jin 2010; Jin et al. 2012). Large numbers of animal bones, including cervids, bovids, and micro-mammals have been documented during excavation. There were no signs of intensification in the exploitation of animal resources, suggesting people at Tangzigou engaged in broad-spectrum subsistence.

In North China, use-wear analyses on grinding slabs (mortars and pestles) recovered from early Neolithic sites have demonstrated that these tools likely had a multi-use function purpose, being used for processing wild plant, such as acorns,[10] rather than domesticated cereals, as previously hypothesised. This interpretation is supported by the apparent lack of convincing domesticated plant remains from these sites (Liu 2008; Liu et al. 2010; Lu 1999, 60-1). Recent archaeological investigations in Guangdong and Guangxi provinces (as well as mainland Southeast Asia)[11] have revealed large groups of foragers inhabiting these regions in the millennia preceding the emergence of cereal-based agriculture. These groups exploited local wild resources (see § 2.4.4), and grinding stones have been retrieved at sites dating to the ninth to seventh millennia BCE in Guangxi (Xie 2022). Here, grinding stones have been interpreted as evidence of local (wild) plant

7 Further sites along the Mekong in modern Yunnan sharing a similar lithic industry are listed in a preprint article (Wu Y. et al. 2023), however these lack certainty of chronology.

8 Ji et al. 2016a; Li Y.H. et al. 2020; Zhou 2021; Zhou et al. 2024.

9 For a recent discussion of Hoabinhian terminology and limits on Hoabinhian lithic classifications see Shoocongdej 2022. On Hoabinhian and more broadly hunter-gatherers in Southeast Asia see Higham 2013; 2024.

10 For example, hackberry seeds, identified as *Celtis bungeana* and *C.* cf *koraiensisseeds* have been retrieved from Burial 4 in Donghulin (Hao, Xue, Cui 2008).

11 For a review of subsistence before cerealiculture in South China see Zhang, Hung 2012; in Southeast Asia see Higham 2014.

processing. Interestingly, grinding stones decline from sites in mainland Southeast Asia after the appearance of domesticated crops (see § 5.3; Wang W. et al. 2022). Although direct evidence of ancient plant remains is mostly lacking, the emergence of pottery in South China has been linked to the boiling of wild plant, so to increase their digestibility.[12] Since most of these sites have been excavated before the introduction of flotation techniques, the absence of plant remains should not surprise (however, flotation is still rarely conducted during the excavation of Palaeolithic sites). Some authors argue that the abundant tropical and sub-tropical vegetation provided ample resources to fulfil the subsistence needs of hunter-gatherer populations, and that cultivation practices began only after the migration of farming populations from elsewhere (Liu, Chen 2012, 73). The general lack of a clear evidence for a Palaeolithic-Neolithic transition during the Holocene in regions such as Southwest China reinforces this hypothesis. However, the current lack of evidence may be largely due to the insufficient scope of systematic archaeological investigation.

12 Lu 1999, 124; Pearson 2005; Fuller, Castillo 2016; see Ch. 4 fn. 3.

4.3 Archaeological Sites from the Third Millennium BCE and the Beginning of Farming

Although two of the earliest known flotation studies in China were carried out in the Yunnan, at Mopandi and Shifodong (Zhao 2003a; 2010b; see § 1.3); prior to 2009, most of the known ancient plant remains derived from chance findings. This changed after the 2007-08 excavation of Haimenkou, when systematic flotation was undertaken across the whole site, and especially after the publication of the updated *Field Work Archaeology Protocol* in 2009 (Guojia 2009), which mandated flotation during all archaeological excavations (see § 1.2.3.2). Since then, flotation has become standard practice in archaeological excavations in Yunnan. This has resulted in a wealth of archaeobotanical data from over twenty sites for the time period considered in this book **[tab. 12] [fig. 19]**. In this chapter I review archaeological data for sites in Yunnan that provide evidence for ancient plant remains, with a focus on macro-botanical data, including both remains systematically collected through flotation and those handpicked. Only sites for which systematic archaeobotanical studies have been undertaken will be described in detail in text. Isotope studies will also be mentioned, as they can provide complementary data to the macro-botanical dataset. Information on all mentioned sites is listed in Table 12, and their location is illustrated in Figure 19.

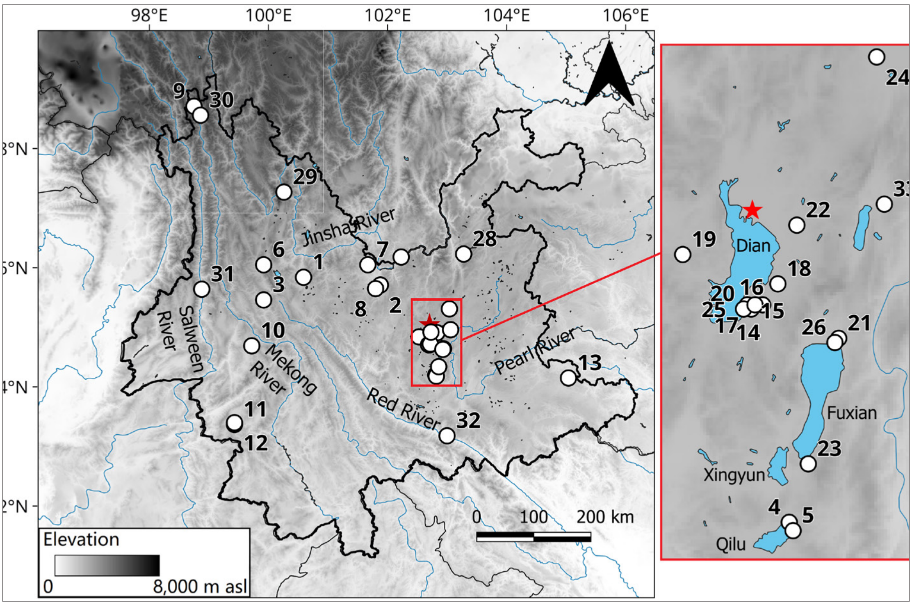

Figure 19 Map showing location of sites in Yunnan with evidence for ancient plant macro-botanical remains and sites with isotope studies mentioned in text. 1. Baiyangcun; 2. Dadunzi; 3. Xinguang; 4. Haidong; 5. Xingyi; 6. Haimenkou; 7. Mopandi; 8. Mopanshan; 9. Zongzan; 10. Yingpanshan; 11. Shifodong; 12. Nanbiqiao; 13. Dayingdong; 14. Gucheng; 15. Shangxihe; 16. Hebosuo; 17. Shizhaishan; 18. Anjiang; 19. Dayingzhuang; 20. Xiwangmiao; 21. Xueshan; 22. Xiaogucheng; 23. Guangfentou; 24. Qujing Dongjia; 25. Jinshashan 26. Jinlianshan; 27. Jiangxifen; 28. Yubeidi; 29. Gaozhai; 30. Adong; 31. Shilinggang; 32. Mayutian; 33. Shamaoshan. Made by the Author with QGIS 3.28.5-Firenze, Natural Earth and EROS Digital Elevation basemap, U.S. Geological Survey

Table 12 Archaeological sites in Yunnan dating between the third millennium BCE to the early first millennium CE with evidence for ancient plant remains. Both sites with systematic flotation (indicated by Latin names of plants) and chance findings (indicated with common English name of plants) are included. Modified after Dal Martello 2022, Table 1

Site (Location)	Exc. Date Exc. Area/ Est. site size	Chronology	Features	Material Culture	Plant Remains	Faunal Remains	References
Baiyangcun 白羊村 Middle Jinsha River, Binchuan county	1973-74; 2013-14 390 m²/ 10~20 ha	2650-1690 cal BCE (charred seeds)	29 houses (wattle-daub) 39 hearths 290 pits 56 burials (shaft pit/ urn) Unspecif. no. of living floors	Ceramics: Impressed/ incised, Baiyangcun type Lithics: Ground, polished Perforated knives	*Oryza sativa, Setaria italica, P. miliaceum, Echinochloa* sp., *Glycine soja, Vigna* sp., *Cajanus* sp., *Cucumis* cf *melo, Melia azerdach, Euryale ferox, Juglans* sp., *Vitis* sp., *Crataegus* sp., *Perilla* sp., *Lycium* sp., Peach? [Isotopes] Predominantly C_3 in the early phase	Pig, Cattle, Goat/sheep, Wild boar, Black bear, Deer	Yunnan 1981; Yunnan Kaogu 2014; Dal Martello et al. 2018; Dal Martello 2020; Ma et al. 2022a
Dadunzi 大墩子 Middle Jinsha River, Yuanmou county	1972-73; 1999; 2010 1985 m²/ 1.6 ha	2200-1610 cal BCE (charred seeds)	61 houses (wattle-daub/ semi-subterr./ stilt) 5 hearths 25 pits 2 sacrificial pits 98 burials (shaft pit, urn, stone cist)	Ceramics: Impressed/ incised, Dadunzi type Lithics: Ground, polished Grinding stones; perforated knives	*Oryza sativa, Setaria italica, P. miliaceum, Vigna* sp., Cucurbitaceae	Pig, Dog, Cattle, Goat/sheep, Chicken, Muntjac, Deer Lacustrine resources	Kan 1977; Yunnan Kaogu 2009; Jin et al. 2014a; Jin et al. 2014b; Li et al. 2016
Xinguang[13] 新光 Upper Mekong River, Yongping county	1993-94 1000 m²/ 3~8 ha	2620-1780 cal BCE (charred peat)	21 pits 6 houses (Semi-subterr./ wattle-daub) 1 moat 7 hearths	Ceramics: Impressed/ incised, Xinguang type (red paint) Tools: Ground, polished Perforated knives	Charred rice grains from G3	Deer, Horse teeth?	Yunnan 2002; Yao 2010

13 Yao (2010) lists the following plants for Xinguang: rice, millet, and wheat; however, no mention of these remains is found in the Chinese reports of Xinguang.

Site (Location)	Exc. Date Exc. Area/ Est. site size	Chronology	Features	Material Culture	Plant Remains	Faunal Remains	References
Haidong 海东 (shell mound) Qilu Lake, Tonghai county	1988-89 372 m²/ 0.3~0.85 ha	3090-2200 cal BCE (human bone)	40 hearths 30 burials (shaft pit)	Ceramics: Corded ware, Shizhaishan (Neolithic) type Lithics: Ground Harvesting knives?	Rice?	Lacustrine resources: tortoise shells, and other unspecified animal bones	He 1990; Xiao 2001; Zhang, Hung 2010; Yao 2010
Xingyi 兴义 Phase II (shell mound) Qilu Lake, Tonghai county	2015-16 190 m²/ 5.2 ha	2900-2300 cal BCE (human and animal bones, wood charcoal)	12 burials (Shaft pit; urn)	Ceramics: Corded ware, Haidong (Neolithic) type Tools: Unspecified Harvesting knives?	No seeds retrieved in the samples [Isotopes] Predominantly $C_{3,}$ Increase in $C_{4,}$	Bovid, Cervidae Abundant freshwater resources: *Margarya* sp.	Yunnan 2017; Zhang 2017; Ma et al. 2024
Xingyi 兴义 Phase III (shell mound) Qilu Lake, Tonghai county	2015-16 190 m²/ 5.2 ha	1800-1300 cal BCE (human and animal bones, wood charcoal)	47 floors 18 houses (Semi-subterr.; stilt, pavilion houses) 24 burials (Shaft pit; urn) 16 pits 4 streets 2 ditches 1 walled structure	Ceramics: Corded ware, Xingyi type Lithics: Steppe style stone adzes	*Setaria italica, P. miliaceum, Oryza sativa, T. aestivum, Glycine max, Fagopyrum esculentum, Perilla frutescens*	Pig, Bovid, Bird, Cervidae Abundant freshwater resources: *Margarya* sp.	Yunnan 2017; Zhang 2017; Ma et al. 2024
Haimenkou 海门口 Phase I Middle Jinsha River, Jianchuan county	1957; 1978; 2007-08; Ongoing 1350 m²/ 5~10 ha	1600-1450 cal BCE (charred seeds)	Unknown no. of houses (wood pile- stilt), pits, hearths	Ceramics: Incised/ impressed, Baiyangcun type Lithics: Polished Half-moon shaped knives	*Oryza sativa, Setaria italica, P. miliaceum, Chenopodium* sp., *Fagopyrum* cf *esculentum, Cannabis* sp., *Prunus* cf *persica, Prunus* cf *armeniaca, Quercus* sp.	Sus domesticus Ovis/Capra sp., *Canis familiaris, Bos gaurus, Cervus unicolor, Sus scrofa, Axis porcinus, M. muntjak, M. berezovskii, Macaca* sp., *Ursus* sp., *Lepus* sp., *Volpe* sp.	Yunnan 1958; Xue 2010; Jin 2013; Li, Min 2014; Wang 2018; Xue et al. 2022

Site (Location)	**Exc. Date Exc. Area/ Est. site size**	**Chronology**	**Features**	**Material Culture**	**Plant Remains**	**Faunal Remains**	**References**
Haimenkou 海门口 Phase II, III Middle Jinsha River, Jianchuan county	1957; 1978; 2007-08; Ongoing 1350 m²/ 5~10 ha	1450-400 cal BCE (charred seeds)	Unknown no. of houses (wood pile-stilt), pits, hearths	Ceramics: Incised/ impressed, Haimenkou type Lithics: Polished Bronze objects (mould casting)	*Oryza sativa*, *Setaria italica*, *P. miliaceum*, *Chenopodium* sp., *Triticum aestivum*, *Hordeum vulgare*, *Fagopyrum* cf *esculentum*, *Cannabis* sp., *Prunus* cf *persica*, *Prunus* cf *armeniaca*, *Quercus* sp., *Vitis* sp., *Perilla* sp. Uncharred aquatic species (e.g., *Butomus*, *Najas*, *Ranunculus*)	Sus domesticus Ovis/Capra sp., *Canis familiaris*, *Bos gaurus*, *Cervus unicolor*, *Sus scrofa*, *Axis porcinus*, *M. muntjak*, *M. berezovskii*, *Macaca* sp., *Ursus* sp., *Lepus* sp., *Volpe* sp.	YPM 1958; Xue 2010; Jin 2013; Li, Min 2014; Wang 2018; Xue et al. 2022
Mopandi 磨盘地 Middle Jinsha River, Yongren county	1983; 2001 340 m²/ 0.8 ha	1400 BCE (assoc.)	2 houses (wattle-daub) 1 hearth 17 postholes 1 ditch 7 burials (stone cist)	Ceramics: Incised/ impressed, Caiyuanzi type Lithics: Ground, polished Perforated knives	Rice	Pig, Cattle, Goat/sheep, Dog, Chicken, Deer, Muntjac	Yunnan 2003; Zhao 2003a
Mopanshan 磨盘山 Middle Jinsha River, Yuanmou county	2012-13 116.5 m²/ 0.9 ha	'Neolithic' (assoc.)	4 burials (Shaft pit, Stone cist) 41 houses (Semi-subterr.; Stilt houses) 30 pits 1 ditch 1 kiln 9 floors	Ceramics: Unspecif. Lithics: Perforated stone knives	Acorns? Millets? (broomcorn, foxtail?), Rice?	Bovid, Caprine, Dog, Pig, Bird	Kang 2013; Yunnan Kaogu 2013
Zongzan 宗咱 Upper Mekong River, Weixi county	2013 1600 m²/ Unspecif.	2000 BCE-200 CE (assoc.)	45 walled structures 1 ditch 1 pit	-	Buckwheat? (dated to Western Zhou dyn., 1045-771 BCE)	Cattle, Sheep, Deer, Pig, Monkey, Black bear	Yang 2014; Li 2016; Chen, Chen, Zhu 2019
Yingpanshan 营盘山 Upper Mekong River, Changning county	1990 50 m²/ 1 ha	1800 BCE (assoc.)	1 House (Semi-subterr.?) 2 Hearths	Ceramics: Unspecif. Lithics: Polished Perforated knive	Rice	Not reported	Xiang et al. 2015; Xiao 2006; Geng, Li, Zhang 1990

Site (Location)	Exc. Date Exc. Area/ Est. site size	Chronology	Features	Material Culture	Plant Remains	Faunal Remains	References
Shifodong 石佛洞 (Cave site) Middle Mekong River, Gengma county	1982; 2003 750 m²/ 0.3 ha	1400-1100 BCE (assoc.)	Several hearths	Ceramics: Incised/ impressed, Shifodong type Lithics: Polished	*Oryza sativa, Setaria italica Chenopodium* sp., *Tamarindus* cf *indica,* Indet. tree legume, Indet. fruits	Pig, Dog, Cattle, Deer, Horse? Indet. birds/ fish species	Kan 1983; Liu, Dai 2008; Yao 2010; Zhao 2010b; Dal Martello 2020
Nanbiqiao 南碧桥 (Cave site) Lower Mekong River	1982 Unspecif./ 0.3 ha	1250-970 BCE (assoc.)	-	Ceramics: Incised/ impressed, Shifodong type	Rice	-	Kan 1983; An 1999
Dayingdong 大阴洞 (Cave site) SE Yunnan, Guangnan county	2017-18 300 m²/ 1500 m²	1400-1100 cal BCE (human bones)	12 pits 17 burials	Ceramics: Corded ware, Black polished pottery Lithics: Ground	Charred rice found in a pit [Isotopes] C_3	Not reported	Yunnan Kaogu 2018; Zhao et al. 2022
Toujushan 头咀山 Xingyun Lake, Jianchuang county	1961 Unspecif.	'Neolithic' (assoc.)	Unspecif.	Ceramics: Neolithic (Dian) type Lithics: Polished	Rice	Not reported	Ge 1978
Gucheng 古城 (古城村) (shell mound) Dian Lake, Jinning county	2012 (survey); 2020-22 (exc.) 16,500 m²/ 2.7 ha	Shang dyn. 1600-1050 BCE (assoc.)	111 burials (81 shaft pit; 30 urn) 1 house (Semi-subterr.)	Metal agricultural tools	Wild local plants (Grape, Peach, Apricot, Chinese Hawthron)	Sambar, Deer, Muntjac Gastropod, Shells	Yao, Jiang 2012; Yunnan Kaogu 2024a; 2024b
Shangxihe, Yi area 上西河乙区 (shell mound) Dian Lake, Jinning county	2014; 2016-17 500 m²/ 1.6 ha	1212~1081 - 380~209 cal BCE (charred seeds)	40 houses (Semi-subterr.; pile-dwelling) 470 pits 12 wells 62 ditches 3 burials (vertical shaft pit)	Ceramics: Dian type Tools: Agricultural tools Unspecif. metal artefacts	Rice, Wheat, Fruits	Not reported	Yao A. et al. 2020; Yunnan, Chicago 2019; Yunnan Kaogu 2017a; Yang et al. 2017

Site (Location)	Exc. Date Exc. Area/ Est. site size	Chronology	Features	Material Culture	Plant Remains	Faunal Remains	References
Hebosuo 河泊所 (shell mound) Dian Lake, Jinning county	2014; 2016-17; 2021-22 12.5 m²/ 31 ha	900-109 cal BCE (charred seeds)	13 Houses (Semi-subterr.; pile-dwelling) 33 burials (Shaft pit, urn) 4 pits 1 ditch	Ceramics: Dian type Metal agricultural tools	*Oryza sativa, Triticum aestivum, Setaria italica, P. miliaceum, Fagopyrum esculentum, Cerasus* sp., *Zanthoxylum, Bungeanum* Uncharred aquatic species (i.e., *Potamogeton, Najas*)	Pig, Cattle, Dog, Sheep, Deer, Fish, Birds, Reptiles, Gastropod shells	Yao, Jiang 2012; Yao et al. 2015; Yang 2016; Yunnan, Chicago 2019; Yao A. et al. 2020; Yang et al. 2023
Gucheng 古城 (古城村) (shell mound) Dian Lake, Jinning county	2012 (survey); 2020-22 (exc.) 16,500 m²/ 4~10 ha	900-530 cal BCE (charred seeds)	21 houses (14 Semi subterr.) Unspecif. no. of pits, floors	Ceramics: Unspecif. Metal agricultural tools	*Triticum* sp., *Oryza sativa, Setaria italica,* Pea? Uncharred aquatic species (i.e., *Potamogeton, Najas*)	Domestic mammals Large quantities, of gastropod shells	Yao, Jiang 2012; Yunnan Kaogu 2024a; 2024b
Shizhaishan 石寨山 Dian Lake, Jinning county	1953; 1955; 1958; 1960; 1996 504.3 m²/ 0.05? ha	Dian to Western Han periods 779-488 cal BCE (charred seed)	86 burials (shaft pit: supine extended large graves have wooden coffins)	Ceramics: Incised/ Impressed, Dian type Casted bronze tools and weapons; drum-shaped cowrie shell containers in elite burials	*Triticum* sp., *Oryza sativa, Setaria italica* Uncharred aquatic species (i.e., *Potamogeton, Najas*)	-	Yunnan 1963; Yao, Jiang 2012
Anjiang[14] 安江 (shell mound) Dian Lake, Jinning county	2008; 2010-11 (survey); 2020-21 (exc.) 4000 m²/ 4 ha	Dian to western Han periods 770-430 cal BCE (charred seeds)	42 postholes 3 shell deposits Unspecif. no. of pits	Ceramics: Dian type	*Oryza sativa, Triticum aestivum, Hordeum vulgare, Setaria italica, P. miliaceum, Chenopodium* sp. (aquatic species; i.e., *Potamogeton, Najas*)	Cattle, Water buffalo, Pig, Dog, Deer, Felidae, Other mammals	Yao et al. 2015; Yunnan Kaogu 2024c
Dayingzhuang 大营庄 (shell mound) Dian Lake, Xishan county	2017 500 m²/ 10 ha	750-390 cal BCE (charred seeds)	35 pits 4 houses (Pavillion structure) 5 rivers 2 floors 5 *jicao*	Ceramics: Dian type Small bronze dagger	*Oryza sativa, Setaria italica, Triticum aestivum, Hordeum vulgare, Chenopodium* sp., *Zantoxhylum* sp., *Castanea* sp.	Unspecif.	Dal Martello, Li, Fuller 2021

14 The site is referred to by Anjiang North (Anjiang Bei) 安江北 in the most recent report by the Yunnan Provincial Institute of Cultural Relics and Archaeology (see Yunnan Kaogu 2024c).

Site (Location)	Exc. Date Exc. Area/ Est. site size	Chronology	Features	Material Culture	Plant Remains	Faunal Remains	References
Xiwangmiao 西王庙 Dian Lake, Jinning county	2014; 2016 81 m²/ Unspecif.	800-109 cal BCE (charred seeds)	8 houses (Semi-subterr.; wattle-daub) 22 pits; 4 ditches	Ceramics: Dian type Lithics: Grinding stones Bronze knives	Rice, Wheat, Millets, Soybean	Cattle, Sheep, Pigs, Dogs, Horses, Gastropods, Turtle, Birds, Deer	Yang et al. 2019
Xueshan 学山 Dian Lake, Chengjiang county	2006; 2009; 2010-11 2335 m²/ 1.5 ha	Dian period 800-300 BCE (assoc.)	29 houses (Semi-subterr./ wattle-daub) 260+ burials Unknown no. of pits 1 sacrificial pit?	Ceramics: Dian type	*Triticum aestivum*, *Oryza sativa*, *Setaria italica*, *P. miliaceum*, *Hordeum vulgare*, *Glycine max*, *Lens culinaris*, *Vigna* sp., *Fagopyrum esculentum*, *Zanthoxylum* sp., Fruits, Acorns [Isotopes] C_3 dominant; one individual mixed C_3/C_4	*Margarya melanioides*	Wang 2014; Wu, Jiang, Feng 2010; Wang et al. 2019; Wang et al. 2022
Xiaogucheng 小古城 (shell mound) Dian Lake, Chenggong county	2007-08; 2010-11 Unspecif./ 5~10 ha	800-670 cal BCE (wood charcoal)	Wooden 'palisade'	Ceramics: Dian type	*Oryza sativa*, Panicoideae, Verbenaceae, *Polygonum* sp. Aquatic species, *Ranunculus* sp., *Rumex* sp.	Gastropod shells	Yao et al. 2015
Guangfentou 光坟头 (shell mound) Fuxian Lake, Jiangchuan County	1984; 2011-12 600 m²/ 1.7 ha	Dian period (Spring-Autumn to Western Han) 700- 300 BCE (assoc.)	26 houses (Semi-cript) 30 pits 11 floors	Ceramics: Dian type Metal objects production centre	*Triticum aestivum*, *Oryza sativa*, *Setaria italica*, *Hordeum* sp., *P. miliaceum*, *Chenopodium* sp., *Duchesnea indica*, *Perilla frutescens*, *Ziziphus spinosa*	Cattle, Dog, Pig, Horse?, Sheep/goat, Deer, Bear, Rats, Porcupine, Rabbit	Yunnan 2013; Li, Liu 2016
Qujing Dongjia Village[15] 曲靖董家村 Dian Basin Qujing county	1982 n/a	700-300 BCE (assoc.)	Pit	-	Rice	-	Li, Li 1983

15 Also known by locals as Macaodong 马槽洞 or Biankukeng 蝙库坑.

Site (Location)	**Exc. Date Exc. Area/ Est. site size**	**Chronology**	**Features**	**Material Culture**	**Plant Remains**	**Faunal Remains**	**References**
Jinshashan 金砂山 Dian Lake, Jinning county	1999-2000; 2014-15; 2016 Unspecif.	Dian-Han period 800BCE-200 CE (assoc.)	84 burials (Vertical shaft pits; Some with sacrificial pits and burial chambers) 12 pits 2 ditches	Ceramics: Dian type Metal agricultural tools	Wheat, Nuts Flot. results unpublished	Unspecif.	Kaogu 2015; Yunnan Kaogu 2015; 2017b
Jinlianshan 金莲山 Dian Lake, Chengjiang county	2006; 2008-09 Over 600 m²/ Unspecif.	500-400 BCE (human bones)	265 burials (shaft pits)	Ceramics: Dian type Grinding stones Perforated knives	[Isotopes] C_3 prevalence (rice?); C_4 secondary	Not reported	Zhang 2011; Jiang et al. 2011
Jiangxifen 江西坟 Middle Jinsha River, Wuding county	2018-19 12,000 m²/ Unspecif.	900-400 BCE (human and animal bones)	530 burials (stone cist; shaft pit) 13 pits 1 floor 17 ditches	Ceramics: Impressed/ incised	*Oryza sativa, Setaria italica* [Isotopes] mixed C_3/C_4 one individual predominant C_3	Pig, Bovid	Yunnan Kaogu 2019; Lu et al. 2021
Yubeidi[16] 玉碑地 Bingu (Lower Jinsha River), Dongchuan County	1988; 2013 300 m²/ 1.8 ha	Dian period (Spring Autumn to Western Han) 700-300 BCE (assoc.)	15 houses (Semi-subterr.) 49 pits 6 burials (urn) Unknown no. of floors and postholes	Ceramics: Dian type Metal agricultural tools	*Oryza sativa, Setaria italica, Triticum aestivum, Glycine max, Zantoxhylum bungeatum, Chenopodium* sp., *Morus alba* Fruits, Tubers	Unspecif.	Huang 1990; Jiang, Zhu 2014 Yang 2016; Yang, Jiang, Chen 2020
Gaozhai Upper Jinsha River, Yulong county	2020 n/a	850-450 BCE (human bones)	4 burials (Stone cist)	Bronze knives	[Isotopes] Primarily C_3	Not reported	Ma et al. 2022b; Lu et al. 2023
Adong NW Yunnan, Deqing County	2020 n/a	750-450 BCE (human bones)	Unspec. no. of burials (Stone cist)	Bronze knives	[Isotopes] Mixed C_3/C_4	Not reported	Ma et al. 2022b; Lu et al. 2023

16 Previously referred to as Yingpancun 营盘村.

Site (Location)	Exc. Date Exc. Area/ Est. site size	Chronology	Features	Material Culture	Plant Remains	Faunal Remains	References
Shilinggang 石岭岗 Middle Salween River, Lushui county	2003; 2013-14 500 m²/ 10 ha	723-339 cal BCE (charred seeds)	42 burials (shaft pits) 4 pits 4 floors 2 houses (wattle and daub?) Burnt soil	Ceramics: Dianbian type	*Oryza sativa, Setaria italica, Zanthoxylum bungeanum, Perilla frutescens, Rhus chinensis* [Isotopes] mixed C_3/C_4; Tubers, roots, Acorns, Palms	Pig, Goat, Cattle, Dog, Deer	Li et al. 2016; Zhang et al. 2017; Ren et al. 2017
Mayutian 麻玉田 Red River, Yuanjiang section	2006; 2010 1325 m²/ Unspecif.	570- 440 BCE (human bones)	21 burials (Vertical shaft pits)	Ceramics: Mayutian type Metal artefacts, spearheads and axes	[Isotopes] Mixed C_3/C_4	Not reported	Xiao, Wan 2013; Zhang et al. 2014
Hebosuo 河泊所 (shell mound) Dian Lake, Jinning county	2014; 2016-17; 2021-22 12.5 m²/ 31 ha	202 BCE- 220 CE (charred seeds)	2 foundations 1 house (semi-subterr./ pile-dwelling) 1 road 375 pits 65 ditches 7 wells 1 river 31 burials (Vertical shaft pits) 14 dust heaps 6 floors 5 hard surfaces 6 ceramic heaps	Ceramics: Dian type, some Han objects	*Oryza sativa, Triticum aestivum, Setaria italica, P. miliaceum, Glycine max, Vigna angularis, Fagopyrum esculentum, Vitis vinifera, Crataegus cuneata, Chenopodium* sp., *Zantoxhylum bungeatum, Lagenaria* sp., *Prunus persica, Prunus salicina, Prunus cerasus, Choerospondias axillaris*	Not reported	Yao, Jiang 2012; Yao et al. 2015; Yang 2016; Yunnan, Chicago 2019; Yao A. et al. 2020; Yang et al. 2023; Jiang et al. 2023
Shamaoshan 纱帽山 Lake Yangzong, Yiliang county	1989 2,100 m²/ Unspecif.	250 BCE- 55 CE (human bones)	57 burials (vertical shaft-pits)	Ceramics: Dian type, some Han objects Metal weapons, buckles	[Isotopes] Predominantly C_3	Not reported	Zhang et al. 2012; Wu et al. 2019

4.3.1 Baiyangcun

Baiyangcun is located on the banks of the Binju River, which flows into the Jinsha River, in Binchuan county, northwest Yunnan **[fig. 19]**. Radiocarbon dating on charred seeds retrieved through flotation during the 2013 excavation established that Baiyangcun was occupied between 2650-1700 BCE (Dal Martello et al. 2018; Appendix 4). Both rice and millet have been reported since the lowest occupation layers, directly dated to 2650 BCE (Dal Martello et al. 2018, Dal Martello 2020). The occupation of the site has been further divided in two phases; phase I dating between 2650-2450 BCE, and phase II, dating between 2200-1700 BCE. Based on differences in ceramic typology, phase II was divided in two periods (Min Rui, pers. comm. September 2016), with a proposed phase III dating between 2000-1700 BCE (Dal Martello et al. 2018). The reasons why the site was briefly abandoned and then re-occupied between phase I and phase II are still unclarified. Baiyangcun has been among the most cited sites in Yunnan Archaeology since its discovery in 1972 and excavation between November 1973 and January 1974 (Yunnan 1981). Finds of rice remains (presumably silicified rice husks and panicles) were reported in less than half of the excavated pits during the first excavation season.[17] This was taken as evidence that Yunnan may have been the centre for rice domestication, a theory that is now no longer supported by the archaeological and archaeobotanical evidence (see § 2.2.1.1; see also below).

Information on the archaeological material is available from the first excavation (Yunnan 1981), and a preliminary report on the second season has been published on the official website of the Yunnan Provincial Institute of Cultural Relics and Archaeology (Yunnan Kaogu 2014). Both settlement and cemetery areas have been excavated. Features unearthed include at least 29 houses, 290 pits, over 50 burials, and numerous 'hearth' features. The preliminary report of the second excavation season distinguishes open air hearths (*huotui* 火堆; n=11), fire pits (*huotang* 火塘; n=4), and 'stove', indicated with the term *zao* 灶 (n=1; Yunnan Kaogu 2014); however, these have been grouped together in Table 12. At Baiyangcun, houses are wattle and daub structures with poles around the foundation perimeter; oval or rectangular pits with irregular openings have been documented around the houses. Chronologically, earlier houses present a groove along the foundation perimeter where poles were placed; later houses have poles dug straight into the ground. Burials are mostly primary inhumation in vertical shaft pits with the deceased placed in extended or flexed supine position, mostly without any funerary object. Urn inhumation of new-borns and infants and a few secondary and multiple burials have also been reported. A peculiar characteristic of Baiyangcun burials is the removal of the skull from some of the secondary interments. Scholars have suggested this custom may be tied with ancestral worship (Zhao, Zhu, Min 2016; Zhang, He 2022).

The ceramics at Baiyangcun are characterised by coarse/sandy pottery (*jiashatao* 夹砂陶) mostly brownish/dark-coloured (*he* 褐), and secondarily greyish or reddish in colour, vessels are produced with the coil technique, and are decorated with the so-called 'incised/impressed' style (*kehuawen* 刻划纹), characterised by geometrical and dotted designs (Rispoli 2007). The ceramic assemblage comprises *guan* 罐 and *gang* 缸 type vessels

17 The first excavation report states: "*Yuanxing jiaoxue ershiwu ge*. [...] *tiantu songruan, neihan huibaise de liangshi fenmo yu daohe, daogan henji* 圆形窖穴二十五个 。 [...] 填土松软，内含灰白色的粮食粉末与稻壳、稻秆痕迹。" (25 round-shaped pits. [...]. Filled soil soft, it contained greyish grain powder and impressions of rice husks and stalks; Yunnan 1981, 352); "(*wu) guwu, guohe baiyangcun yizhi qingli zao, wanqi de jiaoxue sishiba ge, qizhong ershisan ge jiaoxue nei tiantu zhong huibaise de liangshi fenmo yu daoke, daogan henji (dai jianding). T4 chutu guohe yimei, jing zhongguo kexueyuan yichuan yanjiusuo li lu tongzhi jianding ke 'yunnan shan tao' (zhengshi xueming daiding*). （五）谷物、果核 白羊村遗址清理早、晚期的窖穴四十八个，其中二十三个窖穴内填土中灰白色的粮食粉末与稻壳、稻秆痕迹 （待鉴定）。T4出土果核一枚， 经中国科学院遗传研究所李璐同志鉴定可' 云南山桃' （正式学名待定）。" (5-Cereals and Fruits. Among the 48 early and late phase pits excavated at Baiyangcun, the soil of 23 contained greyish grain powder and impressions of rice husks and stalks (awaiting identification). A peach stone was found in Trench no. 4; Li Lu Comrade from the Institute of Genetics, Chinese Academy of Sciences has identified it as 'Yunnan Mountain peach' (scientific name awaiting determination)"; Yunnan 1981, 365).

(Yunnan1981, 362, fig. 16).[18] Guan jars have an ovoid body, restricted neck, and outward protruding lips. Gang jars present a round base, cylindrical body that expands greatly towards the shoulders, and are generally larger in size than *guan* vessels **[fig. 20]**. Guan jars are considered suitable for cooking through boiling, while *gang* jars are often described as used for storing grains. Gang round base suggests that if these were indeed used for storing cereals, they would be partially buried in the ground or be placed on a support. Other ceramic artefacts include typical daily objects that can be used for drinking or eating, such as *bo* 钵 bowls, *pen* 盆 plates/basins, and, in the upper layers, so-called *ye* vessels have also been recovered **[fig. 20]**.

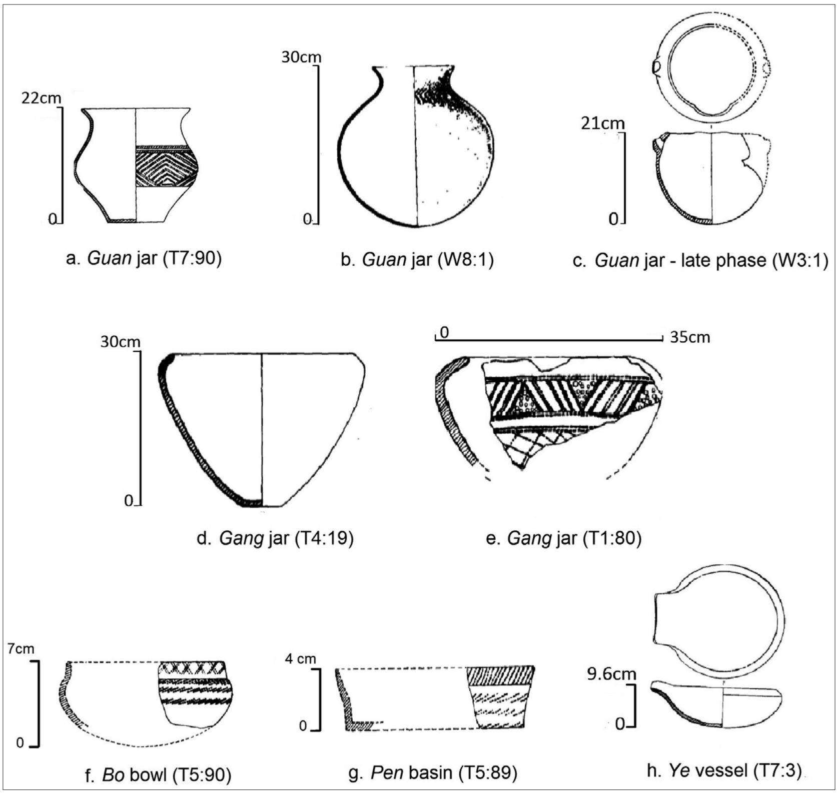

Figure 20 Examples of ceramic vessels from Baiyangcun. Redrawn from Yunnan 1981, adapted from Dal Martello 2020

Ye vessels are shallow dishes with a spout. The 1981 report states that vessels suitable for pouring liquids (identified by having a spout) increase in quantity during the second phase. It is worth noting, however, that vessels at Baiyangcun (and other sites discussed here) are classified based on conventional descriptive categories based on their shape, and no scientific studies have been undertaken so far to confirm their actual use. Of interest is the retrieval of two ceramic 'feet' (*qizu* 器足) from the first phase of occupation. They are made of reddish-coloured coarse pottery, pointy and

18 1 to 7 for *guan*, and 9, 15 for *gang*; some examples have been illustrated in Figure 20.

elongated, undecorated. This indicates that some vessels at Baiyangcun had feet; however, the fragmentary nature of the remains prevents us from fully understanding the type of vessel to which they were attached. Ground and polished stone tools, including serrated and perforated knives, have been reported through the sequence. Knives recovered at Baiyangcun include both rectangular and half-moon shaped blades. These are usually interpreted as suitable for harvesting cereals, such as rice and millet, at the panicle or slightly lower (see § 2.3.2.2). This would allow the collection of straws too, which may have been used as animal fodder or construction material (Bray 1984, 323-31; Thompson 1996). Their retrieval is seen as evidence of agricultural practices.

Systematic archaeobotanical sampling across the whole stratigraphic sequence and features was undertaken during the 2013 excavation of the site. The study of flotation samples not only confirmed the presence of rice, but also revealed a variety of other species, both domesticated and wild, that were potentially exploited by the Baiyangcun people **[fig. 21]**. These include foxtail and broomcorn millets, soybean, *Vigna* and *Cajanus* legumes, foxnut (*Euryale ferox*), goji berry (*Lycium* sp.), melon (*Cucumis* cf *melo*), chinaberry (*Melia azerdach*), walnut (*Juglans* sp.), hawthorn (*Crataegus* sp.), and wild grape (*Vitis* sp., Dal Martello 2020) **[fig. 21] [tab. 12]**. Peach stones have been reported from the 1981 excavation (see fn. 17); however, systematic flotation revealed no peach remains. A large amount of *Echinochloa* sp. grains have also been reported. Seven *Echinochloa* species are currently documented in Yunnan (Chen, Philipps 2006), including the cultivated *frumentacea* and *esculenta*,[19] all but one presenting a wetland habitat. It is not clear when and how this species was domesticated and used in the past (see § 2.4.2.2); however, *Echinochloa* is also known to be a rather difficult to extirpate irrigated rice field weed. At Baiyangcun, seeds of *Echinochloa* are present in high quantity, but contextual analyses were inconclusive in determining whether they were associated with cereal crops or weed species (Dal Martello 2020). Therefore, it is difficult to establish whether this plant was cultivated on its own or if it became incorporated in the archaeobotanical assemblage by infesting rice fields (and being accidentally collected during harvest). If so, the combined presence of *Echinochloa* and other typically wetland rice weeds, such as *Fimbristylis* sp., *Polygonum persicaria*, and *Schoenoplectus macronatus*, would indicate that rice at Baiyangcun was cultivated in a wet regime (Dal Martello et al. 2018). The presence of both rice and millet, along with the site's location in a valley surrounded by high mountains, suggests that rice was cultivated near the river, likely irrigated by seasonal flooding, while millet was grown on the surrounding slopes. Only 89 wild-type rice spikelet bases have been reported compared to the 1,714 domesticated-type found in the archaeobotanical assemblage. This indicates that rice at Baiyangcun was fully domesticated. Morphometric measurements on rice grains demonstrate a predominance of <2 grain length/width ratio (Dal Martello et al. 2018), which is considered indicative of *japonica* variety, based on established ratio differences between *indica* and *japonica* in previous studies (Castillo et al. 2016; Fuller, Harvey, Qin 2007; Harvey 2007).

19 The two cultivated *Echinochloa* species are known in Chinese as *hunan baizi* 湖南稗子 (*E. frumentacea*), and *zisuibai* 紫穗稗 (*E. esculenta*). In Yunnan, *Echinochloa* is also used to produce a local alcoholic beverage (D.Q. Fuller, pers. comm. 2017).

Figure 21 Ancient seeds from Baiyangcun, 2013 excavation. Black lines indicate 1 mm scale. a. Rice – *Oryza sativa*; b. Rice spikelet bases, domesticated-type; c. Foxtail millet – *Setaria italica*; d. Broomcorn millet – *Panicum miliaceum*; e. *Echinochloa* sp.; f. Foxnut – *Euryale ferox*; g. Soybean – *Glycine max*; h. *Vigna* sp.; i. *Cajanus* sp.; j. Acorn type A; k. Acorn type B; l. Wild grape – *Vitis* sp.; m. Hawthorn – *Crataegus* sp.; n. Possible melon – *Cucumis* sp.; o. *Fimbristylis* sp.; p. *Polygonum persica;* q. *Schoenoplectus macronatus*. © Author, modified from Dal Martello 2020

Of great interest is the retrieval of 'cracked' rice grains **[fig. 22]**. These have been retrieved especially from floor contexts, indicated in the excavation records as *huodongmian* 活动面 (activity floor). *Huodongmian* are most likely house floors for which the perimeter could not be individuated, and therefore archaeobotanical finds from such contexts may be related to cooking activities. According to charring experiments on rice grains, if grains are broken before charring, the fracture surface becomes glossy and bulges after charring (Lian 2015). This is the case for the cracked grains recovered at Baiyangcun, and if confirmed, it would suggest that people were pounding and cracking the grains before cooking them. This is an unusual find and it is currently difficult to determine what types of meals may have been prepared by cracking rice grains. Some charred lumps of organic materials were recovered in the flotation samples; SEM (Scanning

Electron Microscopy) examination established these were not charred food byproducts, but instead they were cracked rice grains agglomerates **[fig. 23]**.

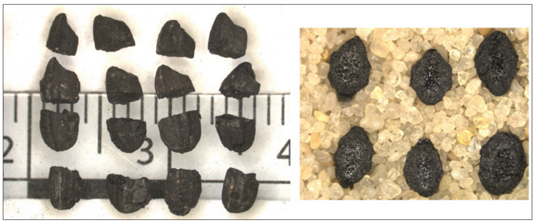

Figure 22
Cracked rice grains at Baiyangcun from context F11. © Author, modified after Dal Martello 2020 figs 5.16-17

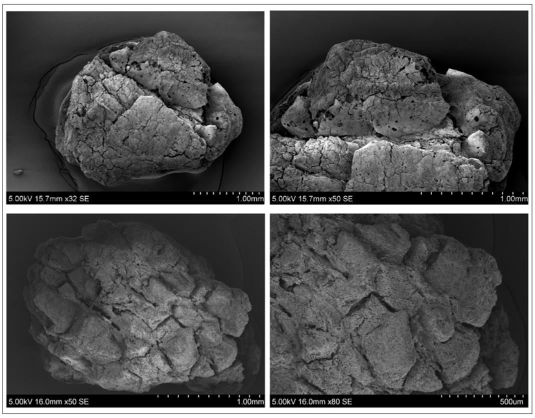

Figure 23
SEM pictures of cracked rice grain lumps from context layer 18; right images show close up of left pictures. © Author, modified after Dal Martello 2020, fig. 5-15

Chronologically, cereals are predominant over all other types of plant species in all three phases of occupation. According to macro-botanical remains, rice and millets constitute the basis of the agricultural system. Rice, although maintaining its overall prominence, decreases in favour of millet in phase II. Legumes, fruits and nuts, although accounting for a small proportion in the overall assemblage, show an increase in the second phase. This may be due to changing climatic conditions across the third to second millennia BCE, especially the drying monsoon. Palaeoenvironmental reconstructions (see Ch. 3) indicate that, at the time of Baiyangcun occupation, precipitation in the area may have been as much as 20% higher than today (est. 680 mm versus present day ca. 565 mm). This would not have been sufficient to support the rainfed cultivation of rice, and the retrieval of typically irrigated rice weed species confirms that rice was cultivated in a wet regime. The drying climate during phase II may have caused uncertain rice harvests and pushed people to increase millet cultivation (Dal Martello et al. 2018).

In addition to archaeobotanical studies, stable isotope analyses have been undertaken on human and animal bone collagen from material derived from the second excavation. The results of the study show that people had a predominantly C_3 diet for all time periods (Ma et al. 2022a). One individual was sampled for phase I (ca. 2750-2350 BCE, $\delta^{13}C$ value −17.8‰) compared to twenty from the 'later phase' (ca. 1750-1250 BCE; $\delta^{13}C$ average value −18.9‰ ± 0.4‰). It is important to note that most of these individuals date to later than the last phase from which we have direct archaeobotanical remains (dating to ca. 2200-1700 BCE; see above), with only one possibly dating to the cusp of the transition from phase III to the 'later phase' (ca. 1740-1630 BCE). Isotopes on two pigs from the later phase showed they predominantly fed on C_3 plants ($\delta^{13}C$ average value –20.4‰). This suggests that both people and domestic animals fed on either rice or local wild resources, assuming a scarcity of natural C_4 plants in the background vegetation. Subtropical and tropical regions today are characterised by C_3 dominant vegetation. However, numerous edible tropical grasses and sedges are C_4, and today Yunnan has a high diversity of C_4 grasses compared to other provinces in China (Zhang A. et al. 2023; Wang 2006), therefore, caution is needed when inferring the specific plants that constituted ancient diets, as many plants other than cereals are edible and have C_3 and C_4 signatures. Authors of the isotope study suggest that millet was not cultivated for food at Baiyangcun, and its presence in the archaeobotanical assemblage may indicate it was used as animal fodder or for ritual purposes. However, this contrasts with the results from the two sampled pigs, which fed on C_3 plants rather than millet – a crop that, if used as animal fodder, would be unlikely to appear charred in the archaeobotanical records alongside rice grains. The macro-botanical evidence from Baiyangcun shows that millet grains are ubiquitous and associated with rice from domestic contexts. This would suggest both crops were seen as food resources. The lack of a C_4 signature in both humans and animals could be due to the fact that most of the sampled individuals date to a later phase for which available macro-botanical remains are available. A phase during which the site may have been used a cemetery only, for people residing elsewhere. Given the uneven sample size, as well as the absence of a baseline for herbivores, needed to understand the background vegetation, it is difficult to fully assess the diet composition of ancient Baiyangcun people and further data is needed to confirm a millet production decline as hypothesised by Ma et al. (2024). Moreover, the one individual sampled for phase I (from which we have direct archaeobotanical remains) may also have been an outsider, or someone belonging to a special group with differing eating habits, which would explain the discrepancies between the macro-botanical and isotope data. In addition to plant cultivation, at Baiyangcun hunting and animal husbandry may have both been practiced, as evidenced by the presence of pigs, cattle, goats/sheep, wild boars, black bears, and deer (Yunnan 1981).

According to a survey carried out after the end of the second excavation, Baiyangcun is estimated to be between 10-20 hectares in size (Min Rui, pers. comm. April 2018). Although there are currently no ancient population estimates for Yunnan, similar studies undertaken at other Neolithic sites in China proposed an estimate of 50/53 people per hectare for rice producing sites (Sun 2013, 563; Liu 2004, 79), and about half for sites based on millet farming (Carlstein 1980; see also Qin, Fuller 2019). If applicable to Yunnan, this estimate would suggest a population of 500-1000 people living at ancient Baiyangcun.

4.3.2 Dadunzi

Dadunzi is located on the northern bank of the Longchuan River, a tributary of the Jinsha River, in Yuanmou county, northwest Yunnan **[fig. 19]**. The site was discovered in 1972 and excavated for a first time across 1972-73, with successive excavations conducted in 1999 and 2010. In 1972, greyish powder and charred rice grains had been reported (Kan 1977).[20] Based on radiocarbon dating on charred seeds retrieved through flotation in 2010, Dadunzi was occupied between 2200-1610 BCE (Li et al. 2016; Jin et al. 2014a; 2014b). According to the report from the first excavation (the only one published so far; Kan 1977), Dadunzi material culture shows strong affinities with that of Baiyangcun. Of the 61 houses uncovered, most are of the wattle and daub type, with a few semi-subterranean and stilt houses. The cemetery included vertical shaft pit burials, urn (for infants), and stone cists burials.[21] The deceased were placed in a variety of positions, including extended, flexed, supine, and prone; about half of the burials had ceramic vessels and other small objects. Dadunzi ceramic vessels are made of coarse pottery, handmade, and decorated with incised/impressed geometric designs. Vessel types include *guan* jars, which are fairly similar to those unearthed at Baiyangcun, and other utilitarian vessels, described in the report as suitable for cooking and eating (e.g., *hu* 壶 flasks, *ping* 瓶 bottles, *bei* 杯 glasses, *bo* bowls). A peculiar shape not encountered at Baiyangcun is the so-called 'ring-foot' (*quanzuqi* 圈足器). This indicates a round and hollow pedestal. Such a pedestal may have been used as a base for other vessels. Of note is the retrieval of a small 'chicken'-shaped ceramic pot (*jixinghu* 鸡形壶) from a burial. This is only 12 cm tall; the vessel is shaped so that the beak of the chicken serves as spout. The surface of the chicken-pot is decorated with incised lines (to resemble feathers?), and three rows of circular studs are placed on the back of the bird; two more studs are placed on the mouth of the vessel, probably to resemble the bird's eyes (Kan 1977, 70). Lithic tools from Dadunzi include half-moon shaped and perforated knives, grinding stones, and other tools suitable for cultivation activities. Three stone stamps show a square grid pattern on one surface; such stamps may have been used to impress the decoration on the pottery vessels; but this hypothesis needs further research. Finally, 69 knives made of freshwater shells have been reported, most are fragmented but two whole ones show small, drilled holes in the middle.

The archaeobotanical samples collected in 2010 revealed an assemblage dominated by cereals, specifically rice and millets (Jin H.T. et al. 2014a; 2014b). Foxtail (n=1136) and broomcorn millet (n=228) grains were much more numerous than rice grains (n=78); however, the samples contained a staggering 3,520 domesticated-type rice spikelet bases. Although rice grains are present in lower quantities than millet, the high presence of rice spikelet bases indicate that rice was locally cultivated. Other edible species include potentially edible *Vigna* and Cucurbitaceae seeds, but these are present in negligible quantities compared to cereal grains (Jin H.T. et al. 2014a; 2014b). Seeds of *Digitaria* sp., *Setaria* sp., *Chenopodium* sp., *Fimbristylis* sp., and

20 The original report states: "*H1 chutu daliang huibaise de hecao lei yezi, guke fenmo, K7 de san ge taoguan nei, jun faxian daliang de dalei tanhua wu. Jing zhongguo kexueyuan zhiwu yanjiusuo jianding, huibaise fen lishu hezhang lei (ru daozi) fenmo. Jing chubu jianding, guan nei de gulei tanhua wu shi jingdao* H1出土大量灰白色的禾草类叶子、谷壳粉末, K7的三个陶罐内, 均发现大量的答类炭化物。经中国科学院植物研究所鉴定, 灰百色粉隶属禾章类(如稻子)粉末。经初步鉴定、罐内的谷类炭化物是粳稻。" (A large quantity of greyish grass powder and leaves was unearthed in H1. Large numbers of charred grains were found inside three ceramic jars recovered in K7. The Institute of Botany of the Chinese Academy of Sciences identified the remains as Poaceae, most likely rice grains of the *japonica* type; Kan 1977, 70-1).

21 Only the total number of excavated graves is reported from the 2010 excavation, and no quantitative information is known on the different types of graves unearthed in this occasion.

Scirpus sp. have also been reported (Jin H.T. et al. 2014a). The presence of both wetland and dryland cultivation weeds suggests that people at Dadunzi were cultivating along a vertical gradient, presumably planting rice in the lowlands close to the river, and moving onto the slopes for millet fields, similar to the mixed farming system attested at Baiyangcun. No systematic zooarchaeological study has been undertaken at Dadunzi yet, but a similar suite of animals to that found at Baiyangcun has been reported, with the addition of lacustrine resources, which may indicate fishing was an important component of the economy.

4.3.3 Xingyi Phases I, II

Xingyi 兴义 is a large shell-midden site located on the shore of Qilu Lake, south from the Dian Lake **[fig. 19]**. Excavations in 2015-16 revealed an over 9 m deep archaeological deposit, and radiocarbon dates individuated three phases of occupation: phase I ca. 5500-3350 BCE; phase II ca. 2950-2350 BCE; phase III ca. 1850-1350 BCE (Ma et al. 2024). No full report has been published yet, but features from phase II include 12 burials, the deceased placed in flexed position, and 3 pits (Yunnan 2017). Xingyi ceramics are decorated with corded patterns (*shengwen* 绳纹), described as Haidong style (see below), and the most prevalent vessel type is the wide-mouthed, high-neck *guan* jar. Corded ware is specific to Neolithic sites located in the Dian Lake Basin during this millennium (Yao 2010). This indicates two different cultural traditions and presumably groups inhabited northwest and central Yunnan at the time, represented in this book by Baiyangcun (and possibly Dadunzi) with incised/impressed ceramics in northwest Yunnan, and Xingyi/Haidong with corded ware in the Central Lakes area of Yunnan. At Xingyi, extremely abundant lacustrine resources have been reported, particularly *Margarya* sp. (a freshwater gastropod), suggesting significant exploitation of the lake during the occupation of the site.

Although archaeobotanical samples were collected from all phases, no seeds were retrieved from the first two phases, possibly due to the poor preservation of organic remains given the shell midden nature of the site (Ma et al. 2024). Archaeologists that excavated the site suggest that the first phase represent the transition from a 'pre-agricultural' to a settled agricultural lifestyle. Stable isotope analysis on human and animal bones was undertaken to investigate Xingyi's people diet. Two individuals were sampled for phase I and showed a predominantly C_3 diet ($\delta^{13}C$ average value –19.2‰), which the authors of the study have interpreted as consistent with wild plants foraging or possibly rice consumption. However, this is based on only two individuals (one adult and one infant), a too small sample size to make broad inferences. Since no archaeobotanical remains were retrieved from this period, the results cannot be correlated with specific evidence that would clarify which species were exploited and whether they were wild or domesticated, collected or cultivated. Given the absence of macro-botanical remains, rice consumption at Xingyi during the earliest phases of occupation remains, as yet, an unproved hypothesis. Wild rice was present throughout this region at the time (see Ch. 3), however, in cases where systematic archaeobotanical studies have been conducted (such as at Baiyangcun, see § 4.3.1), wild rice appears in negligible quantities in the overall archaeobotanical assemblage, possibly indicating that its wild collection was not practiced by local groups, and the C_3 signature detected at Xingyi may refer instead to local wild plants. More evidence, specifically archaeobotanical remains, is needed to clarify this issue.

Fourteen individuals were sampled for phase II. The results show an increase in C_4 plants intake ($\delta^{13}C$ values range from –18.9 to -12.6‰, average value –16.8‰), which the authors of the study interpret as evidence of millet consumption. While direct evidence for millet consumption in the form of charred millet grains is presently missing, the absence of C_4 isotopic signature from the earlier period would support such an interpretation. Data on ancient herbivores at the site indicate a low natural presence of C_4 plants in the background vegetation of Qilu Lake at the time of Xingyi's occupation (Ma et al. 2024, 108).[22] However, given the lack of macro-botanical remains, it is difficult to fully establish what plant resources were consumed by Xingyi's inhabitants, and whether isotope differences indeed relate to a change in subsistence from rice (or rather other local wild resources; see above) in phase I to millet in phase II, as suggested by Ma and colleagues (Ma et al. 2024). It is also worth noting that several shellfish species have a C_4 signature, which could skew the isotope data. More data is needed to clarify the diet composition of the early occupation of Xingyi.

4.3.4 Other Third Millennium BCE sites

In a summary about agricultural dispersal to South China by Zhang and Hung (2010) (handpicked) rice remains from Haidong 海东, a shell midden site located not far from Xingyi **[fig. 19]**, were described as the earliest attested at the time in Yunnan (Zhang, Hung 2010, 15).[23] Human bones from the site were directly dated to ca. 3090-2200 BCE (Yuan et al. 1994). Excavated features include 30 burials, which were mostly shaft pits with the deceased placed in a flexed position. Ceramics from Haidong are characterised by cord-impressed decoration (He 1990, Yao 2010). The same type of ceramic remains have been reported from third millennium BCE layers at Xingyi. A tortoise shell and high quantities of lacustrine mollusc shells were also found at Haidong **[tab. 12]**. However, both the original report on Haidong's discovery (He 1990), and the article cited by Zhang and Hung (Xiao 2001) do not mention rice grains from the site. An article about early agriculture in Yunnan authored by A. Yao (2010) and summarising plant remains from sites in Yunnan does not list Haidong among the sites with rice remains. At present the presence of rice at Haidong is unclear but given the great similarity and proximity of Haidong to Xingyi, we may assume that people at Haidong had access to similar wild plant resources as those attested from Xingyi, but this needs to be confirmed with future flotation studies.

In 1993, charred rice grains were found at the bottom of an ancient ditch (G3) at Xinguang, a site located in the upper Mekong Basin, in northwest

22 The reconstruction of a C_3 based background vegetation is based the C_3 predominant diet of herbivores from the site (attested with stable isotopes studies). This contrasts with other studies (e.g., Zhang et al. 2023; Wang 2006) which instead reconstruct a high diversity of C_4 grasses in Yunnan compared to other provinces in China.

23 Zhang and Hung state that "in Yunnan, the earliest rice remains belong to the Shizhaishan Neolithic phase in the Lake Dian region, dated to 3100-2450 cal BC at Haidong" (Zhang, Hung 2010, 15).

Yunnan **[fig. 19]**.[24] The site was occupied between, ca. 2620-1780 BCE (Yunnan 2002). Features unearthed include 4 wattle and daub houses, 2 semi-subterranean houses, 21 irregularly shaped pits, and 3 ditches. The ceramic assemblage from Xinguang is vastly similar to that from Baiyangcun. Ceramic pots at Xinguang are handmade with coarse pottery, have a greyish-coloured surface, and are decorated with incised/impressed geometric designs. At Xinguang, the most prevalent vessels are *guan* jars with flat bases, round bellies, and outward protruding lips. The report states that ceramic sherds from the lowest levels show occasional traces of red paint. Lithic implements perforated knives, and grinding stones (Yunnan 2002). Preliminary data from Xinguang suggest its inhabitants were sedentary agriculturalists cultivating rice. Yao (2010) lists rice, millet and wheat at Xinguang, but the original excavation reports do not mention millet and wheat. Therefore, the presence of these two cereals needs to be confirmed with future studies.

4.4 The First Bronze Implements and the Arrival of Wheat and Barley

4.4.1 Haimenkou Phases I, II

Haimenkou is located in the Jinsha Basin, in Jianchuan county, northwest Yunnan. The site was excavated in 1957, in 1978, and in 2007-8, when archaeobotanical samples were collected. At present, the site is still undergoing excavation as part of Sichuan University Archaeology Field School Program (J.X. Song, pers. comm., 2023). It is estimated to be as large as 5 to 10 hectares (Min 2009a; 2009b). Extensive radiocarbon dating on charred seeds in conjunction with changes in material culture identified three phases of occupation: phase I (Neolithic) ca. 1600-1450 BCE, phase II (Neolithic/Bronze Age Transition) ca. 1450-1100 BCE, phase III (Bronze Age) ca. 800-400 BCE (Li, Min 2014). Metal objects were found in layers from phases II and III, and these are the earliest metal artefacts recovered in Yunnan today. After the site was abandoned, it was submerged and preserved by waterlogging. This resulted in excellent preservation of organic remains, including whole wooden poles and hundred thousand of plant remains (see below). Due to this unparalleled preservation, Haimenkou was included in the *Year 2008 10 Best Archaeological Discoveries of China* (2008 *Nian Quanguo Shida Kaogu Xin Faxian* 2008 年度全国十大考古新发现; PKU 2009).

Features unearthed at Haimenkou include an unspecified number of rectilinear pile dwellings, or elevated wattle and daub houses (Min 2009a; 2009b). Ceramic tiles have been reported. The wooden poles increase significantly in number in the second phase, indicating an expansion of

24 "G3 *dibu caji daode tanhuadao biaoben, jing yunnansheng nongkeyuan cheng kansheng jiaoshou jianding shi daogu lei. You jing jiangsusheng nongye kexueyuan zhang linghua tongzhi jianding, renwei 'cong zhiwu danbaishi de xingzhuang laikan, yingdang shi gengxing dao'*" "*G3*底部采集到的碳化稻标本，经云南省农科院程侃声教授鉴定是稻谷类。又经江苏省农业科学院张陵华同志鉴定，认为 '从植物蛋白石的形状来看，应当是粳型稻'" (Charred rice specimens were collected from the lower layer of G3, Prof. Cheng Kansheng from the Yunnan Academy of Agricultural Sciences identified it as ancient rice. Further identification by Comrade Zhang Linghua of the Jiangsu Academy of Agricultural Sciences stated "from the perspective of the phytolith morphology, it should be *japonica* type rice"; Yunnan 2002, 226).

the settlement. Phase I ceramics were handmade with mostly incised/impressed geometric decorations. The majority had a coarse pottery of greyish/dark surface colour, with some vessels having fine polished black pottery. Generally speaking, vessels appeared fired at high temperature. The most common vessel type are *guan* jars; however, these are rather small in size, and many are fragmented and lack the bottom section **[fig. 24]**. In phase I, several ring-foot pedestals (similar to those found at Dadunzi) have been reported, but they disappear in phase II (Yunnan, Dali 2009; Min 2009b). During phase II, red-coloured surface vessels and painted ceramics appear, high-neck and double-handled *guan* jars increase, and some vessels are made of fine pottery (*nizhitao* 泥质陶), but these are always minor compared to those made of coarse pottery. The Haimenkou ceramic vessels were decorated with incised/impressed triangles, zigzags, lozenges and other simple geometrical elements that show affinities with ceramic decoration traditions from third millennium BCE Northwest China (mostly referring here to Gansu and Qinghai provinces, Xiao 1995). High-neck and double-handled *guan* jars are considered diagnostic of Northwest China Neolithic Cultures (those from Gansu and Qinghai), and their increase at Haimenkou is seen as evidence of cultural connections, through either trade or migrations of Neolithic populations from that region (see below; Wang 2018). Pottery fishnet weights have been reported, and this may indicate that fishing had a role in the overall economy. Tools from Haimenkou include perforated stone knives and other stone implements that may be associated with agricultural or deforestation activities. The overall number of stone tools rises considerably in phase II, which has been correlated with increased deforestation, as indicated by the greater number of wooden beams in this phase. Metal objects were reported from the first two excavation seasons, but no stratigraphic information was provided. According to the 2007-8 campaign, copper/bronze and iron objects were recovered from layer 6 (see Li, Min 2014 for composition analyses of metal artefacts unearthed at Haimenkou, and Liu et al. 2021b for a more recent analysis and dating of the objects). Metal artefacts form Haimenkou are small tools, such as knives, chisels, awls, sickles **[fig. 25]**. A small bell (3.8 cm long and 2.6 cm wide) and three bracelets are the only non-utilitarian metal objects reported so far from Haimenkou. The bell has a simple cylindrical shape with a round hook at the top; two circular holes at the top and a larger eight-shape hole are present on one side of the bell (Min 2009b) . In addition to metal artefacts, stone casting moulds for producing metal hatchets have been retrieved **[fig. 25]**, and this indicates that the metal objects were manufactured locally (Xiao 1995).

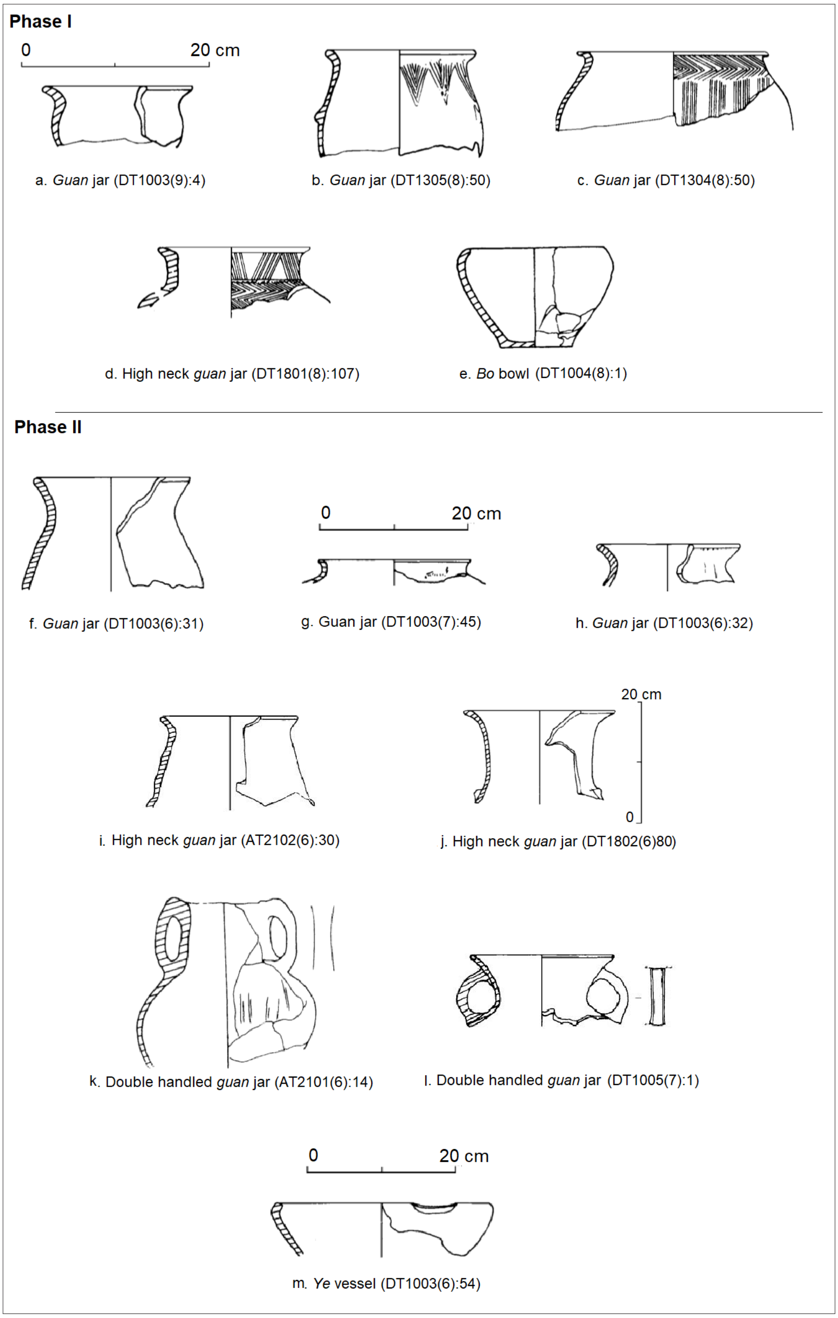

Figure 24 Examples of ceramic vessels from Haimenkou. Phase I indicates objects from layers 10-8; Phase II indicates objects from layers 7-6. Redrawn from Yunnan et al. 2009, modified from Dal Martello 2020

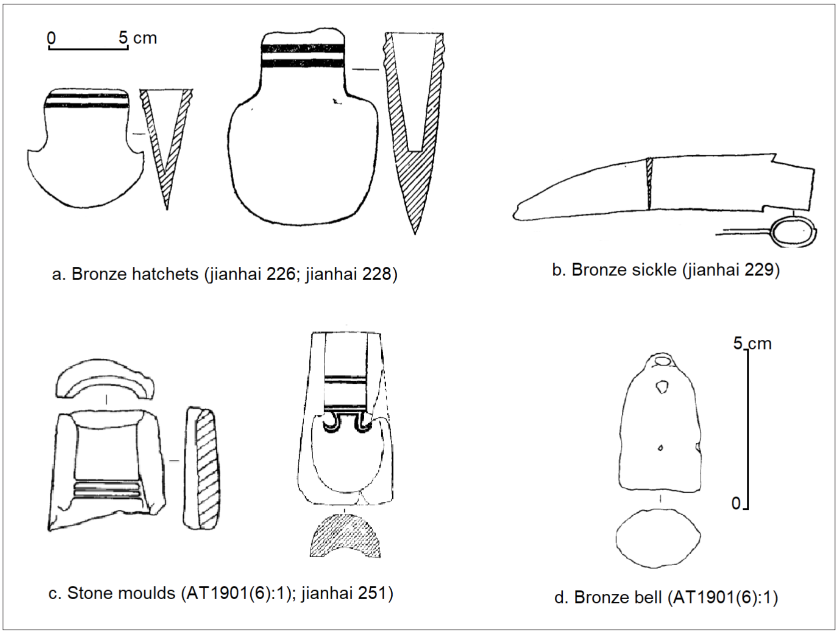

Figure 25 Examples of bronze and stone artefacts from Haimenkou. a.-c. redrawn from Xiao 1995; d. redrawn from Yunnan et al. 2009; modified from Dal Martello 2020

The archaeobotanical remains from Haimenkou have an unparalleled level of preservation, with over 117,000 individual plant remains retrieved (Xue et al. 2022). In phase I, cereals include rice and (foxtail) millet. In phase II, low numbers of seeds of wheat (*Triticum aestivum*) and barley (*Hordeum vulgare*) have been reported **[fig. 26]**. Wheat seeds have been directly dated to ca. 1500-1400 BCE,[25] at present, this is the earliest report of wheat in Yunnan. Barley seeds are present in much lower quantities compared to wheat grains (Xue et al. 2022). One seed of buckwheat (*Fagopyrum* cf *esculentum*) has been reported from each phase. Other species that may have been exploited for food include *Chenopodium album*, soybean, peach and apricot (*Prunus persica*, *P. armeniaca*), foxnut, wild grape, and possible raspberry (*Rubus* sp.). *Chenopodium* seeds were found in high concentrations in cereal-rich samples; the quantity of *Chenopodium* seeds exceeded that of any other species in some of the samples (Xue et al. 2022; Dal Martello 2020). This suggests that *Chenopodium* was exploited, possibly as food (Xue et al. 2022). Finally, *Cannabis sativa* – probable hemp seeds were found. Comparative morphometric studies on modern and archaeological cannabis seeds indicate that at Haimenkou this plant may have been cultivated either for psychoactive purposes and for oil/fibre or possibly both (Dal Martello et al. 2023b). Over 700 seeds of cannabis have been found in one sample, suggesting this crop was stored individually. This further supports the exploitation of this plant for human use. A textile fragment and a rope bundle

25 Although 11 wheat grains were found in samples from phase I layers, direct radiocarbon dating furnished a date congruent with phase II, indicating those 11 grains were intrusive (Xue et al. 2022).

have been reported from the 2007-08 excavation; however, the fibres have not been identified (Xue et al. 2022).

In addition to charred remains, waterlogged plant seeds have also been retrieved from layer 6 upward. These are believed to derive from the rising of the ancient underground water levels, which sealed the site underwater and allow the excellent preservation of organic remains seen at the site. Waterlogged remains include mostly seeds of wild aquatic species such as *Butomus* sp., *Najas* sp., and *Ranunculus* ssp. It has been inferred that waterlogged remains relate to post-depositional processes, and as such they have been excluded from quantitative analyses in previous studies (Xue et al. 2022).

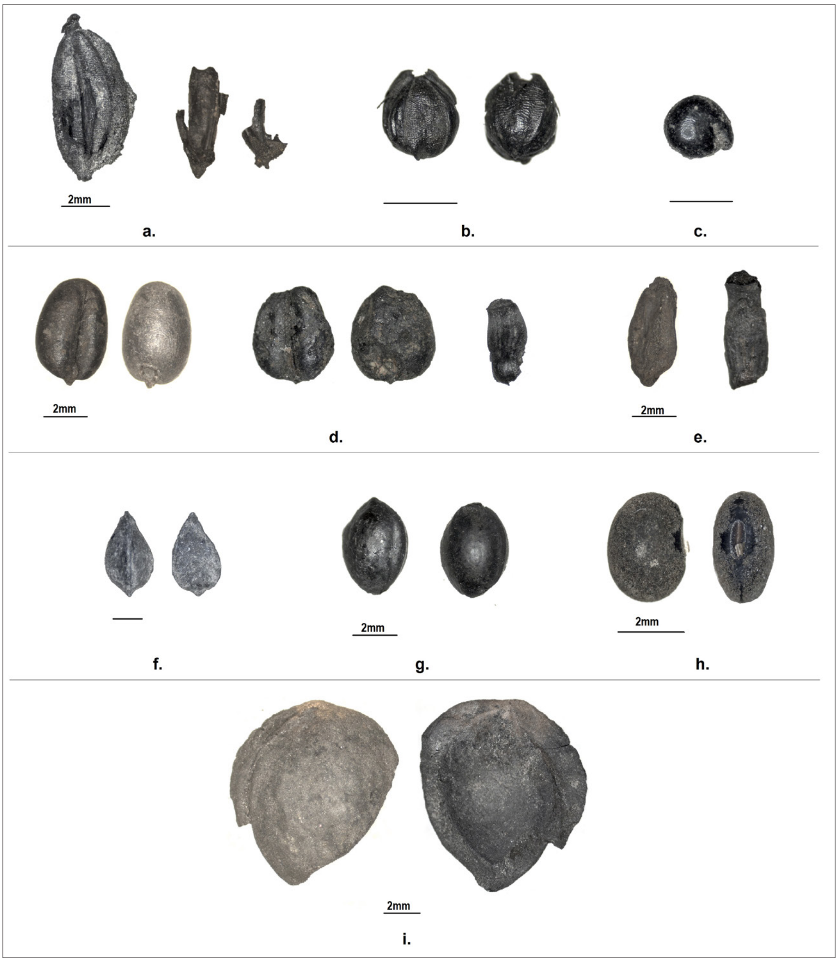

Figure 26 Ancient seeds from Haimenkou, 2008 excavation. Black lines indicate 1 mm scale. a. Rice – *Oryza sativa* and spikelet bases; b. foxtail millet – *Setaria italica*; c. *Chenopodium* sp.; d. Wheat – *Triticum aestivum* grain and rachis; e. barley – *Hordeum vulgare* grain and rachis; f. Buckwheat – *Fagopyrum* cf *esculentum* grain; g. *Cannabis* sp. grain; h. Soybean – *Glycine* cf *max* grain; i. *Prunus* sp. © Author, modified from Dal Martello 2020

A systematic study on the faunal remains collected during the 2007-08 excavation reported the presence of both domesticated and wild taxa, including pigs (*Sus domesticus,* the most prevalent species), goat/sheep (*Ovis/*

Capra sp.), dogs (*Canis familiaris*), and potentially gaurs (*Bos gaurus*), which may have been under human management (Wang 2018). Today gaurs are found confined to southern Yunnan, and gayal (*Bos frontalis*, domesticated gaur) is sporadically attested in Northeast India and Myanmar.[26] Gaur's presence at second millennium BCE northwest Yunnan indicates their distribution in the past was much more widespread than it is today. This may provide clues for understanding their domestication. Another interesting feature of the animal assemblage is an increase in goat/sheep remains in phase II.

The appearance of wheat and barley, the expansion of the settlement, the increase in sheep/goat remains, along with rise artefacts associated with Neolithic Northwest China (Gansu/Qinghai) at Haimenkou from ca. 1400 BCE have been taken as evidence of strong cultural connections or even migrations of Majiayao populations from the north (see below).

4.4.2 Xingyi Phase III

Phase III of Xingyi has been radiocarbon dated to ca. 1750-1250 BCE (Ma et al. 2024). Features unearthed from phase III include 47 floors, 18 houses, 24 burials, 16 pits, 4 streets, two ditches, and one walled structure (Yunnan 2017). The most prevalent vessels in the ceramic assemblage are flared rim *guan* jars and spouted vessels. These have a greyish-coloured surface; only the top section of the pots is decorated in what is described as Xingyi style. Foot-ring ceramic supports, bronze objects, and moulds were also unearthed. Among the lithic implements, knives and grindstones are reported, but no further details about the objects have been published (Yunnan 2017).

Both archaeobotanical and isotope studies are available from this time. Macro-botanical remains include seeds of foxtail and broomcorn millets, rice, wheat, one buckwheat seed, soybean, and *Perilla frutescens* seeds (Ma et al. 2024). Although acorns were not retrieved in the archaeobotanical samples, acorn presence is mentioned in the preliminary excavation report (Yunnan 2017); at present it is unclear which phase acorns belong to. Analyses on carbon isotope from human bone collagen show the widest range compared to the previous two periods ($\delta^{13}C$ values comprised between –18.9‰ and –12.6‰; average value –15.9‰). However, this is based on 12 samples, all from infants. Sampled pigs show a C_4 rich diet ($\delta^{13}C$ range from –18.3‰ to –13.5‰; Ma et al. 2024). This wide range possibly indicates a mixed C_3/C_4 diet; this is corroborated by the presence of rice, wheat and millet in the macro-botanical assemblage. The authors of the isotope study suggest that compared to phases I and II, inhabitants of Xingyi in phase III practiced "a more integrated plant and animal agriculture" (Ma et al. 2024, 111). While an agriculture subsistence is well supported for phase III – through both macro-botanical and isotope data – the absence of macro-botanical data for the first two phases, along with the small sample size for phase I, means that evidence for farming prior to phase III is currently lacking. Therefore, at present caution is warranted in inferring an agricultural subsistence for the earlier phases, and further data is needed to explore this issue.

26 Simoons, Simoons 1968; Shaller 1967; Larson, Fuller 2014; Murphy, Fuller 2018.

4.4.3 Other Second Millennium BCE Sites

Other sites for which we have information, either macro-botanical remains or data from stable isotopes, are Mopandi and Mopanshan 磨盘山 in the wider Jinsha River Basin; Toujushan on the shores of Xingyun Lake, in central Yunnan;[27] Yingpanshan, Shifodong, and Nanbiqiao in the middle-lower Mekong River Basin, and Dayingdong 大阴洞, in southeastern Yunnan close to Guizhou Province **[fig. 19] [tab. 12]**.

Mopandi was excavated in 2001; one context was floated after excavation, providing evidence for rice at the site (Zhao 2003a). Mopandi is a settlement site with wattle and daub structures similar to those found across northwest Yunnan in this period. Ceramic vessels are handmade with reddish, coarse pottery. The most prevalent vessel type are *guan* jars with outward protruding lips and flat bases. Some pots are decorated with incised/impressed geometric designs. Although no systematic study has been undertaken on the animal species, pig, cattle, and sheep/goat bones were reportedly found at the site. A section of the cemetery was also excavated, this was located on the slopes, although the skeletal remains were not well preserved. Mopanshan is only 3 km from Dadunzi; it was excavated in 2012-13, and at present only preliminary reports have been published. According to these reports, Mopanshan is a settlement characterised by semi-subterranean and stilt houses, vertical shaft pits and stone cists burials. These varieties in house and burial structures may indicate different phases of occupation, or diversified customs within the people living at the site. Preliminary archaeobotanical analysis attests the presence of acorns, millets, and rice. The presence of pig bones further suggests a settled agricultural lifestyle. Both Mopandi and Mopanshan sites have been dated by association to the second half of the second millennium BCE.

Yingpanshan is located in the middle Mekong Basin; it was excavated in 1990, and it was reported that a 8 to 10 cm thick layer (estimated to weigh 7,000 g) of charred rice grains was found clustered on a corner of a semi-subterranean house, under which there were fragments of a (storage) basket (Xiang et al. 2015, 41). No further information is available about the site.

Shifodong is a cave-site located in the middle Mekong Basin, further south from Yingpanshan and close to the Myanmar border **[fig. 19]**. Shifodong was excavated in 1982 and in 2003, when several hearth-like features were found inside the cave. Archaeologists working at the site inferred that the hearth structures may indicate a division of the internal space for specialised use (Liu, Dai 2008). One context was floated after excavation and the extracted material sent for identification to Prof. Zhao Zhijun (Istitute of Archaeology, Chinese Academy of Social Sciences). The retrieved macro-botanical remains comprised of rice grains, a great quantity of rice husks, few foxtail and broomcorn millets grains, *Chenopodium* sp. grains, seeds of possible cf. *Tamarindus indica* (Dal Martello 2020, albeit this have been identified

27 The exact location of Toujushan is unknown since the original report did not contain a map and did not provide further information beyond its location in the surrounding of the Xingyun Lake; for this reason, the site has not been included in Figure 19.

via photographs only and needs future confirmation)[28] **[fig. 27]** and another unidentified tree legume, and some possible fruit stones (Zhao 2010b). The ceramic assemblage at Shifodong is characterised by a large quantity of *fu* 釜 cauldrons (these are large vessels with unrestricted openings, usually a flat base, and wide shoulders. *Fu* cauldrons are considered suitable for cooking), *guan* jars, *bo* bowls, *bei* drinking cups, and *pen* plates/basins. Ceramic vessels at Shifodong are decorated both with incised/impressed and corded designs. Incised/impressed decorations show a strong resemblance with earlier Yunnan incised/impressed pottery style, as well as contemporaneous Southeast Asian ceramics (see Ch. 5); however, no in-depth report on the objects unearthed at Shifodong has been published yet (Kan 1983; Liu, Dai 2008).

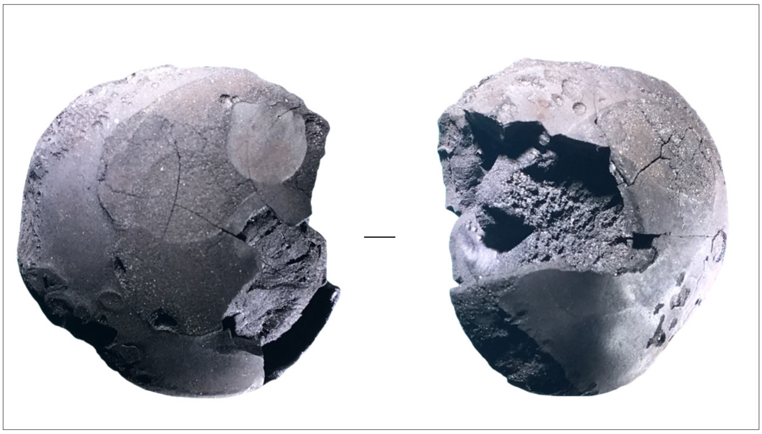

Figure 27 Seed of possible tamarind (cf. *Tamarindus indica*) from Shifodong. Seed stored at the Archaeobotany Laboratory at the Institute of Archaeology, Chinese Academy of Social Sciences. © Author, modified after Dal Martello 2020, fig. 8-4

Nanbiqiao is a cave site located close to Shifodong with which it shares similarities in material culture (Yao 2010). Charred rice grains were reported during its excavation in 1982, but no further information is available.

Finally, Dayingdong is a cave site in southeastern Yunnan, which was excavated in 2017-18 (Yunnan Kaogu 2018). Inside the cave the archaeologists found 12 pits, and 17 burials. Burials included both primary and secondary interments, and the deceased were placed both in flexed and extended positions. According to radiocarbon dating on human bones, the site was occupied in the second half of the second millennium BCE. Charred rice grains have been reported, and isotope analyses on human bones evidenced a predominantly C_3 diet ($\delta^{13}C$ range from –20.2‰ to –17.5‰; Zhao et al. 2022; Zhang Y. et al. 2024).

28 The retrieval of seeds of possible tamarind is interesting as this species was thought to be native to Africa and only recently introduced to India. Recent archaeological work in India has found possible tamarind wood remains (dating to ca. 1300 BCE at Narhan in the middle Ganges), this, together with with linguistic data, indicate a much earlier spread (Asouti, Fuller 2008; Fuller 2007). However, there are also a variety of local tree legume species which may produce similar seeds (i.e., *Parkia* ssp. present in Yunnan, and *Dialium indum* present in broader Southeast Asia), therefore tamarind presence in Yunnan needs to be confirmed.

4.5 Archaeobotany of the Dian Kingdom

The number of sites with evidence for plant remains dating to the first millennium BCE is higher compared to the previous two millennia, most of which cluster in the Central Lakes region and are culturally connected with the Dian Kingdom (see below). There may be several reasons for this increase in the number of sites, one being that the area around the Dian Lake and Kunming, the capital city of Yunnan, has seen more infrastructural development in the last decades compared to other areas of the province, leading to a greater number of archaeological sites being investigated. Another reason being the recent academic focus on understanding the Dian Kingdom through systematic surveys of the Dian Basin, which led to the individuation (and subsequent excavation) of sites relating to this period. Finally, given that these sites have been excavated within the last 15 years, thus after the introduction of mandatory archaeobotanical sampling and analysis (see § 1.2.3.2), this results in a greater number of sites with systematic archaeobotanical studies and radiocarbon dating compared to the previous two millennia.

Archaeological sites dating to the first millennium BCE from the Dian and Central Lakes basins belong to the Dian 滇 Culture (previously known as Shizhaishan Culture or Shizhaishan Culture Complex), today also referred to as the Dian Kingdom. The Dian Culture was discovered in 1955 with the excavation of the Shizhaishan cemetery. Here, in grave M6, a gold seal bearing the inscription 'Seal of the King of Dian' (*Dianwang zhi Yin* 滇王之印) was buried together with cowrie shell containers and 166 small jade plaques, interpreted by local archaeologists as intended for making a funerary suit (Allard 1999, 79). Based on this find, scholars have identified the Shizhaishan people with 'the southwestern Barbarians', which were described by Sima Qian in Chapter 116 *Xinan Yi Liezhuan* 西南夷列傳 (The Southwestern Barbarians) of the the *Shiji* (Watson 1971). According to Sima Qian, the southwestern barbarians were sedentary agriculturalists cultivating rice. He also stated that Zhuang Qiao 莊蹻, a general from the Chu State, fought the Dian in 279 BCE and upon his return home was blocked by the Qin armies and thus went back to Yunnan, adopted local customs and established himself as King thanks to the strength of his troops (Sun, Xiong 1983, 244). Further accounts tell that in 122 BCE the Dian captured and detained Han envoys who were trying to reach Bactria through India (Allard 1998; 2006). Finally, in 109 BCE, during the reign of Emperor Wudi (*Han Wudi* 漢武帝), Han armies conquered the Dian and established the Yizhou prefecture, ending the Dian reign (see § 4.6; for a summary of textual records referring to the Dian see Allard 1998).

Dian sites cluster around the Dian Basin and the Central Lakes region in eastern Yunnan **[fig. 19]**. West from Kunming, the Dian Lake (*Dianchi* 滇池) is the sixth largest freshwater reservoir of China, with an area of 312 km^2, average depth of 5.7 m, reaching up to 8 m in the deepest point. A few km south from it, smaller lakes constitute the Central Lakes region, which include Fuxian 扶仙, Xingyun 星云 and Qilu 杞麓 lakes. Altogether, these lakes sit right in the middle of the Yungui Plateau, at altitudes ranging between 1,885 and 1,900 m asl. Today this region presents a monsoonal, humid, and subtropical climate, mild weather year-round, and an average annual precipitation of ca. 1,000 mm. This makes the area extremely productive for agriculture and up to four harvests per year are documented, making it among the most productive regions of Yunnan. The main plant species cultivated today include rice, wheat, rapeseed and broadbean (NBS 2024). Climate conditions stabilised to those attested today around the first millennium BCE (see Ch. 3), which means that the Dian Basin has offered conducive conditions to intensive cultivation for well over two thousand years. In addition to this, the Dian Basin is also strategically located at the intersection of the Yangzi, Pearl and Red River basins, providing connection routes in and out of Yunnan, which link Central China with Southeast Asia and beyond. This makes it an important region for understanding the history of long-range connections in broader East Asia.

Recent archaeological work has individuated numerous cemeteries that are culturally associated with the Dian. According to radiocarbon dating, the Dian Culture flourished between the eighth and the first centuries BCE, although archaeological work at the site of Shangxihe 上西河 suggests that the origin of the Dian may extend back in time to the tenth or twelfth century BCE (Yao A. et al. 2020, see below). The Dian Culture is famous for lavish bronze artefacts found in 'elite' burials, namely drums and drum-shaped cowrie shell containers from deposits dating after the sixth century BCE.[29] These are stylistically strikingly different from bronze vessels from both Shang and Zhou dynasty traditions in the Central Plains and the Sanxingdui Culture in Sichuan. The tympanum and sides of the Dian drums, and the top of the cowrie shell containers have elaborated, realistic scenes depicting battles, rituals with music and dance, tribute offerings, and weaving activities (Allard 1998, 334). Some scholars interpret these scenes as the celebration of the deceased life achievements (Yao 2016). It is important to note that the number of 'elite' graves accounts only for a small percentage of all the graves in any given Dian cemetery, for example at Shizhaishan they constitute only 1% of the total excavated graves (although many of the Shizhaishan graves were damaged, either by later graves or illicit digging, Yao 2016). This highlights that the Dian were a strongly hierarchical and stratified society. Other bronze artefacts commonly found in Dian cemeteries include small (animal and human) figurines, armour pieces, weapons, buckles and plaques (some decorated with precious stones), and musical instruments. Metal composition analyses on over 500 bronze artefacts from Dian sites show these were made of tin bronze alloys or pure copper, with very little or no lead present. Manufacturing processes included hot forging for small tools and weapons, casting for elaborated scenes on cowrie shell containers, and tinning and gilding were also sometimes used. Yunnan is rich in geological resources, including copper, gold, lead, silver and tin deposits (Zaw et al. 2014). It is inferred that bronzes recovered from Dian sites were locally produced and a few specialised bronze production sites have been individuated. For example, at Guangfentou 光坟头 there is evidence for smelting, melting and casting bronzes (see below). Metal composition analyses established that artefacts found at the Shizhaishan and Lijiashan 李家山 cemeteries were most likely produced at Guangfentou (Zou et al. 2017). Stable isotope studies on Dian metal artefacts indicate strong consistency among the objects retrieved in the Dian Basin, and this

29 Some scholars individuate in the Dian the origin of Dong Son drums in northern Vietnam (Calo 2014; Han 2004). Beyond Shizhaishan, other Dian cemeteries with the richest graves found so far include third century BCE Lijiashan 李家山 and first century CE Tianzimiao 天子庙 (Yao 2016).

is indicative of short-range metal exchange networks between the sites (Pryce et al. 2022)

Only few settlements have been individuated so far, many of which were investigated between 2008 and 2012 during the joint Sino-American survey of the Dian Basin, known as the Dian Heartland Survey Project, led by the Yunnan Provincial Institute of Cultural Relics and Archaeology, and the Department of Anthropology at the University of Toronto. The principal aim of the project was to understand the settlement pattern of the Dian.[30] Two main large settlement sites were investigated, Hebosuo 河泊所 and Xiaogucheng 小古城. Smaller sites located in their surrounding were also surveyed. The majority of the available archaeobotanical data for the Dian Kingdom comes from settlements individuated during these surveys, when flotation samples were taken from exposed profile sections (see below). At these sites, no palaces or defensive structures have been unearthed so far, although material culture points to a great importance of warfare, attested by the prevalence of weapons and warfare scenes. Differently from the bronze artefacts retrieved from cemeteries, metal objects from Dian settlements are usually small utilitarian tools, such as axes, arrowheads, daggers, and personal accessories such as bracelets.

4.5.1 Hebosuo

Hebosuo is a large settlement site located 650 m from the southeastern shore of the Dian Lake, 60 km from Kunming, and only one km south from the important Dian cemetery of Shizhaishan **[fig. 19]**. It is estimated to be 31 hectares in size at its apex and considered the most important among sixteen other settlement sites in the area, all contemporaneous to Hebosuo, which constitute the so-called Hebosuo cluster (Yao A. et al. 2020). Subsequent archaeological surveys recorded at least 34 settlements in the southeastern area of the Dian Basin, with settlements located close to each other at distances ranging between 750 m to 1,000 m (Yao et al. 2020). Archaeologists excavating the site hypothesise that people buried at Shizhaishan cemetery may have lived at Hebosuo. According to radiocarbon dating, Hebosuo was occupied continuously from the ninth century BCE until a few centuries after the Han conquest of the Dian (see below). The site was excavated in 2014, in 2016-17, and in 2021-22. Dian features unearthed at Hebosuo include semi-subterranean houses or possibly pile-dwellings (see below), 18 vertical shaft pit burials, and 13 urn burials. Grave goods include numerous small bronze artefacts, such as arrowheads, rings, bracelets, and belt hooks. The ceramic assemblage is mostly comprised of undecorated *guan* jars and *pen* basins; some vessels have simple impressed/incised geometric decorations. Of interest is the retrieval of ceramic fishing net weights, indicating fishing was practiced by the Hebosuo people.

Preliminary archaeobotanical samples collected during the 2012 survey attested the presence of uncharred plant remains from stratified cultural layers at the site (Yao, Jiang 2012). Plants retrieved in that occasion include *Potamogeton*, *Najas*, Characeae, Cyperaceae, *Myriophyllum*, *Rumex* and *Juncus* species, which are indicative of a possible marshy environment. This

30 Yao, Jiang 2012: Yunnan Meiguo 2012; Yunnan, Meiguo, Meiguo 2014; Yao et al. 2015.

led scholars to hypothesise that houses were pile-dwelling structures, similar to those depicted in Dian bronze artefacts (Yao, Jiang 2012). Systematic archaeobotanical samples collected during subsequent excavations revealed an agricultural assemblage dominated by rice, followed by wheat and millets during the Dian period. Other cultivated resources include buckwheat, Sichuan pepper (*Zanthoxylum bungeatum*), and possibly managed cherry fruit (*Cerasus* sp.), which was among the 8 retrieved waterlogged remains from this period (Yang et al. 2023; Yang 2016). An interesting feature of the archaeobotanical assemblage from Hebosuo is the high quantity of charred charcoal fragments, which are positively correlated with charred seed presence. This may suggest that seeds entered the archaeological record most likely by people routinely burning their domestic waste, such as food left-over or crop processing byproducts (Yang et al. 2023). The most prevalent species of agricultural weeds retrieved in the Dian samples include *Polygonum lapathifolium* (syn. *Persicaria lapathifolium*), which is known today to infest rice or other irrigated crop fields but also surviving some dry periods, therefore, we cannot infer the extent or presence of rice irrigation practices at Hebosuo.

4.5.2 Dayingzhuang

Dayingzhuang 大营庄 is a shell mound settlement site located 13 km from the northwestern shore of Lake Dian **[fig. 19]**. It was excavated in 2017 due to the imminent construction of a tobacco factory. Radiocarbon dating on charred seeds show that Dayingzhuang was occupied between ca. 780-390 BCE (Dal Martello, Li, Fuller 2021). Features unearthed at Dayingzhuang include 35 pits, 4 houses, 2 living floors, 1 hearth, and 5 wall foundations. Of note, 5 paleochannel deposits (*hedao* 河道) were individuated, and these have been identified as the ancient vestiges of modern Tanglang 螳螂 River, which today flows just a few km west from the site and stabilised its course around Han times (Li X.R., pers. comm. April 2018). The Tanglang flows into the Jinsha River and connects the Dian Basin to northwest Yunnan. It is believed that Dayingzhuang was a connection hub between the two regions.

Two type of house structures have been attested at Dayingzhuan; pavilion-like structures in the lowest levels, and wattle and daub in the upper levels. Ceramics from Dayingzhuang include utilitarian shapes such as *fu* caludrons, *bo* bowls, *pen* plates, and *guan* jars. These were made of coarse, reddish or greyish pottery, and decorated with simple incised, comb or corded patterns. The lithic artefacts retrieved include axes, adzes, grindstones, and other daily objects. Although metal slags have been found at Dayingzhuang, only a small number of metal objects were retrieved during excavation, these included a dagger and a bracelet.

The organic remains preservation at the site was rather poor. Charred remains of cereal retrieved include wheat, rice, millets and barley. Wheat and rice are the two prevalent species, with a higher quantity of seeds found compared to other cereals. Among the two, wheat was present in higher numbers than rice, but rice was more ubiquitous across the samples. The bulk of wheat grains derives from one individual context: *hedao* 1, where over 300 charred wheat grains have been found (Dal Martello, Li, Fuller 2021). In addition to cereals, soybean, possible Sichuan pepper, chestnut – *Castanea* sp., foxnut, and other unidentified acorns have been found in the archaeobotanical assemblage. This indicates people at Dayingzhuang relied both on the cultivation of domesticated crops and the collection of local wild resources. Seeds of field weeds are not numerous. Typical dryland species, which may be associated either with millet or wheat cultivation, include *Chenopodium* sp., *Pennisetum* sp., and *Vicia* sp.; along with typical wetland species, which may be associated to rice paddies, such as *Alisma* sp. and *Schoenoplectus* sp. (Dal Martello, Li, Fuller 2021). In addition to macro-botanical studies, phytoliths covering the whole stratigraphic sequence were collected to investigate the cultivation ecology of the crops grown at Dayingzhuang. Results from the phytoliths analysis showed that the area around Dayingzhuang was heavily deforested by the time the site was occupied. Phytoliths also indicated a shift from a dry to a wet environment at the end of the occupation sequence; however, since phytolith samples were not crop dominant, it was not possible to determine whether this shift was due to a change in crop irrigation practices or more broadly to environmental fluctuations. Regardless of the issue of irrigation, the archaeobotanical assemblage from Dayingzhuang illustrates a dualistic nature of the agricultural system at the site. At the time of the occupation, the climate and environment were similar to those of today. It is thus hypothesised that year-round cultivation of winter wheat and summer rice and/or millet would have already been feasible. Given the proximity of different vertical zones, it seems plausible that the people at Dayingzhuang were cultivating rice near the lake and moved to higher elevations to grow dryland crops. In doing so, the inhabitants of Dayingzhuang would have maximised their available resources, potentially intensifying agricultural production through year-round cultivation (Dal Martello, Li, Fuller 20021). Beyond plants, pigs, cattle, horses, deer, fish bones, and a thick deposit of *Margarya melanioides* shells, indicate that people most likely raised domesticated animals and exploited the nearby lake resources (Li X.R. pers. comm. April 2018).

4.5.3 Xueshan

Xueshan 学山 is situated on the shores of Fuxian Lake, ca. 60 km south of Kunming city **[fig. 19]**. It was excavated in 2006, 2009, and 2010-11, and the site has been dated by cultural association to the Dian Culture (Yunnan Kaogu 2011). 29 houses were excavated during the last excavation season. These are mostly semi-subterranean structures and have been classified according to their size into large (30 m^2) and small houses (10 m^2; Yunnan Kaogu 2011). The houses were orderly built along roads (Wang T. et al. 2022). A small bronze arrowhead was found inside a house. The ceramic assemblage from Xueshan is characterised by *guan* jars, *pen* basins, and *fu* cauldrons. The vessels are made of coarse pottery of reddish (*pen* basins) and greyish (*guan* jars and *fu* cauldrons) colour, all decorated with simple geometric designs. Of note is the retrieval of several *zhan* 盏 bowls; these are small, shallow and mostly undecorated vessels described as tempered with rice remains (Wu, Jiang, Feng 2010). At Xueshan, several ceramic ‘feet’ were reported, but these are too fragmented to reconstruct the vessel type they represent.

Archaeobotanical samples collected in 2011 showed a cereal-based assemblage containing, in order of prominence, wheat (n=7,481), rice (n=3,783), and both foxtail (n=209 and broomcorn (n=50) millet grains. Seven grains of barley were also reported. In addition to cereals, other species reported include 149 seeds of buckwheat, 7 seeds of possible Sichuan pepper (reported as *Zanthoxylum* sp.), 63 seeds of soybean, *Vigna* sp. (Wang 2014; Wang Q. et al. 2019). Finally, 16 lentil seeds have also been reported from Xueshan (Wang Q. et al. 2019), referred to as *Lens culinaris* (*bingdou* 兵豆; see Wang 2014, 17, tab. 2.2) in the text, but indicated in Chinese as *bingdoushu* 兵豆属 – which translates to *Lens* sp. – in the photo (Wang 2014, 50 colour plate 2, fig. 2). It is difficult to ascertain a positive identification from the photos. Lentils were domesticated in Southwest Asia (Zohary, Hopf, Weiss 2012), from there the crop spread to South Asia, where lentil seeds are reported from Harappan sites and sites in Uttar Pradesh from the second millennium BCE.[31] At present there are no known reports of ancient lentil seeds in China dating to the first millennium BCE, and although a southern route of dispersal via India is likely (since lentil does not tolerate high altitudes and high latitudes), this may be dated to a later period than the Dian and further research is needed to clarify this question.

Isotope analyses on the dentinal collagen of 19 individuals demonstrated that they had a predominantly C_3 diet ($\delta^{13}C$ values range from –18.9‰ to –17.8‰), except for one individual which showed a mixed C_3/C_4 signature ($\delta^{13}C$ –14.1‰; Wang T. et al. 2022). This means that people at Xueshan likely had a diet based on wheat and rice, which are both C_3 plants. This is in line with the macro-botanical evidence. Starches and phytoliths were also extracted from the dental calculus; the results indicate the presence of rice phytoliths, and Triticaceae, possible millet, rice, buckwheat, and possible yam or other tuber starch grains (Wang T. et al. 2022). However, there is currently a lack of established identification criteria, and some authors raise questions regarding the reliability of these methods to reconstruct past diet due to potential cross-contamination issues.

4.5.4 Guangfentou

Guangfentou is located on the northeast shore of the Xingyun Lake, only 2 km south from Fuxian Lake **[fig. 19]**. It is a shell mound settlement that was discovered in 1984 and excavated in 2011-12. The site has been dated through cultural association to between the Spring and Autumn to Western Han periods (ca. 700-300 BCE). Features unearthed include 26 semi-subterranean houses, 11 living floors, and 30 pits. Metal slags recovered during excavation, along with the site's location at only 3 km from copper mines suggest Guangfentou was a specialised metal production centre. Although no precise workshop area has been individuated during excavation, scholars suggest that smelting was the main activity conducted at the site; refining and casting may also have been undertaken (Zou et al. 2017). Scholars further suggest that metal artefacts from Shizhaishan and Lijiashan graves may have been produced here (Zou et al. 2017). The ceramic assemblage from Guangfentou is characterised by reddish and brown/dark vessels with simple decorations; vessel types include *fu* cauldron, *guan* jars, and *bo* bowls and *pen* plates.

31 Saraswat 1993a; 1993b; Fuller 2003; Pokharia 2008; Kingwell-Banham 2019.

Archaeobotanical samples collected in 2011-12 revealed a mixed agricultural system based on wheat, which was the predominant species among the cereals, rice, and millets; 8 grains of barley were also found. Rice spikelet bases attest to the local cultivation of rice. Numerous seeds of field weeds were reported, including *Digitaria sanguinalis, Setaria virids, Vicia sepium, Fimbristylis dichotoma,* and *Echinochloa crus-galli*; these are in line with the reconstructed mixed farming system (Li, Liu 2016). Among them, 5,301 seeds of *Chenopodium album* were the most abundant across all other plant species retrieved, including cereals (wheat, for example, included 523 whole seeds, and 456 fragmented ones; Li, Liu 2016, tab. 2). Authors of the study categorised the *Chenopodium* as a weed rather than a potential food source, but the staggering amount of seeds may indicate that it was cultivated independently as a crop and exploited as a food resource (Li, Liu 2016). Other potentially edible species include possible Indian strawberry (*Duchesnea indica*), *Perilla frutescens*, and wild jujube *(Ziziphus spinosa*), but these are present in rather low numbers.

Bones of cattle, dogs, pigs, horses, deer and bears, along with a high quantity of freshwater gastropod shells have been included in the preliminary report, but no systematic study on these remains has been conducted yet.

4.5.5 Yubeidi

Yubeidi 玉碑地 is located in the middle Jinsha Basin, in north Yunnan **[fig. 19]**, it was previously referred to as Yingpancun 营盘村, where a layer of carbonised rice grains had been reported during the 1987-88 excavation of the site (Huang 1990). It was excavated in 2013 and dated by cultural association between the Spring and Autumn to the Western Han periods (700-300 BCE; Yang 2016). Features uncovered include 15 semi-subterranean houses, 49 pits, and 6 urn burials. Some of the pits contained large quantities of charred rice; the walls of these pits were plastered in red clay, which may suggest that they were underground storage deposits for cereals. Agathe and turquoise ornaments were interred in some of the graves. Bronze artefacts recovered from Yubeidi are mostly small, utilitarian objects such as arrowheads, needles and fishhooks, knives; some perforated stone knives have also been reported. Due to the numerous metal slags and ore fragments retrieved during excavation, local archaeologists suggest Yubeidi was a metalworking production centre (Jiang, Zhu 2014).

Rice, foxtail millet, and wheat seeds have been recovered through flotation in 2013. However, only 8 grains of wheat have been retrieved compared to the 2,452 rice grains (and 510 rice spikelet bases), and 229 foxtail millet grains. This may indicate that wheat was not an important component of the agricultural system at Yubeidi, but it could also relate to preservation and/or sampling biases. Other edible resources include soybean, Sichuan pepper, possible white (silkworm) mulberry (*Morus alba*), and unidentified fruits and tubers; however, only a few seeds of these other edible species have been reported (Yang 2016; Yang, Jiang, Chen 2020). Based on the 8 *Morus alba* seeds from Yubeidi we cannot conclusively infer silk production; historical sources indicate that sericulture was practiced in Yunnan at least from the Eastern Han Dynasty period (25-220 CE); however, mulberry fruits can also be fermented to produce brews or provide animal fodder; further investigation will clarify its use at Yubeidi (Yang, Jiang, Chen 2020).

4.5.6 Haimenkou Phase III

Archaeobotanical samples from Haimenkou phase III (ca. 800-400 BCE) had a much lower seed density compared to previous periods. This may be attributed to environmental and taphonomic factors. Ceramic vessels from this period have been fired at much lower temperatures compared to the previous two phases. In phase III, ceramics are similar to those attested in phase II (see § 4.4.1), there is an increase in number of red painted double-handled *guan* jars, in addition to the previously attested types (*bo* bowls, *pen* basins, *gang* jars, *fu* cauldrons, *ye* vessels), however, there is a decrease in firing temperature compared to the previous phases (see Min 2009a; 2009b). There are no new species retrieved in the archaeobotanical samples from phase III, but there is a marked increase in dryland crop (wheat and millet), compared to phases I and II. This may indicate a drying of the environment; however, the much poorer preservation conditions of the organic remains from this phase makes it difficult to confirm whether changes in crop abundance relate to dietary shifts or taphonomic factors. A recent genomic study on six individuals from Haimenkou (radiocarbon dated to ca. 1200-900 BCE) has demonstrated close genetic affinity with Late Neolithic agricultural populations from the Upper Yellow River Basin (Tao et al. 2023). According to this study, the six sampled individuals shared 90% of their ancestry with Late Neolithic Yellow River (millet) agriculturalists. This suggests that the expansion of the settlement in phase II, at least in part, may derive from migrating populations from Northwest China (Majiayao, ca. 3000-2000 BCE, distributed in modern Gansu and Qinghai provinces), which themselves originated from the expansion of Late Yangshao millet farmers (ca. 5000-3000 BCE; Tao et al. 2023, 4999). This could also explain the decrease of rice and increase in millet attested in this period. Finally, it may also indicate that the potential route through which agriculture spread to Yunnan followed the eastern Tibetan Plateau rim and was driven by migrating millet farmers that adopted rice during their expansion (Tao et al. 2023, 4999, see Ch. 5).

4.5.7 Shilinggang

Shilingang 石岭岗 is the only site located on the middle Mekong River with archaeobotanical study undertaken for this time period **[fig. 19]**. Direct radiocarbon dating on charred rice grains dated the occupation of the site to between the late eighth and the fourth centuries BCE (Li et al. 2016). No excavation report has been published yet but information on past subsistence is derived from flotation and isotope studies. Archaeobotanical samples were not rich in plant remains. Crops include rice, foxtail millet, and a suite of dryland weed species, including *Eleusine indica, Setaria viridis,* and *Vicia sepium*. Moreover, seeds of Sichuan pepper, *Perilla frutescens,* and *Rhus chinensis*, which has some medicinal properties, were also reported (Li et al. 2016). Beyond macro-botanical remains, stable isotopes and dental calculus from humans buried at Shilingang were analysed (Ren et al. 2017). Stable isotopes on 16 individuals indicated a mixed C_3/C_4 diet (δ^{13}C values range from –19.5‰ to –16.3‰), possibly with a slightly higher consumption of C_3 (Ren et al. 2017), presumably derived from rice as attested by the macro-botanical remains. Carbon isotope values on herbivores (deer) indicated they fed on

C_3 plants ($\delta^{13}C$ values range from –25.9‰ to –19.9‰), and therefore we can infer a C_3 dominant background vegetation. Starches and phytoliths were extracted from human dental calculus and the results indicate the presence of rice phytoliths, and starches of millets, tubers, roots, acorns and palms (Zhang N.M. et al. 2017). However, the reliability of such studies is still not completely demonstrated due to possible cross-contamination issues.

4.5.8 Other First Millennium BCE Sites

Further sites with archaeobotanical remains retrieved from flotation (albeit not systematically collected) associated with the Dian Kingdom include Shizhaishan, Shangxihe, Xiwangmiao 西王庙, and Jinshashan 金砂山, Gucheng 古城 (also known as Gucheng Village, *Guchengcun* 古城村), and Anjiang 安江 **[fig. 19] [tab. 12]**. At these sites, flotation samples were collected during surveys from one or two individual contexts from exposed profiles, therefore, the information we have does not represent systematic studies but can nevertheless indicate broad presence of plant species.

Shangxihe is located 280 m east from Hebosuo, one of the sixteen smaller sites in the Hebosuo cluster. Direct radiocarbon dating indicates the site was occupied from the twelfth to the third century BCE, and metal work has been attested from at least the eleventh/tenth century (Yao A. et al. 2020). Today this is the earliest known site related to the Dian. Successive excavation in 2014, and 2016-17 revealed a large settlement comprised of 40 houses (semi-subterranean or pile-dwelling), 470 pits, numerous wells and ditches, and three vertical shaft pit burials with the deceased placed in flexed, supine position **[tab. 12]**. Small bronze and copper implements have been reported. The ceramic assemblage shows strong similarities in pottery types with other settlement sites in the Dian Basin (Yunnan Kaogu 2017a; Yang et al. 2017). Since no full excavation report has been published, we don't know how the features unearthed related with the chronology and potential phases of occupation. Preliminary flotation samples collected during a survey attested the presence of both rice and wheat (Yao A. et al. 2020), further flotation samples have been collected during systematic excavation, but full results have not been published yet (Yang W., pers. comm. 2023).

Shizhaishan cemetery has undergone five seasons of excavation, but flotation was not carried out during any of the seasons. Possible rice husks tempered ceramic vessels are mentioned in the first report (Yunnan 1963); however, during the Dian Heartland Project, a small flotation sample was collected from a stratified cultural layer. The sample included seeds of rice, wheat and millet (*Setaria italica*; Yao, Jiang 2012).

Xiwangmiao is located only 600 m southeast from Hebosuo. It was excavated in 2014 and 2016; it has been dated by radiocarbon dating on unspecified material to ca. 1200-550 BCE (Yang et al. 2023). Features unearthed include semi-subterranean and wattle and daub houses; pits and ditches. Flotation samples attest to the presence of rice, wheat, foxtail millet, soybean and Sichuan pepper, but no full report has been published yet (Yang, Jiang, Cheng 2020). Given its close chronological occupation and location proximity to Hebosuo, we can infer that people at the two sites conducted a similar subsistence.

The site of Jinshashan is located 2.2 km from the present-day shore of the Dian Lake, and only 1.5 km from Shizhaishan. The site was excavated in 1999-2000, in 2014-15, and a large grave (M190) was excavated in 2016 (Yunnan Kaogu 2017b). Over 80 graves have been excavated so far and dated by cultural association to the Dian to Han periods (Yunnan Kaogu 2015). Based on the high presence of objects buried in the graves, which included jade artefacts, Jinshashan is considered a cemetery where members of the Dian elite were buried. M190 was particularly rich and notably included a clay seal, this indicates that the owner of the grave had a high rank (Yunnan Kaogu 2017b). Burials dated to the Dian period are mostly vertical shaft pits; however, burials dated to the Han period are underground structures with walls and tiles and have sacrificial pits at the entrance of the burial chamber (Yunnan Kaogu 2017b). Preliminary mention of flotation samples' results indicates the presence of wheat and nuts at the site (Kaogu 2015).

Located only 8 km east from the large shell-mound of Hebosuo, the site of Gucheng was initially discovered in 2008, excavation was conducted between 2020-22 (Yao, Jiang 2012; Yunnan Kaogu 2024a; 2024b). Two periods of occupation have been determined, dated by cultural association to ca. between twelfth and third centuries BCE. Direct radiocarbon dates on charred seeds collected during the Dian Heartland Survey furnished a date of 900-530 BCE (Yao, Jiang 2012). The 2020-22 excavation revealed a large cemetery (dating to the twelfth-tenth centuries BCE) with 81 shaft pits and 31 urn graves. Most of the deceased were placed in the extended supine position. Only one house was reported from this phase. Generic wild animals and plants are mentioned as present in this period (Yunnan Kaogu 2024a; 2024b). 21 semi-subterranean houses, with a minority showing evidence of foundation or posts have been unearthed from the Warring State period layers. According to the preliminary report, domestic mammals and agricultural crops, including rice, wheat, and pea increase in this period (Yunnan Kaogu 2024a, 2024b). A small flotation sample collected during the Dian Heartland Archaeology Survey Project provided evidence for rice, wheat, and millet (Yao, Jiang 2012). Albeit possible pea seeds (referred to as *wandou* 豌豆) have been reported by more recent flotation studies (Yunnan Kaogu 2024a). However, their identification and time period need confirmation, as they are quite large in size, which most likely indicates a much more recent age than the Dian occupation of the site (Yang W., pers. comm. 2025). Pea (*Pisum sativum*) was domesticated in Southwest Asia (Zohary, Hopf, Weiss 2012) and spread to South Asia by the second millennium BCE, when pea seeds are reported from Harappan sites and sites in Uttar Pradesh.[32] Although possible pea seeds have also been reported from southern Tibet at the end of second millennium BCE[33] (see § 5.2; which may hint to a dispersal route via the Himalayas), the current lack of data from northeast India and the presence of securely identified pea seeds from Wupaer in Xinjiang, dating to 1400-400 BCE (Yang Q. et al. 2020), and slightly earlier from Tasbas (1500-1300 BCE, Spengler, Frachetti, Doumani 2014) currently suggests a northern route of dispersal to China for this plant, but more evidence is needed to confirm this hypothesis.

Anjiang, or Anjiang North, is a small shell mound site located on the eastern side of Dian Lake at less than 10 km northeast from Hebosuo. The

32 Saraswat 1993a; 1993b; Fuller 2003; Pokharia 2008, Kingwell-Banham 2019.

33 Possible pea seeds have been reported for example from Changguogou/'Phreng-po-lung 昌果沟, on the southern Tibetan Plateau, dating to 1500-1200 BCE (Fu 2001; d'Alpoim Guedes et al. 2013a; Gao et al. 2020b; see § 5.2), at comparable dates of the reported finds from Xinjiang.

site was initially reported during the Dian Heartland Archaeology Survey Project (Yao et al. 2015) and subsequently excavated in 2020, when part of the settlement was unearthed (Yunnan Kaogu 2024c). During the survey an exposed profile was cleaned and partially excavated to previously unexposed depths, flotation samples were taken both from the exposed pit and from a well located off-site 300 m west of the mound (Yao et al. 2015). The samples provided evidence for rice, wheat, barley and broomcorn millet grains. Plant remains from the off-site well included wild species, such as *Chenopodium* sp., *Cyperacea* sp., *Potamogeton* sp., *Characea* sp., *Najas* sp., *Salvinia* sp., all apart from *Chenopodium* indicating a paddy environment (Yao et al. 2015). In 2020, further flotation samples were collected during excavation, but no report has been published yet.

Xiaogucheng is a large shell mound site located on the northeastern shore of the Dian Lake. A small section of the site was investigated during the Dian Heartland Survey, and it revealed a wooden palisade structure surrounded by shells (Yao et al. 2015). Flotation samples collected in that occasion contained rice grains, and large quantities of seeds of weed species. Wild species included Verbanaceae, *Polygonum* sp., *Amarantus* sp., and typical paddy field weeds such as *Rumex* sp. and *Ranunculus* sp. (Yao et al. 2015). It has been hypothesised that the structure unearthed was related to the processing of rice after its harvest.

One last location worth mentioning is a pit found in the vicinity of the Batatai 八塔台 cemetery during its 1982 excavation (Yunnan Kaogu 2016), when the surrounding area was surveyed for cultural remains. A large pit with ancient rice was discovered in the vicinity of the modern-day village of Dongjia, which was referred to by locals as Macaodong 马槽洞 or Biankukeng 蝙库坑 (Li, Li 1983). The estimated area of the charred rice layers was 4-5 m^2 in area and between 1 to 3 m in depth. No other cultural artefacts were found in the pit. Presently, it is unclear how this related to the Batatai cemetery.

Outside the Dian Basin, the site of Zongzan 宗咱, in the upper Mekong Basin, has been dated by association to 2000 BCE-200 CE **[fig. 19] [tab. 12]**. It is included here as preliminary archaeobotanical report only mentioned buckwheat seeds from layers dated to between the fifth and third centuries BCE (Li 2016). Ceramic artefacts show affinities with incised/impressed traditions such as that from Baiyangcun but given the presumed long chronology of the site and lack of further information, we cannot determine the role of buckwheat at the site.

4.5.9 Dietary Evidence from Isotopes

In addition to macro-botanical studies, numerous isotope studies have been undertaken from sites in Yunnan dating to the first millennium BCE, these include Jiangxifen 江西坟, Gaozhai, and Adong, in northwest Yunnan; Jinlianshan 金莲山, in the Dian Basin; and Mayutian 麻玉田, in southeastern Yunnan **[fig. 19]**.

At Jiangxifen 530 burials were excavated in 2019. These were radiocarbon dated on human bones between the ninth and fifth centuries BCE (Lu et al. 2021). 65 individuals and two pigs were samples for stable isotopes analyses. The results indicated that most people had a mixed C_3/C_4 diet ($\delta^{13}C$ values range from –18.6‰ to –9.4‰; average value –14.2‰). The two sampled pigs show a C_3 signature ($\delta^{13}C$ median value –19.5‰). A small flotation study conducted retrieved rice (n=83), and foxtail and broomcorn millet grains (n=11), thus indicating that pigs likely foraged in the forest (consuming locally available wild C_3 resources) and humans fed on both rice and millets, possibly giving pigs C_3 food too.

Gaozhai is located in the Jinsha basin, further upstream from Jiangxifen. Here, 4 stone cist tombs have been excavated in 2020, and radiocarbon dating on human bones indicate the people buried in them lived between the ninth to the fifth centuries BCE (Lu et al. 2023). Isotope analyses show a primarily C_3 diet ($\delta^{13}C$ median value −18.4‰ ±0.4‰; Lu et al. 2023). Animal bones found in the graves were also sampled, and their isotope signature was similar to that of humans. This could mean they fed on either rice or wheat, or both, since by the time of Gaozhai occupation wheat and rice were available in the Jinsha basin.

Adong is located in the very northwestern section of Yunnan, close to a modern Tibetan village in Deqin county. In 2020 some tombs were found and dated to the eighth to fifth century BCE (Lu et al. 2023). Three individuals were sampled for carbon isotope studies. The analyses indicate that two of the sampled individuals had a mixed C_3/C_4 diet ($\delta^{13}C$ values range from −15.7‰ to −15.2‰) and one had a primarily C_3 diet ($\delta^{13}C$ values range from −18.5‰ to −17.8‰). In the absence of macro-botanical remains we cannot conclusively determine which were the plants people buried at Adong consumed.

Jinlianshan is a site located close to Xueshan in the Dian Basin; it was excavated in 2006, and in 2008-09. The site has been dated through radiocarbon dating on human bones to between the eighth and sixth centuries BCE, although according to the artefacts unearthed, the cemetery was used until the Eastern Han period (25-220 CE). 265 graves have been excavated. Objects buried in the graves include metal spearheads, buckles, and undecorated pottery *guan* jars, among other artefacts (Jiang et al. 2011). Stable isotope analyses on human bones attest to a C_3 predominant diet ($\delta^{13}C$ values range from −19.3‰ to −18.2‰), which has been interpreted as derived from rice consumption (Zhang 2011). However, a C_3 signature could also derive from wheat, which was the prevalent species retrieved through flotation at the nearby and contemporaneous site of Xueshan.

Mayutian is located on the northern bank of the Yuanjiang River, an affluent of the Red River, in the very south of Yunnan. It was discovered and excavated in 2006, and in 2010. A total of 21 burials were unearthed, although human bones were not well preserved. Bronze spearheads and axes were the most frequent type of metal artefact buried in the graves. Ceramic vessels were mostly undecorated *guan* jars. An isotope study was conducted on human bones and human tooth enamel. The results indicate that people buried at Mayutian had a mixed C_3/C_4 diet ($\delta^{13}C$ values range from −12.04‰ to −6.33‰; average value −9.14‰ ±1.6‰; Zhang X.X. et al. 2014). The lack of macro-botanical remains limits our understanding of which plant species contributed to the diet.

4.6 Agriculture and the Han Conquest of the Dian

According to the *Shiji*, Han armies conquered the Dian in 109 BCE and established the Yizhou prefecture 益州 (or Yizhou commandery) after which they restored the Dian King and gave him seals (Watson 1971, 285). According to the *Han Shu* 漢書 (The Book of Han) after establishing the Yizhou Prefecture, the Han divided it into counties and undertook a census (Sun, Xiong 1983, 247). There were at least seven major uprisings against the Han between 105 BCE and 176 CE, and during the reign of Wang Mang 王莽 (45 BCE-23 CE) the Han abolished local royal titles (Allard 1998). An increase in Han style artefacts is attested after the first century CE, when bronze censers, lamps, ceramic models of daily scenes, such as cultivated fields and animal pens, are retrieved in much higher quantities than the previous centuries (Allard 2006).[34] By the second century CE, most of the graves were Han style brick tiled structures covered by mounds. This indicates that Han customs became widespread more than a century and a half after the Han conquest of the region (Allard 2006, 248-9).

4.6.1 Hebosuo

Although initially thought to become secondary after Han conquest, excavations in 2016 revealed both Dian and Han remains, indicating that the site was continuously occupied from ca. 1200 BCE to ca. 220 CE. Further excavations in 2021-22 found a stash of over 2000 bamboo and wooden slips and 837 clay seals. The slips detailed government policies, dates and locations; the seals bear inscriptions such as *Yizhou Taishou Zhang* 益州太守章 (Seal of the Governor of Yizhou) and *Tonglao Cheng Yin* 同劳丞印 (Seal of the Deputy of Tonglao; see Jiang et al. 2023). This led archaeologists to identify Hebosuo with the Yizhou Commandery (or Prefecture), described in Han textual sources as an important settlement and administrative centre for the southern regions (Yang et al. 2023; Jiang et al. 2023). One large structure was excavated in Han layers, and Han artefacts were retrieved between layers 16 and 7. These include corded decorated tiles, a typical Han style chariot implement known as *gegongmao* 盖弓帽, numerous coins bearing *wuzhu* 五銖 (produced from 118 BCE and in use until the end of the Eastern Han Dynasty in 220 CE; Yang et al. 2023), and a small bronze bell. The bell has a curved opening, a trapezoidal body, a flat top with a hanging round loop, and raised knobs on the surface. These findings all support the increased incorporation of Hebosuo people into the Han administration.

The archaeobotanical samples retrieved from the Han layers have a high presence of rice remains. The extremely high quantity of rice spikelet bases is a strong indication of local cultivation of this species, and the predominance of wetland type weeds, including *Schoenoplectus juncoide*s, *Scirpus triqueter*, *Bulbostylis* sp., *Eleocharis* sp., and *Potamogeton* sp., suggests that rice was cultivated in a wet regime. Historical sources document irrigation was practiced in the north-eastern area of the Lake Dian by 16 CE (Yao et al. 2015), however, archaeological data to confirm this is currently still lacking (see for example Dal Martello, Li, Fuller 2021).

34 Before Han conquest, Han style objects have been reported from less than 5% of the graves. This may indicate they were gifts (Allard 2006).

Other crops attested at Han Hebosuo include both wheat and millet; however, wheat remains in the Han period are lower than those attested in the Dian period. Some authors have suggested this represent flavour preferences of the incoming Han population, among which wheat is never documented to gain a prominent role (Yang et al. 2023). In the Central Plains it is only after the Han Dynasty that wheat became predominant (Boivin, Fuller, Crowther 2012; Deng et al. 2020). During the Han period, there is an increase in presence and variety of plant taxa not previously recorded at the site. These include soybean and adzuki bean (*Vigna angularis*), Sichuan pepper, grape (indicated as *Vitis* sp. in the table, but as *Vitis vinifera* in text),[35] hawthorn (*Crataegus cuneata*), and Indian strawberry (*Duchesnea indica*; Yang et al. 2023). The charred assemblage also contained a few fragments of unidentified fruits and/or nut species and tubers. Waterlogged remains were also retrieved from the Han layers at Hebosuo, and these include seeds of bottle gourds (*Lagenaria* sp.), stones of peach (*Prunus persica*), possible cherry (*Prunus cerasus*), Japanese plum (*Prunus salicina*), and indeterminate *Prunus* stones, as well as *Rubus* seeds. Some handpicked plant remains were also collected during excavation, including possible hog plum remains (*Choerospondias axillaris*; Yang et al. 2023). While the decrease in wheat may indicate Han preferences, the increase in fruit remains may indicate the development of fruit trees management practices. The management of fruit trees is thought to development after cereal agriculture, and to be associated with urbanisation (Fuller, Stevens 2019; Dal Martello et al. 2023a). Overall plant density in the archaeobotanical assemblage also increased in the Han period.[36] This has been interpreted as evidence for an intensification of agricultural production, which could have been driven by the population increase linked with the Han arrival (Yang et al. 2023). Records in the *Hou Han Shu* 後漢書 (Book of the Later Han) document 2000 hectares of land not previously cultivated were cleared for agriculture during the Protectorate of Wen Qi in the Wang Mang period (ca. 19 CE; Yang et al. 2023). This seems to be supported by the increase in charcoal fragments in the Han dated archaeobotanical samples at Hebosuo. Palaeoclimate reconstructions on Dian Lake sediments also attest to an increase in charcoal signature in the first century CE, possibly derived from an increased fire activity to clear the forest vegetation (Xiao et al. 2020).

35 The most recent evidence indicates a dual origin for table and wine grape, happening around the ninth millennium BCE in western Asia and the Caucasus (Dong et al. 2023). According to the *Shiji* by Sima Qian, grapes would have reached China from a region possibly situated in the Fergana Valley, in modern Uzbekistan, around the second century BCE (Jiang et al. 2009). At present, the earliest attested archaeobotanical evidence for domesticated grape (*Vitis vinifera*) in China comes from the site of Yanghai, in Xinjiang, dating to the third century BCE (Jiang et al. 2009). No photos are available of the *Vitis* seeds from Hebosuo, so it remains unclear whether these represent a local wild grape species (attested at earlier sites in Yunnan, such as at Baiyangcun) or domesticated grape, which, if confirmed, would imply a rather early dispersal of the plant to Southwest China.

36 According to Yang et al. (2023, 18), cereal crops increase from 90 to 92.5% of the total recovered archaeobotanical remains, overall density of archaeobotanical remains increases from 29.8 to 124.3 grains/floated L of soil.

4.6.2 Shamaoshan

Shamaoshan 纱帽山 is a cemetery site located on the eastern shore of the Yangzong Lake, only 30 km away from Xueshan **[fig. 19]**. Radiocarbon dates on human bones indicate the site was used between ca. 250 BCE to 55 CE (Zhang et al. 2012). A total of 57 graves have been excavated. The graves had a northwest-southeast orientation, and were mostly single interments, with the deceased placed in extended supine position. Numerous joint graves were present, showing both primary and secondary interments. Burial goods included mostly bronze tools and weapons, such as spears, swords, axes, daggers, which were minimally decorated or undecorated (Zhang et al. 2012). The type of objects at Shamaoshan indicate a non-elite group within the Dian. There is a slight increase in Han-style objects from the upper layers (Wu et al. 2019). Stable isotopes were measured from tooth enamel extracted from 18 individual; the results indicate a predominant C_3 diet ($\delta^{13}C$ values range from −24.7‰ to −23.1‰; Wu et al. 2019), which may derive from rice and/or wheat consumption. Both species have been documented archaeobotanically from earlier sites in the region, including at the nearby Xueshan site.

4.7 Summary

Prior to 2009, flotation studies in Yunnan were scarce. Knowledge on past subsistence derived from handpicked material (mostly rice grains) from sites such as Baiyangcun. Systematic archaeobotanical sampling was conducted at Haimenkou during its 2008-09 excavation. Flotation analyses at the site revealed excellent preservation conditions of ancient plant remains and a high potential for this type of study in Yunnan. Since then, flotation has been carried out at all newly excavated sites; archaeobotanical reports are now available from around fifteen sites, more data is available from stable isotope study in bone collagen **[tab. 12]**. This greatly expanded our understanding of early plant use in Yunnan.

Palaeonvironmental reconstructions along with the examination of stone toolkits from Palaeolithic sites provide insights into the hunter-gathering lifestyle of groups inhabiting Yunnan in the late Pleistocene/early Holocene. These groups possibly collected local wild resources, such as tropical acorns, roots, and tubers. However, specific evidence supporting these inferences remains scarce. Domesticated cereals appear in northwest Yunnan from at least 2650 BCE, as attested through direct radiocarbon dating of charred millet and rice grains at Baiyangcun (Dal Martello 2020). Although a study argued for rice and millet presence inferred through isotope analyses on human bones collagen at Xingyi possibly from ca. 2900 BCE (Ma et al. 2024), conclusive evidence about farming at the site prior to the second millennium BCE is lacking. While Li et al. (2016) proposed an initial stage of farming in Yunnan based on rice cultivation only, it remains to be determined whether C_3 consumption at Xingyi prior to 2900 BCE results from rice or local wild resources. At present, mixed farming systems incorporating millet and rice cultivation, are the first attested farming systems in the province, dating back to at least the first half of the third millennium BCE **[fig. 28]**. Weed species associated with rice at Baiyangcun suggest the crop was cultivated in a wet regime. At Baiyangcun, the retrieval of *Euryale* and other acorns suggests that even after the development of farming, the collection of local wild resources continued to play a role in the overall economy. The scarcity of fruits, nuts and other economic species beyond cereals implies that these resources were either collected and consumed off-site or played a secondary role to cultivated plants in the overall diet. Pigs have not been reported at sites prior to Baiyangcun (Yunnan 1981) and clearly domesticated pigs were the most numerous faunal species at Haimenkou (Wang 2018); their presence indicates they were introduced to the region together with domesticated crops, and animal husbandry developed alongside farming. However, large quantities of lacustrine resources (*Margarya* sp. shells) at Xingyi and wild animal bones presence at Baiyangcun indicates that fishing and hunting were also practiced. It remains unclarified what role, if any, pre-existing hunter-gatherer populations played in the emergence of agriculture in Yunnan. More research is needed to understand whether they were replaced by incoming farmers or adopted agricultural crops themselves.

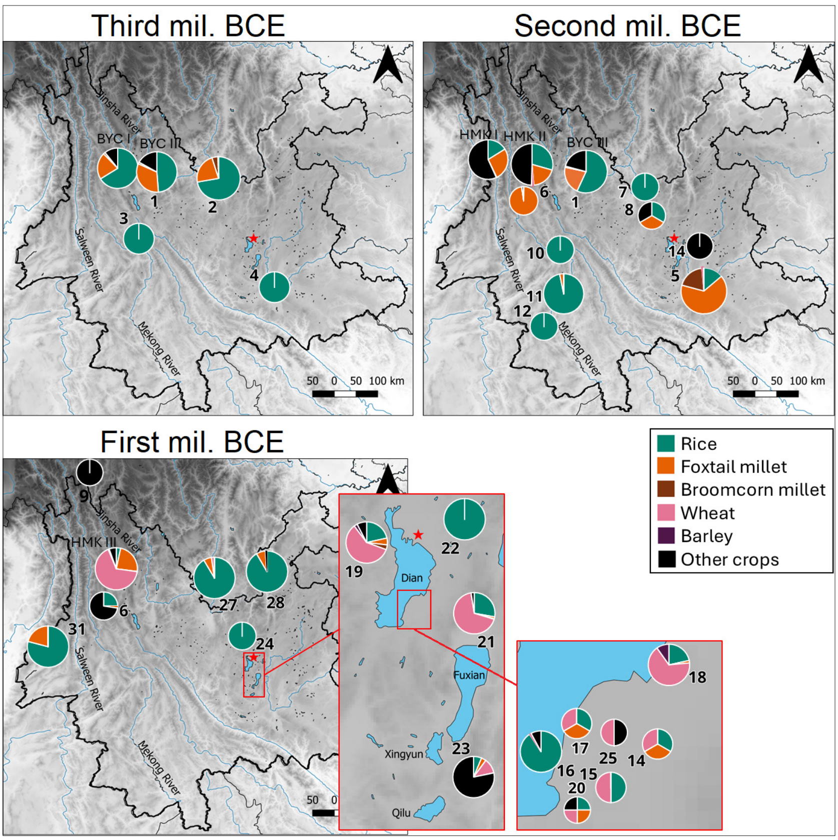

Figure 28 Crop ratios from sites in Yunnan dating to between the third and first millennia BCE as evidenced from macro-botanical remains; smaller pie charts indicate handpicked/unsystematic flotation remains. For seed counts and sources see Appendix 4. Sites numbered as in Figure 19: 1. Baiyangcun; 2. Dadunzi; 3. Xinguang; 4. Haidong; 5. Xingyi; 6. Haimenkou; 7. Mopandi; 8. Mopanshan; 9. Zongzan; 10. Yingpanshan; 11. Shifodong; 12. Nanbiqiao; 14. Gucheng; 15. Shangxihe; 16. Hebosuo; 17. Shizhaishan; 18. Anjiang; 19. Dayingzhuang; 20. Xiwangmiao; 21. Xueshan; 22. Xiaogucheng; 23. Guangfentou; 24. Qujing Dongjia; 25. Jinshashan 27. Jiangxifen; 28. Yubeidi; 31. Shilinggang. Made by the Author with QGIS 3.28.5-Firenze, Natural Earth and EROS Digital Elevation basemap, U.S. Geological Survey

Agricultural systems in Yunnan expand around the mid-second millennium BCE with the arrival of wheat and barley, two crops originally domesticated in Southwest Asia. Wheat grains have been directly dated to ca. 1400 BCE at Haimenkou, in northwest Yunnan (Xue et al. 2022) **[fig. 28]**. The route(s) through which wheat and barley spread to China is still debated (see § 2.5.2). The appearance of these two species at Haimenkou, at the same time as a sudden increase in houses, an increase in goat/sheep remains (Wang 2018), and innovations in material culture (the emergence of metallurgy) suggests contacts and possibly migrations of agro-pastoral populations from Northwest China (mostly from Gansu and Qinghai, Min 2009a; 2009b). This view is substantiated by strong ceramic affinities and by recent genomic data, albeit from individuals from later periods (1200-900 BCE). The results showed that sampled individuals from Haimenkou shared 90% of their ancestry with late Neolithic Yellow River farmers (Tao et al. 2023), whose expansions in the fifth millennium BCE brought to the development of agriculture in Northwest China (see § 5.2) and thus migrated from there to northwest Yunnan at the end of the second millennium BCE. The presence of goat/sheep bones at Baiyangcun (albeit their domestication status has not been ascertained, contrarily to goat/sheep bones from Haimenkou which appeared domesticated; see Wang 2018), however, indicates that connections with the eastern part of Northwest China may predate the occupation of Haimenkou, but it remains to be confirmed whether agriculturalist migrations from modern Gansu and Qinghai were also responsible for the establishment of agricultural systems in the millennium prior the occupation of Haimenkou. It also remains uncertain if population growth at Haimenkou relates to agricultural innovation, or if trade and exchange played a role. An alternative view is that barley diffused separately via a southern route, through the Himalayas, supported by modern barley landraces genetic studies and direct dating of barley at sites along the southern Himalayas (see § 2.5.2). This cannot find confirmation due to the presently patchy archaeobotanical data in East India, Tibet and Myanmar. In Yunnan, there is also no reported wheat and/or barley from sites dating prior to Haimenkou, although this may change with the increased application of flotation techniques in archaeological excavations across the province. Their concurrent presence at Haimenkou indicates the crops spread to Yunnan together and thus favour a single dispersal route of both crops to Yunnan. Their incorporation in the cultivation systems of Yunnan, however, was slow, and at late second millennium BCE Haimenkou, rice and millet continue to be the predominant species. Seeds of *Chenopodium album*, a plant today sparsely grown and consumed for its leaves and grains by groups in Taiwan and on the Tibetan Plateau, have been retrieved in high quantities from the Haimenkou samples. *Chenopodium* seeds were strongly associated with cereals in domestic contexts, which indicates the plant was possibly exploited as food. The species is highly tolerant to unfavourable environmental conditions, needs little water, and can withstand low temperatures (see § 2.4.2.3). Its cultivation may indicate a worsening of the environmental conditions at the site, which may have affected cereal harvests. Other species attested include buckwheat, soybean, peach and apricot fruits, wild grape, and cannabis. *Cannabis* at Haimenkou may have had a multi-function use as medicinal and textile plant (Dal Martello et al. 2023b). Beyond Haimenkou, few other sites have been systematically investigated from this period, but overall the archaeobotanical data shows a diversification in number of species present, now including a greater number of legumes (e.g., soybean, cf. tamarind), fruits (e.g., peach, apricot, grape, perilla), and other economic species (e.g., cannabis). This indicates a diversification of the productive economy in Yunnan in the second millennium BCE.

The first millennium BCE in Yunnan is characterised by the establishment of the Dian polity, which flourished in the Dian Basin until 109 BCE, when, according to historical sources, the Han established control over the region. In this period, wheat cultivation becomes more widespread and even predominant at some sites, such as Dayingzhuang and Xueshan (Dal Martello, Li, Fuller 2021; Wang Q. et al. 2019). However, wheat uptake does not substitute previously cultivated crops, such as rice and millet, which continue to be cultivated alongside wheat (with varying degrees of importance in different areas of Yunnan) **[fig. 28]**. This indicates that the availability of new crops, rather than replacing pre-existing systems, allowed the expansion of the agricultural production, a strategy most likely facilitated by the peculiar vertical zonation of Yunnan. In the first millennium BCE, environmental and climatic conditions in Yunnan were close to those of today, albeit highly fluctuating. Today, the Dian Basin and Central Lakes region have mild weather year-round, average winter temperatures of 10°C degrees. This is the most productive area of the province. The co-existence of lowlands and highlands at close distance would have provided environmental conditions suitable to grow crops with different watering and temperature needs, by establishing fields at different levels of the landscape. The presence of summer and winter crops at Dian sites suggest that, already during the Dian, agricultural production was undertaken year-round, taking full advantage of water-rich lowlands and nearby drier highlands. Rice could have been grown in the summer months in the lowlands close to the water reservoirs, and millet in the nearby slopes, where it would rotate with winter wheat. Cereal cultivation was complemented by the cultivation of legumes such as soybean, possibly buckwheat, along with a modest contribution from wild resources, including local fruits and nuts. Although possible lentil seeds have been reported from Xueshan (Wang Q. et al. 2019; Yunnan Kaogu 2024a), their identification needs to be further confirmed. Lentil (and pea) have been found from Harappan sites and sites in Uttar Pradesh from the second millennium BCE,[37] as well as in northeast India between the second and first millennium BCE.[38] Prior to that, lentil (and pea) have been reported from sites in southern Central Asia, including at several sites in Pakistan dating to after the fifth millennium BCE.[39] Between the third to second millennia BCE, both lentil and pea are a common occurrence at sites in modern Turkmenistan (e.g.,

37 See for example 1993a; 1993b; Fuller 2003; Pokharia 2008, Kingwell-Banham 2019.

38 For example, both lentil and pea have been found at Chirand ca. 2100-1300 BCE (Vishnu-Mittre 1972) and lentil has been reported from Wari-Bateshwar, in Bangladesh, in the first millennium BCE (Rahman et al. 2020).

39 These include, for example, lentil at fourth millennium BCE Shahi Tump I and Miri Qalat (Desse et al. 2008; Tengberg 1999); pea and lentil at fourth to third millennia BCE Harappa (e.g., Weber 2003), third millennium BCE Miri Qalat (Tengberg 1999), and other sites (e.g., Vishnu-Mittre, Savithri 1982; Costantini 1990).

Gonur Depe, Togolok 1, Adji Kui 1, and Chopantam),[40] and both species have been found at Shortugai, in Afghanistan, also dating to between the third and second millennium BCE (Willcox 1991). These crops originate from Southwest Asia and reports from early sites in China are scarce. Possible pea seeds have been reported from the end of second millennium BCE in southern Tibet (see § 5.2, see also Ch. 4 fn. 33), from Wupaer in Xinjiang, dating to 1400-400 BCE (Yang Q. et al. 2020), and slightly earlier at Tasbas (1500-1300 BCE, Spengler, Frachetti, Doumani 2014). More research is needed to confirm the timing and route(s) through which these legumes spread to China.

Outside of the Dian Basin, we see a preference of rice at sites located deep in river valleys (such as Shilingang on the Mekong Basin, and Yubeidi on an affluent of the Jinsha River) **[fig. 28]**, and fishing was particularly important at lacustrine sites, such as Haidong and Xingyi. The fluctuating climate of the first millennium BCE may have had a role in preserving a highly mixed subsistence system such as outlined above in Yunnan, while the variety of landforms may have facilitated the local diversification of agricultural systems based on rice only or on the mixed cultivation of seasonally different crops.

Archaeobotanical data from Han period is scarce, but samples from Hebosuo show continuity in subsistence strategies, with a potential expansion in the consumption of fruit and nut species (Yang et al. 2023). This may represent a change in flavours brought by the arrival of the Han or the beginning of fruit trees management in the province. This continuity may also result from specific limitations posed by local soils and environments. As we have seen, a mixed system based on the rotation of wetland and dryland crops is well-suited to the rugged landscape of Yunnan, where lowland plains provide rich water resources to sustain rice paddy cultivation, while the adjacent highlands offer ideal conditions for growing millet and wheat. Yang et al. (2023) suggested that the continuity of agricultural systems after the arrival of the Han derives from their efforts to avoid disrupting pre-existing cultivation systems, thereby preventing local upheavals and maintaining their political control over Yunnan (Yang et al. 2023, 71). An intensification of the agricultural production during the Han period is attested by the overall increase in relative proportion of cereal crops and density of charcoal fragments (indicative of increased fire activity) in the archaeobotanical assemblage at Hebosuo (Yang et al. 2023). Rice production may have been intensified with the development of irrigation or other water management practices. Historical records indicate that irrigation was practiced in the north-eastern area of the Lake Dian at least from 16 CE (Yao et al. 2015); however, current archaeobotanical data has not conclusively determined whether irrigation began earlier or it developed following the Han arrival to the region.

40 For Gonur Depe see Miller 1993; Sataev and Sataeva 2014; Togolok 1 see Billings et al. 2022; Adji Kui see Spengler et al. 2018, Chopatam see Spengler et al. 2014.

5 A Story of Outside Influence and Local Adaptation

5.1 The Beginning of Mixed Rice-Millet Systems and the Spread of Agriculture

After the domestication of rice and millets in their respective centres of origin (see Ch. 2), the two crops dispersed in the surrounding regions and came together to form the first mixed rice-millet agricultural systems **[fig. 29]** **[Appendix 5]**. It is important to note, however, that although it was traditionally thought that native wild millet and rice distribution divided at the boundary of the Qingling Mt. Range, recent archaeological research has shown they overlapped in the area between the Yellow and Yangzi Rivers, for example in the Huai River Basin (e.g., Yang et al. 2016). Such a northerly distribution of wild rice was possible due to higher precipitation and temperatures during the mid-Holocene (estimated to be 2-4°C degrees higher than today; Ge et al. 2007; Wang, Gong 2000; Dykoski et al. 2005). This had caused the expansion of tropical landscapes and environments much further north that attested today (see Ch. 3). A recent survey of over 800 archaeological sites in China dating between the seventh and first millennia BCE (He et al. 2017) individuated 155 sites with attested presence of both rice and either foxtail or broomcorn millet. This survey showed how both crops are present at some sites in the Shandong Peninsula and the Central Plains already during

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the sixth millennium BCE **[fig. 29]**;[1] however, grains are present in overall very low quantities for which is difficult to argue local cultivation, not least because these finds often lack direct chronological dating (Stevens, Fuller 2017). Low numbers of rice grains in a millet dominant assemblage have been reported from Zhuzhai B in Henan (ca. 5700 BCE; Bestel et al. 2018) and from Beiliu, near Xi'an (ca. 5700-5400 BCE; Zhou, Wang, Zhao 2024). Conversely, low numbers of millet grains with high quantities of rice remains have been reported from Baligang in southern Henan (ca. 6700-6500 BCE, Deng et al. 2015), a site representative of the southern expansion of the Yangshao Culture (ca. 5000-3000 BCE). At Balingang, while only 1 grain of broomcorn millet has been reported from the seventh millennium BCE strata, hundreds of foxtail and broomcorn millet grains have been found in flotation samples dating to the late fifth millennium BCE (Deng et al. 2015). Directly dated rice and millet grains are present at Nanjiaokou, in western Henan (north from Baligang), dating to 4000-3800 BCE (Qin, Fuller 2009). While in the successive millennia in the Shandong Peninsula and the Central Plains rice progressively declines in favour of millet, mixed farming is attested from sites dating from the late fourth millennium BCE onward in regions progressively farther away from their domestication centres (He et al. 2017; Stevens, Fuller 2017). For example, both crops are attested at Chengtoushan in the middle Yangzi River Basin at 4300-4000 BCE (Nasu et al. 2012), where previously documented cultivation systems were rice dominant. Mixed farming systems appear widespread in Southwest China (see Ch. 4). Scholars argue that the integration of rice and millet cultivation in a mixed farming system reflects the outward spread of millet agriculturalists, rather than rice (and especially wet rice) cultivators. This is because carrying capacity per unit of land for millet is lower than that for rice. It is thus hypothesesed that intensification of millet production is achieved through continuously incorporating new land into cultivation, which result in outward migrations (Stevens, Fuller 2017; Qin, Fuller 2019; Stevens, Zhuang, Fuller 2024). Despite claims of directly dated broomcorn and foxtail millet grains from 3800 BCE at Anle 安乐, in the Lower Yangzi Basin in northern Zhejiang (Tang, Marston, Fang 2022), upon examination of published photos of the seeds, they appear to be *Echinochloa* sp. (a species also present in the assemblage),[2] rather than either broomcorn of foxtail millet (as proposed by Tang, Marston, Fang 2022).[3] Mixed farming systems in the regions are attested almost a millennia later **[fig. 29]**.

1 For example, Yuezhuang 月庄, in Shandong, has reported 91 grains of broomcorn millet, 9 grains of foxtail millet, and 28 grains of rice (Crawford 2016), however the status of rice as wild or domesticated is unclear. Xihe 西河, another site in Shandong, has 72 reported grains of rice and two of foxtail millet (Jin et al. 2013); but as for Yuezhuang, local rice cultivation has not been conclusively determined. See Appendix 5 for full list of sites.

2 *Echinochloa* seeds often present a flat back, while *Setaria italica* and *Panicum miliaceum* seeds puff and become particularly round when charring. The seeds' hilum also presents substantial differences (author's own observations and C.J. Stevens pers. comm. 2024).

3 The millet seeds are also present in negligible quantities compared to rice (16 of foxtail millet grains and only two of broomcorn millet, compared to 12,719 remains of rice, including grains and spikelet bases), which raises further doubts about any potential local cultivation.

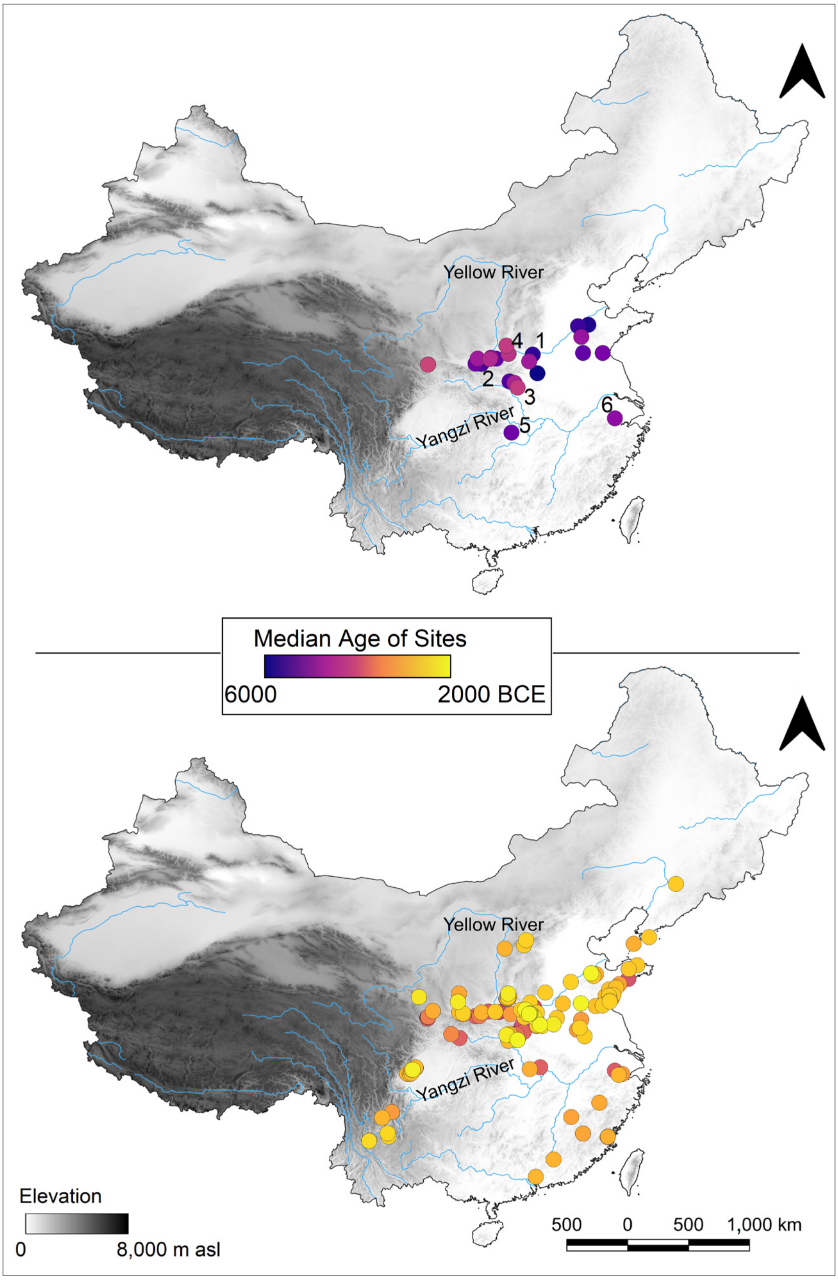

Figure 29 Sites with reported seeds of either foxtail or broomcorn millet and rice, dating between the sixth and third millennia BCE, plotted chronologically based on median age of occupation (see Appendix 5). Sites mentioned in text: 1. Zhuzhai B; 2. Beiliu; 3. Baligang; 4. Nanjiaokou; 5. Chengtoushan; 6. Anle (here, millet presence is disputed). Made by the Author with QGIS 3.28.5-Firenze, Natural Earth and EROS Digital Elevation basemap, U.S. Geological Survey

Scholars argue that the apparent lack of millet at sites with evidence for intensive rice cultivation in the Lower Yangzi (for example those connected with the Liangzhu Culture; see § 2.3.1.2), substantiate the view that it was expanding millet farmers that uptook rice cultivation during their spread (Qin, Fuller 2019; Stevens, Zhuang, Fuller 2024).

5.2 Comparison of Crop Systems and Chronological Crop Dispersal Trajectories in Broader Southwest China

Archaeobotanical data from regions surrounding Yunnan is quite uneven. For broader Southwest China, here including the provinces of Sichuan, Tibet, Chongqing and Guizhou, most of the available data derives from recent work on the Tibetan Plateau and Sichuan Province **[fig. 30] [Appendix 6]**.

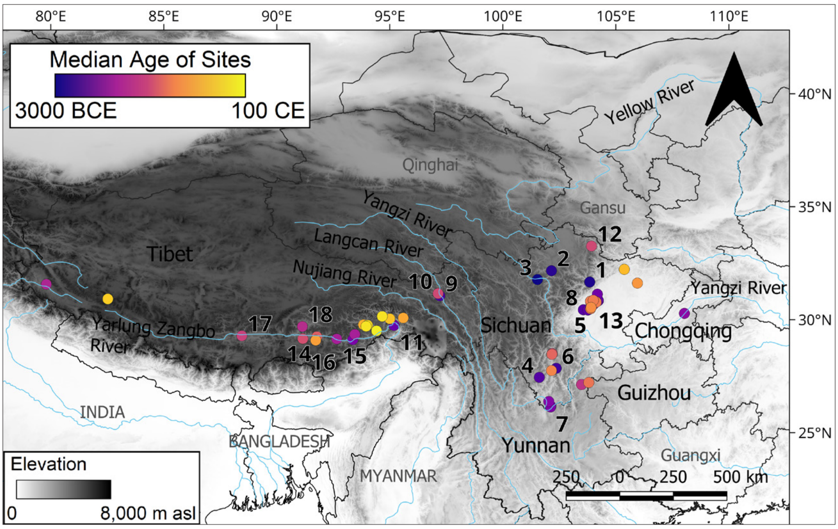

Figure 30 Sites in broader Southwest China with evidence for domesticated crops, plotted chronologically based on median age of occupation (see Appendix 6). Sites mentioned in text. 1. Yingpanshan; 2. Haxiu; 3. Liujiazhai; 4. Guijiabao; 5. Baodun; 6. Henglanshan; 7. Houzidong; 8. Gaoshan; 9. Karuo; 10. Xiaoenda; 11. La Phob; 12. Ashaonao; 13. Zhonghai; 14. Changguogou; 15. Klu lding; 16. Bangga; 17. Kuoxiong; 18. Qugong. Made by author with QGIS 3.28.5-Firenze, Natural Earth and EROS Digital Elevation basemap, U.S. Geological Survey

Chongqing and Guizhou instead are still rather understudied, with only three known sites with archaeobotanical remains.[4] Albeit grouped together, these regions have diverse environments that range from fertile, water-rich basins (such as the Sichuan Basin) to perennial snow mountains and extreme high altitudes on the Tibetan Plateau. This results in a variety of lifestyles and subsistence strategies as well as constraints in feasibility of agricultural production. Sichuan has often been indicated as the source of agricultural spread to Yunnan (e.g., d'Alpoim Guedes 2011), therefore an examination of the agricultural trajectories of broader Southwest China is needed to contextualise the origins of agriculture in Yunnan. In this section I review

4 In Chongqing, rice remains have been reported from Zhongba 中坝 phase I (2470-1700 BCE) and rice, foxtail millet and broomcorn millet have been reported from phase II (1100-200 BCE; Zhao, Flad 2013). Despite the site being located on the Yangzi River, it has been suggested that the vertical topography of the area constrained rice cultivation (d'Alpoim Guedes 2013, 767). In Guizhou, handpicked rice remains have been reported Jigongshan (ca. 1300-800 BCE) and Wujiadaping (ca. 1300 BCE), both sites are dated via cultural association (Zhao 2003a; Guizhou et al. 2006; Zhao, Hung 2010).

archaeobotanical data from sites in broader Southwest China dating from the fourth to the first millennia BCE, with a focus on the earliest documented presence of domesticated crops and the establishment of farming systems. The data presented in this section derives from site-specific archaeobotanical reports published in both Chinese and English academic journals, as well as master's and doctoral theses. These sources provide raw quantitative and qualitative data on the archaeobotanical assemblage composition of each site, along with information on the domestication and exploitation status of plant species recovered. However, since most of the sources consulted did not include detailed sample-by-sample information, the analysis outlined here focuses solely on the overall archaeobotanical assemblage composition to assess the presence (or availability) of species and their inferred role in the local farming system, as suggested by each source primary authors. Previously published archaeobotanical databases have also been consulted and are listed in Appendix 6. Sites from broader Southwest China are mentioned in text and are summarised in Table 13; all sites are illustrated in Figure 30.

Table 13 Summary of sites in broader Southwest China with evidence of agricultural crops mentioned in text. Plants recovery methods are indicated with Latin names for systematic flotation studies, and English common name for handpicked material. Modified from Dal Martello 2020

Site	Chronology	Plant remains	Faunal remains	References
Sichuan				
Yingpanshan 营盘山 Upper Minjiang (northern Sichuan)	3300-2600 BCE	*Setaria italica* *Panicum miliaceum* *Glycine* sp. Fruits	-	Huan et al. 2022c; Zhao, Chen 2011
Haxiu 哈休 Upper Dadunhe (Yellow R.)	3300-2700 BCE	*Panicum miliaceum* *Setaria italica* *Prunus* sp. *Avena* sp. *Zanthoxylum* sp.	Dog Pig Deer Macaca	Wang et al. 2023; d'Alpoim Guedes 2013; Zhao, Chen 2011; Aba et al. 2007; 2008
Liujiazhai 刘家寨 Jinchuan	3300-2700 BCE	*Setaria italica*	-	Chen et al. 2022, 2021
Ashaonao 阿梢垴 eastern Tibetan Plateau (Sichuan)	1400-1000 BCE	*Triticum aestivum* *Hordeum vulgare* *Setaria* cf	Sheep Deer	d'Alpoim et al. 2015
Ashaonao 阿梢垴 eastern Tibetan Plateau (Sichuan)	400-200 BCE	*Triticum aestivum* *Hordeum vulgare* *Chenopodium* sp. *Prunus* sp. *Rubus* sp. *Sambucus* sp. *Potentilla/Fragaria* *Linum usitatissimum*	-	d'Alpoim et al. 2015

Site	Chronology	Plant remains	Faunal remains	References
Guijiabao 皈家堡 Yanyuan county (southern Sichuan)	3300-1700 BCE	*Setaria italica* *Panicum miliaceum* *Oryza sativa* (rice from 3000-2800 BCE)	-	Hao et al. 2022
Henglanshan 横欄山 Xichang county (southern Sichuan)	2500-2200 BCE	*Setaria italica* *Panicum miliaceum* *Glycine max* *Vigna* sp.	-	Liu, Hao 2007 ; Jiang et al. 2016a; 2016b
Houzidong 猴子洞 Huili county (southern Sichuan)	2200-1900 BCE	*Setaria italica* *Oryza sativa* *Vigna* sp. *Ziziphus jujuba* var. *spinosa* *Zanthoxylum bungeatum* *Physalis alkekengi* *Chenopodium* sp.	-	Wang et al. 2023; Wang 2021
Baodun 宝墩 Sichuan Basin (Chengdu)	2700-2000 BCE	*Oryza sativa* *Setaria italica* *Coix lacryma-jobi* *Vicia* sp. *Vigna* sp. *Chenopodium* sp.	-	d'Alpoim Guedes 2013; d'Alpoim Guedes et al. 2013
Gaoshan 高山 Sichuan Basin (Chengdu)	2500-2000 BCE	*Setaria italica* *Oryza sativa*	-	Lee et al. 2019
Zhonghai 中海 Sichuan Basin (Chengdu)	1400 BCE	*Oryza sativa* *Triticum aestivum* *Setaria italica* *Panicum miliaceum* *Chenopodium* sp.	-	Chengdu 2012; Yan, Zhou, Jiang 2014
Zhonghai 中海 Sichuan Basin (Chengdu)	1400 BCE	*Oryza sativa* *Triticum aestivum* *Setaria italica* *Panicum miliaceum* *Chenopodium* sp.	-	Chengdu 2012; Yan, Zhou, Jiang 2014
Tibet				
Chamdo Karuo/ Qamdo Karuo/ Mkhar-ro 昌都卡若 Upper Langcan/ Mekong (Eastern Tibet)	2800- 2300 BCE	*Setaria italica* *Panicum miliaceum* *Fragaria/potentilla* sp. *Rubus* sp. *Chenopodium* sp.	Pig Unspecified large and small game; fish	d'Alpoim Guedes et al. 2013; Song et al. 2021
Xiaoenda/ Gshorngul-mda 小恩达 Eastern Tibet	2900-2200 BCE	*Setaria italica* *Panicum miliaceum*	Musk deer Roe deer Goral Blue sheep Pigs?	Zhang et al. 2019; Lu 2023

Site	Chronology	Plant remains	Faunal remains	References
Xiaoenda/ Gshorngul-mda 小恩达	1550-850 BCE	*Setaria italica* *Panicum miliaceum* *Triticum aestivum* *Hordeum vulgare*	-	Zhang et al. 2019; Lu 2023
Eastern Tibet				
La Phob 拉颇 Southern Tibet	2800-2100 BCE	*Setaria italica* *Panicum miliaceum* *Hippophae rhamnoides* *Chenopodium* sp. *Sambucus* sp. Rosaceae fruits Nuts	Pigs Herbivores	Wang et al. 2024
La Phob 拉颇 Southern Tibet	700-300 BCE	*Setaria italica* *Panicum miliaceum* *Triticum aestivum* *Hordeum vulgare*	-	Wang et al. 2024
Changguogou 昌果沟 Southern Tibet	1420-800 BCE	Wheat Barley Foxtail millet (Avena; Rye) Pea *Potentilla*	-	Fu 2001
Klu liding 立定 Southern Tibet	1600-1400 BCE	*Setaria italica* *Panicum miliaceum* *Triticum aestivum* *Hordeum vulgare* *Chenopodium* sp.	-	Wang et al. 2024
Banga 邦嘎	1000-210 BCE	*Hordeum vulgare*	Wild animal species	Tang et al. 2021
Western Tibet				
Qugong 曲贡 Central Tibet	1500-1250 BCE	*Setaria italica* *Panicum miliaceum* *Triticum aestivum* *Hordeum vulgare* *Fagopyrum tataricum*	Deer Yak Sheep	Gao et al. 2021
Chongqing				
Zhongba 中坝 Three Gorges (Yangzi)	2470-1700 BCE 1100-200 BCE	*Oryza sativa* *Oryza sativa* *Setaria italica* *Panicum miliaceum*	*Sus scrofa* *Nycterteutes procyonides* *Rhizomys sinensis* *Canis familiaris* *Bos* p. *Bubalus* sp. *Cervus* spp. *Vulpes* sp. *Macaca* sp. High quantity of fish remains including: Cypriniformes Siluriformes Perciformes and some giant salamander Snakes Turtles	Flad 2011; d'Alpoim Guedes 2013; Zhao, Flad 2013

Site	Chronology	Plant remains	Faunal remains	References
Guizhou				
Jinggongshan Lower Jinsha (Yangzi)	1300-800 BCE	Rice	-	Zhao 2003a Zhang, Hung 2010
Wujiadaping Lower Jinsha (Yangzi)	1300 BCE	Rice	-	Guizhou et al. 2006; Zhao 2003a

5.2.1 Fourth to Third Millennium BCE Sites and Archaeobotanical Evidence for the Spread of Agriculture to Sichuan and the Tibetan Plateau

The first agricultural systems in broader Southwest China have been attested on the margins of the eastern Tibetan Plateau in western Sichuan **[fig. 30]**. Here, charred millet grains dating to the end of the fourth millennium BCE have been reported from Yingpanshan 营盘山, Haxiu 哈休, and Liujiazhai 刘家寨 (albeit at Liujiazhai seeds are dated by cultural association) **[tab. 13]**.[5] A few centuries later, domesticated crops (mostly millets) have been reported from Guijiabao 皈家堡 in southern Sichuan (3300-1700 BCE); at this site rice appears a few centuries later than millet (ca. 3000-2800 BCE; Hao et al. 2022). Slightly later, the first mixed agricultural systems based on foxtail millet and rice appear on the Chengdu Plain, at Baodun 宝墩 (2700-1700 BCE; d'Alpoim Guedes 2013).

At Yingpanshan, located in modern Sichuan on the western edge of the Tibetan Plateau, broomcorn millet, foxtail millet, and soybean have been retrieved through flotation (Zhao, Chen 2011). Despite the lack of rice grains from flotation samples, isotopes on two skeletons from Yingpanshan showed a mixed C_3/C_4 signature, with a C_3 predominance (Lee et al. 2019, 2020). Some authors argued that the lack of rice macro-remains from Yingpanshan may derive from insufficient sampling (Huan et al. 2022c); however, according to the same study, animal protein intake for these two individuals derived from terrestrial herbivores (deer and cattle; Lee et al. 2019). This is in sharp contrast with inferences of a millet-pig based economy, as attested by the predominant presence of millets and pigs, and isotope analyses showed pigs fed on C_4 plants, presumably millet. The differences in diet for these two individuals may derive from them being non-locals, rather than indicating a possible rice presence at Yingpanshan (Lee et. 2019). At Haxiu, flotation results attested the presence of both broomcorn and foxtail millets and some fruit species, as well as seeds of possible Sichuan pepper (d'Alpoim Guedes 2013).

At Guijiabao, foxtail and broomcorn millet seeds retrieved through flotation have been directly dated to ca. 3300-2900 BCE. Rice grains, which were also retrieved through flotation, dated to a few centuries later (ca. 3000-2800 BCE; Hao et al. 2022). The site is located in southern Sichuan on the western section of the Yalong River before it joins the Jinsha River **[fig. 30]**. Guijiabao shows strong cultural affinities with Neolithic Cultures in northwest Yunnan, especially those in the middle of Jinsha River Basin,

5 Huan et al. 2022c; Chen et al. 2021; 2022; d'Alpoim Guedes 2013; Zhao, Chen 2011; Aba et al. 2007; 2008.

including Baiyangcun, which is about 200 km south from Guijiabao. At Guijiabao, graves are vertical earthen shaft pits with the deceased mostly placed in flexed supine position (like those found at Baiyangcun). Ceramic vessels from 2500-1700 BCE (indicated as phase II in the report) are characterised by coarse, grey pottery with incised/impressed decoration (Hao et al. 2022), which is also the main ceramic tradition at Baiyangcun. Perforated knives and other agricultural tools have been found from cultural layers belonging to phase II, which support an agricultural subsistence. Slightly later than Guijiabao at less than 100 km east from it, archaeobotanical flotation from Henglanshan 横欄山 has found seeds of broomcorn and foxtail millet, as well as soybean and *Vigna* sp. beans, but no rice (2500-2200 BCE; Jiang et al. 2016a, 2016b; Liu, Hao 2007), but some authors argue that the archaeobotanical remains from Henglanshan are not sufficiently representative to make meaningful inferences on the agricultural system of the site (Huan et al. 2022). At the end of the third millennium BCE, mixed rice-millet systems have been reported from Houzidong 猴子洞 (2100-1900 BCE). The site is located south from Guijiabao and Henglanshan, close to the Yunnan border **[fig. 30]**. Here millet is the predominant crop, and flotation undertaken in 2017-18 attested the presence of soybean, *Vigna* sp., jujube (*Ziziphus jujuba* var. *spinosa*), Sichuan pepper, *Physalis alkekengi*, and *Chenopodium* sp., which the authors suggest may have been cultivated/consumed (Wang B. et al. 2023).

On the Chengdu Plain, farming systems are documented from ca. 2700 BCE at Baodun and at a few several other sites in the Sichuan Basin (d'Alpoim Guedes 2013) **[Appendix 6]**. Archaeobotanical assemblages from these sites include both rice and millets. For example, at Baodun rice accounts for ca. 30% of the archaeobotanical assemblage. By being on the Chengdu Plain, people at Baodun would have had plenty of water resources which would have allowed a rich rice production. Archaeological seeds of typical wetland rice cultivation species such as *Fimbristylis* sp. and *Scirpus* sp. indicate that rice at Baodun was grown in a wet regime (d'Alpoim Guedes 2013; d'Alpoim Guedes et al. 2013b). Beyond rice, archaeobotanical remains included seeds of Job's tear (*Coix lacryma-jobi*), *Vigna* sp., *Perilla* sp., *Crataegus* sp., *Sambucus* sp., and peach stones. A slightly later site on the Chengdu Plain with good evidence for agriculture is Gaoshan 高山 (2500-2000 BCE), where also both rice and millet were retrieved through flotation. Isotope studies on human skeletons from the site (n=27) showed a predominant C_3 signature, presumably derived from rice intake (Lee et al. 2019). Genetic analyses were conducted on five individuals buried at Gaoshan; the results indicated they had genetic affinity with Late Neolithic populations from the upper Yellow River Basin (Tao et al. 2023, 4996). Scholars have inferred that people at Gaoshan (and presumably at Baodun too but this is not substantiated by direct genetic evidence from Baodun) were migrant millet farmers adopting rice, rather than being migrating rice farmers (Tao et al. 2023, 4999). Previous hypotheses on the origin of Baodun included an upward spread of rice farmers from the middle Yangzi River Basin, where Daxi 大溪 and Qujialing 屈家嶺 Culture sites (5000-3300 BCE, and 3400-2500 BCE, respectively) have wall enclosures and large architectural structures similar to the one documented at Baodun (Flad, Chen 2006; Fuller, Qin 2009; Zhang, Hung 2010). Other scholars attributed the origin of Baodun to the southward Majiayao expansion, based on ceramic similarities (Huang, Zhao 2004; Jiang, Wang, Zhang 2001). While this is the most favoured hypothesis for the origins of agricultural spread to Southwest China (see below), and it has been confirmed by some genetic data at Gaoshan, Tao and colleagues clarify that further sampling is needed to understand the formation of mixed farming in the area (Tao et al. 2023, 4999).

In Tibet, domesticated crops are reported from the early third millennium BCE at Chamdo Karuo/Qamdo Karuo/Mkhar-ro 昌都卡若 and Gshorngul-mda/Xiaoenda 小恩达, in the upper Langcan (Mekong) River in eastern Tibet, and from La Phob 拉颇 in southern Tibet **[fig. 30] [tab. 13]**.[6] Karuo is located at 3,100 m asl; charred foxtail and broomcorn millet seeds have been retrieved through floration and directly dated to 2800-2100 BCE (d'Alpoim Guedes et al. 2013a; Song et al. 2021). At Karuo foxtail millet is more predominant than broomcorn millet, and the cereals are present throughout the whole occupation of the site (including a second period after a temporary abandonment between 1600-700 BCE, see below). Given the location of the site at an altitude higher than the assumed altitudinal limit for millet cultivation (2,400 m asl),[7] past scholarship suggested that ancient Karuo people were foragers which obtained cultivated crops via trade (e.g., d'Alpoim Guedes, Manning, Bocinsky 2016; d'Alpoim Guedes 2018). However, palaeoclimate studies have evidenced that at the time of Karuo's occupation, the weather was warmer and wetter and therefore could have provided suitable conditions for the cultivation of millets.[8] Other plants retrieved include *Chenopodium* sp. seeds, and *Rubus*, *Artemisia*, and *Potentilla/Fragaria/Duchesnea* species seeds (Song et al. 2021). Fish bones were also reported, and the authors of the study suggest people at Karuo were practicing a broad-spectrum subsistence strategy, which included a wide variety of both floral and faunal resources (Song et al. 2021). Foxtail and broomcorn millet seeds have been retrieved through flotation at Xiaoenda, a site not far from Karuo, located at 3,140 m asl and dated to 2900-2200 BCE on mammalian bones (Zhang et al. 2019; Lu 2023). Here, the large faunal assemblage included mostly wild animals (e.g., musk deer, roe deer, goral, and blue sheep) and possibly domesticated pigs (Zhang et al. 2019). Current genetic and linguistic evidence both indicate that farming on the Tibetan Plateau likely ultimately originates from demic expansion of Yellow River millet farmers (see Jacques, Stevens 2024 for a recent summary of the research on this topic).

At La Phob, located at 2,788 m asl on the Bodui Zangbo River Basin, directly dated foxtail and broomcorn millet grains indicate the contemporaneous presence of the crops as at Karuo, and high quantities of *Chenopodium* seeds have also been reported, suggesting it was most likely exploited as food resource (Yang et al. 2024a). Domesticated pig bones have also been unearthed at the site and directly dated to 2800-2100 BCE, indicating that pigs were possibly raised at the site at the same time as millet was cultivated

6 d'Alpoim Guedes et al. 2013a; Song et al. 2021; Zhang et al. 2019; Lu 2023; Wang Y.R. et al. 2024.

7 This was also empirically inferred from a large survey conducted on the northeastern Tibetan Plateau (in modern Qinghai Province) when flotation samples from test pits were collected during surveys (Chen et al. 2015). The results showed that sites located at elevations lower than 2,527 m asl almost exclusively contained seeds of broomcorn millet, while later sites (especially those dating to after 1600 BCE) were barley dominant and these sites were located at higher elevations than millet sites (as high as 3,000 m asl; Chen et al. 2015). The authors of the study suggest this reflects environmental constraints in millet cultivation; however, recent research from Karuo and La Phob challenge this interpretation, at least for the southern Tibetan Plateau.

8 Today cultivated crops in the area include barley, wheat, turnips and rapeseed (Song et al. 2021).

(Yang et al. 2024a). Stable isotope analyses were conducted on both pigs and other herbivore species found at the site. The results indicated that pigs consumed a C_4 diet ($\delta^{13}C$ average value –8.4‰ ±0.5‰; n=11) in contrast to herbivores, which showed a C_3 based diet (in line with the reconstructed background vegetation make-up; $\delta^{13}C$ average value –19.0‰ ±0.7‰; Yang et al. 2024a). Authors of the study suggested that pig manure was utilised to fertilise millet fields (and before this time the status of pigs as wild boar or domesticated animal is unknown; Yang et al. 2024a). This kind of intensive millet-pig economy has been attested since the fourth millennium BCE in the Yellow River Basin in North China (Yang J.S. et al. 2022; Wang X. et al. 2018)[9] but before the discovery of La Phob, this kind of system was thought to not reach the high altitudes of Tibet. Agricultural crops were thought to spread to the Tibetan Plateau in the absence of domesticated animals, with wild animal hunting maintaining an important role in the early agricultural communities established on the Plateau.

The southward Majiayao expansion, originating in Gansu and moving along the eastern edge of the Tibetan Plateau, is widely regarded as the likely origin of agriculture in Southwest China. This expansion is believed to have stemmed from the earlier Yangshao expansion from the Yellow River Basin during the late Yangshao period.[10] The Majiayao dispersal to Sichuan is supported by similarities in painted ceramic types and chemical composition analyses on ceramic paint, for example documented at Yingpanshan (Hung 2011). Some authors have suggested that the chronological discrepancy in the arrival of millet and rice in Sichuan, as seen at Guijiabao (at present the earliest attested evidence for mixed rice-millet systems in Sichuan), indicates a separate dispersal for the cereals, possibly two successive waves (or routes) of spread. The lack or later appearance of rice in millet predominant systems outside of the Chengdu Plain suggests that the emergence of agriculture in Sichuan may indeed derive from migrating millet agriculturalists, which adopted rice farming. The lack of documented cultural connections and interactions between the Yangzi region and Sichuan in these centuries (Hao et al. 2022), along with the recent genetic evidence from Gaoshan (Tao et al. 2023) substantiate this view, but wider sampling from more sites in Sichuan (including Baodun) is needed to fully confirm this hypotheses.

5.2.2 Second to First Millennium BCE Sites and the Arrival of Wheat and Barley

The agricultural systems of Southwest China expand in the second millennium BCE, following the arrival of wheat and barley (see § 2.5.2). Directly dated wheat grains (1600-1400 BCE; d’Alpoim Guedes et al. 2015) have been reported from Ashaonao 阿梢垴, located in the Jiuzhaigou National Park on the eastern margin of the Tibetan Plateau in Sichuan Province **[fig. 30]**. At the site, the archaeobotanical assemblage is wheat dominant, and

9 Although conclusive proof of millet manuring is still lacking, scholars suggest that this may be the driver behind the expansion of millet agriculture in the millennia previous (Yang et al. 2024b; Wang X. et al. 2018).

10 The literature on this topic is vast, see for example Jiang 2004; Zhao, Chen 2011; d’Alpoim Guedes 2013; d’Alpoim Guedes, Butler 2014; d’Alpoim Guedes et al. 2013a, 2015; Chen et al. 2015; He 2015; d’Alpoim Guedes, Hein 2018; Song et al. 2021.

other potential edible resources include seeds of elderberry (*Sambucus* sp.), *Rubus* sp., and *Potentilla*/*Fragaria* sp. Hexaploid barley and flax (*Linum usitatissimum*) seeds have been reported from samples dating to the late first millennium BCE, at present among the earliest attested evidence for flax in East Asia (d'Alpoim Guedes et al. 2015). Albeit dated via cultural association, wheat grains have also been reported from Zhonghai 中海, on the Chengdu Plain, by the mid-second millennium BCE (Chengdu 2012; Yan, Zhou, Jiang 2014).

Wheat and barley grains have been reported from sites in Tibet from the mid-second millennium BCE, where they appear to be initially cultivated in mixed systems alongside millets **[tab. 13]**. Two grains of wheat and one of possible barley have been retrieved from Karuo and the wheat directly dated to ca. 1500 BCE (Liu et al. 2016; Lu 2016), although these are intrusive to their layer of provenance (with millet grains from the same contexts dating to few centuries earlier; Song et al. 2021). Wheat and barley grains have been reported from Changguogou/'Phreng-po-lung 昌果沟, on the southern Tibetan Plateau, about 580 km southwest of Karuo **[fig. 30]**. Here, archaeobotanical remains also include seeds of foxtail millet and possible pea and oat (ca. 1500-1200 BCE; Fu 2001; d'Alpoim Guedes et al. 2013a; Gao et al. 2020b). Wheat and barley grains, in association to foxtail and broomcorn millet grains, have been directly dated to ca. 1500 BCE at Liding/Klu Lding 立定, in southern Tibet (Wang Y.R. et al. 2024). At Klu Lding, *Chenopodium* seeds are also present, along with several other dryland cultivation species which support the local cultivation of millet (Wang Y.R. et al. 2024). Another important site where wheat and barley have been attested is Qugong 曲贡, located north from Changguogou. Here, flotation samples included seeds of wheat, barley, broomcorn and foxtail millets (directly dated to ca. 1400 BCE), tartary/bitter buckwheat (*Fagopyrum tataricum),* and possible pea. More than half of the archaeobotanical assemblage is constituted by wild seeds, among which *Chenopodium* grains are particularly dominant (Gao et al. 2021). Tartary buckwheat seeds from Qugong represent the earliest archaeological find of this species in China today. At the site, animal remains derived from wild deer and domesticated yak and sheep, possibly indicating the development of agro-pastoral subsistence strategies.

Around the end of the second millennium BCE, a barley dominant subsistence became well established especially at sites located at high altitutes (>2,500 m asl). A barley dominant archaeobotanical assemblage has been reported from Bangga 邦嘎, a site on the southern Tibetan Plateau located at ca. 3,700 m asl (1055-210 BCE; Tang et al. 2021). Barley seeds at Bangga have been directly dated to 1055-899 BCE (Tang et al. 2021). Other species at Bangga include wheat (although wheat grains have been directly dated to a few centuries later than barley; ca. 820-595 BCE), low quantities of buckwheat (identified as *Fagopyrum* sp.), and high quantities of *Chenopodium* seeds, which the authors of the study infer deriving from animal dung burning, rather than human consumption. One flotation sample from Bangtangbu 邦唐布 (ca. 1263-1056 BCE), a site located 10km from Bangga, contained seeds of naked barley, wheat, broomcorn millets and numerous wild species remains, including *Chenopodium* sp. (Tang et al. 2021). Naked barley has been reported from Kuoxiong 廓雄, located at 4,000 m asl further west upstream on the Yarlung Zangbo River **[fig. 30]**, but the archaeobotanical data is ambiguous (Tang et al. 2021). A positive correlation between barley presence and increases in altitudes had been previously attested during a large survey of the northeastern Tibetan Plateau (in modern Qinghai Province; Chen et al. 2015). The survey showed that millet dominant sites are present below >2,500 m asl, while barley dominant sites are found at elevations as high as 3,000 m asl (Chen et al. 2015).[11] Compared to millet, barley is much more tolerant to night frosts; survives well to drought and is known to mature even with short daylight during growing period, which would make it particularly well adapted to high altitudes, and this may be among the reasons for the development of a barley dominant economy in southern Tibet from the end of the second millennium BCE onward.[12]

5.2.3 Summary

When comparing Yunnan with the other southwestern Chinese provinces, the first attested agricultural trajectories in different areas appear quite different. Environmental constraints played a crucial role in directing the individual pathway of each of the diverse regions of Southwest China, but Majiayao millet farmers expansion had an important role in the initial spread of millet to the region. The first attested agricultural systems in Sichuan were based on millet cultivation, with rice appearing a few centuries later than the first appearance of millet regimes. Mixed farming systems based on rice and millet are reported from at least 3000 BCE in southern Sichuan, as attested at Guijiabao, a site close to Yunnan's border. Although the precise origin for rice spread to Guijiabao is unclarified, rice and millet may have formed a package in this area of Sichuan, and from there entered Yunnan. Rice dominant systems, instead, became established in the water-rich Sichuan Basin. While in Sichuan rice predominant systems are confined to water-rich lowlands (such as the Chengdu Plain), within Yunnan, the first documented agricultural systems are mixed regimes based on both rice and millets, with various levels of predominance of either one of these crops in different areas of Yunnan (see Ch. 4) **[fig. 29]**. On the Tibetan Plateau, agriculture initially developed thanks to millet dispersal, which contrary to previous hypotheses, became established even at high elevations, such as at Karuo and La Phob (2,788 m asl). Here, an intensive millet-pig economy has been attested by both macro botanical remains and isotope studies. From the mid-second millennium BCE, the spread of wheat and barley to the region caused a shift to barley predominant systems, especially at high altitudes. Here, the faunal data suggest the development of an agro-pastoral subsistence, based on the cultivation of cereals (barley), the raising of sheep/goat (and possibly yak), and occasionally hunting wild species. While wheat and barley are much better suited than millet to the Tibetan Plateau high altitudes environmental constraints, they have broadly similar ecological and growing requirements, with barley having slightly lower water needs than wheat **[tab. 9]**. Barley's lower water requirement may have led to its

11 Barley has also been reported in western Tibet at the sites of Piyang 皮央 and Jiweng 吉翁 at elevations above 4,000 m asl (both sites have been directly dated on barley grains to ca. 390-210 BCE, see Tang et al. 2022). The authors of the study suggest that barley was cultivated at both sites.

12 Jamieson, Beck 2010; d'Alpoim Guedes et al. 2015; d'Alpoim Guedes, Manning, Bocinsky 2016; Tang et al. 2021, 2022 predominance over wheat, however, other reasons (such as taste preferences and other social factors) cannot be excluded, as already highlighted by other scholars (Tang et al. 2021). Seasonally differentiated harvesting times for cultivated crops are recorded in Chinese written texts from the late first millennium BCE (Liu et al. 2017). Scholars have argued that spring, wheat and barley varieties developed after the dispersal of the two species to the Tibetan Plateau. Based on the available data, spring varieties may have originated around the end of the second millennium BCE. The retrieval of pea seeds at Karuo and Changguogou may indicate the development of connections and spread of crops from India, where peas have been reported from Neolithic and Harappan sites along the southern Himalayas at least a millennium earlier than those reported at Karuo and Changguogou.[13]

5.3 Beyond Southwest China: Ancient Migrations and the Role of Plants

Southern China, but especially Yunnan, has been postulated to be the source for the dispersal of agriculture to mainland Southeast Asia, in part based on linguistic reconstructions for early Austroasiatic languages (see § 2.2.1.1) and in part based on similarities in material culture production and innovations. Recent archaeological research has demonstrated that short and long-range networks for metal sourcing existed across Yunnan and Southeast Asia from at least the late second millennium BCE.[14] While the emergence of metallurgy in Yunnan from the late second millennium BCE was the result of earlier cultural connections, and possibly migrations, from Northwest China (e.g., Ciarla 2013; Min 2009a; 2009b), scholars argue that in mainland Southeast Asia, this technological innovation was the result of cultural connections established with southern China, possibly Yunnan, from the mid-third millennium BCE (based on similarities in ceramic decorations, see below).[15] The spread of metallurgy is attested by the widespread presence of copper alloy deep-socketed axes produced through bivalve casting moulds (a technique ultimately originating in the Steppe; Pigott, Ciarla 2007). Deep-socketed metal axes and bivalve moulds have been found, for example at Haimenkou (1400-400 BCE), in Yunnan, Oakaie and Nyaung'gan in Myanmar (end of second millennium BCE), Thanh Den in Vietnam, Non Pa Wai (1000-700 BCE), Ban Non Wat and Ban Chiang in Thailand (1050-420 BCE; see Higham 2021 for a recent synthesis on the topic). The presence of incised/impressed ceramic remains at late third to second millennium BCE sites in Yunnan and mainland Southeast Asia have been argued to represent those earlier cultural connections and interactions across the regions, which were conducive for the later emergence of metallurgy in Southeast Asia (e.g., Rispoli 2007; Rispoli, Ciarla, Pigott 2013;

13 For examples, pea is reported in northern India from Masudpur VII (ca. 2870-2470 BCE; Bates 2024; Bates, Petrie, Singh 2017); Hetapatti (ca. 2500- 2250 BCE; Pokharia et al. 2016), Senuwar (ca. 2500- 2000 BCE; Saraswat 2004a), Ojiyana (ca. 2450-1500 BCE; Liu et al. 2017), and Kanispur in Kashmir (ca. 2700-2000 BCE; Pokharia et al. 2017). See also Ch. 4 fn. 33, 38.

14 Pryce et al. 2023; 2022; 2021; Higham 2021; Yun, Scott 2020; Chiou-Peng 2018; Ciarla 2013.

15 Although a possible route via Lingnan has also been proposed. For the Yunnan route see Yun, Scott 2020; Chiou-Peng 2018; Ciarla 2013; Rispoli, Ciarla, Pigott 2013; White, Hamilton 2009; for the Lingnan route see Ciarla 2013; 2007; Pigott, Ciarla 2007; Higham 1996b.

Ciarla 2013). In northwest Yunnan, incised/impressed ceramic remains have been reported from Baiyangcun, Xinguang, Dadunzi, Mopandi, Haimenkou, and Shifodong as well as the majority of known Neolithic sites in Yunnan (which have not been discussed in Ch. 4 for lack of archaeobotanical remains). Sites with this ceramic tradition cluster along the upper Langcan (Mekong), middle Nujiang (Salween), Jinsha (Yangzi), and Yalong rivers. At Karuo, in the upper Langcan River in eastern Tibet **[fig. 30]**, incised/impressed zigzags and diamond-shaped designs have been reported. Similarly decorated ceramic remains have recently been reported from Guijiabao, in the Jinsha River Basin in southern Sichuan, dated to 2500-1700 BCE (Hao et al. 2022). From the second half of the third millennium BCE onward, incised/impressed ceramics "appear suddenly at sites distributed in the major river plains" of mainland Southeast Asia (Rispoli 2007, 238; Rispoli, Ciarla, Pigott 2013).[16] This includes sites in Thailand (Higham 2021), Vietnam (such as An Son and Loc Giang; Sarjeant 2014), and north-central Myanmar (Hudson, Lwin 2012; Pautreau, Coupey, Kyaw 2010; Pryce et al. 2024). According to Rispoli and colleagues, two designs are the most recognizable and representative of these cultural connections: the 'meander' and 'double-S' designs **[fig. 31]**. Examples of such designs are known in Yunnan at Dadunzi,[17] Mopandi, Xinguang, and Shifodong (listed here are only the already discussed sites in Ch. 4). Although, upon close examination of the relative proportions of each design presence, this is quite low. For example, at Mopandi the meander design accounts for only 0.6% out of the 8% incised/impressed ceramic remains retrieved at the site (Yunnan 2003); at Xinguang, the double-S design accounts for 5% out of the 30-50% incised/impressed ceramic remains from Xinguang; moreover, the design decreases through time (Yunnan 2002). Unfortunately, no information is provided about the relative proportions of these designs from Dadunzi, where the incised/impressed decorations account for 30% of the overall ceramic assemblage. In mainland Southeast Asia the two designs have been reported from Non Pa Wai, Tha Kae, Khok Phanom Di and Ban Chiang among other sites with incised/impressed decorations (Rispoli, Ciarla, Pigott 2013) **[fig. 31]**.

16 Here incised/impressed ceramics are often associated with small, polished stone tools, stone or shell bracelets and necklace beads.

17 The ceramic sherd illustrated in in Rispoli, Ciarla, Pigott 2013, 120 fig. 12 is mistakenly attributed to Baiyangcun; it comes instead from Dadunzi (illustrated in the 1997 excavation report published in *Kaogu Xuebao* 1, 66 fig. 16-5). Although incised/impressed ceramics constitute most of the ceramic remains reported from the first excavation season of Baiyangcun, this design has not been individuated in the currently published report (Yunnan 1981), but its presence cannot be excluded since material unearthed from the second excavation season is yet unpublished.

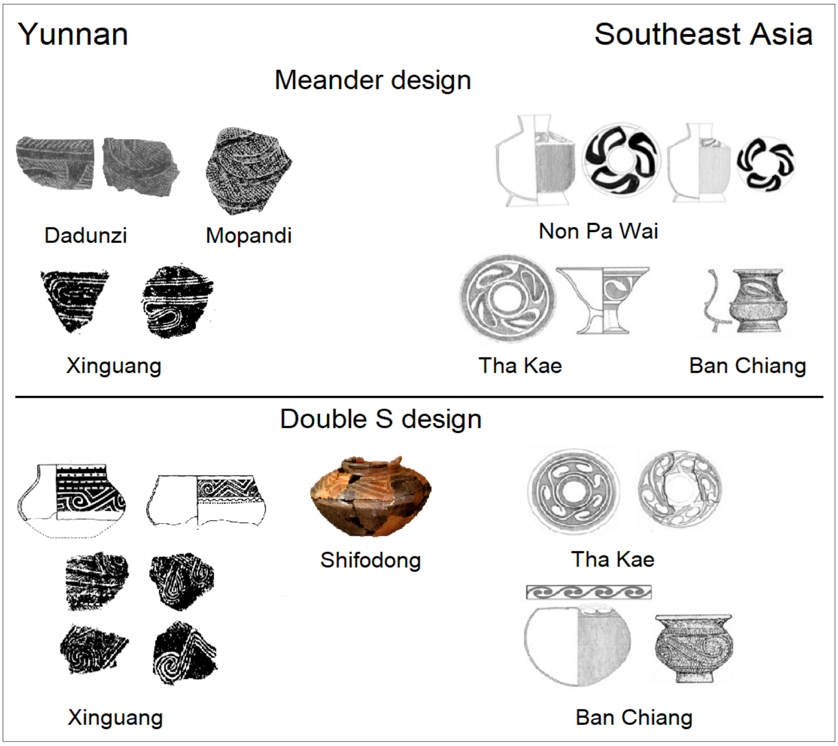

Figure 31 Illustrations of meander and double-S designs in incised/impressed pottery traditions with examples sites in Yunnan and mainland Southeast Asia that hold relevance for the dispersal of agricultural crops mentioned in text. From Dal Martello 2020, fig. 8-13. Redrawn and adapted from Yunnan 1997; 2002; 2003; Rispoli, Ciarla, Pigott 2013

Although such similarities in ceramic decorations from sites dating to the third millennium BCE onward suggest possible cultural contacts between Southwest China and mainland Southeast Asia, it remains unresolved whether these similarities derive from direct dispersal (migration of populations from Yunnan) or from multi-directional trade and exchange. Some scholars highlighted how the meander and double-S designs are absent from the incised/impressed ceramic remains at those sites located north from the middle Jinsha Basin (such as Karuo) and have inferred that this cultural trait originates in the Jinsha Basin before dispersing south, based on the later dates of sites in mainland Southeast Asia (Hao et al. 2022). One limiting factor in fully understanding the nature of these connections is the lack of equivalent shared typewares and systematic chaîne opératoire studies, which would allow the evaluation of homologies in pottery assemblages from the regions (Pryce et al. 2023, 174), but most importantly, as already noted by numerous scholars, incised/impressed ceramics sites from Yunnan and mainland Southeast Asia share rather close chronologies,[18] which further complicates reconstructing the nature and directions of these cultural connections. In this section I review evidence of agricultural practices in mainland Southeast Asia on the basis of archaeobotanical material, so to

18 For recent syntheses on chronologies based on radiocarbon dating from the region see for example Higham, Douka, Higham 2015; Dal Martello 2022; Pryce et al. 2018; 2024; Yao A. et al. 2020.

evaluate the possible role of Yunnan early agricultural communities in the emergence of the first agricultural systems in mainland Southeast Asia.

Many of the known archaeological sites in mainland Southeast Asia dating to between the third and first millennia BCE have been excavated before the introduction of flotation, which results in a limited number of sites with reported archaeobotanical remains **[tab. 14]**. Rice grain impressions and grains and husk inclusions are instead reported from numerous sites. For example, in Laos, where no flotation studies are known, rice inclusions have been reported from Lao Pako, along the Mekong Basin, which however is dated to 300-600 CE (Kallen 2004) **[fig. 32]**.[19]

Table 14 Summary of the main early sites in mainland Southeast Asia; chronological date; recovery methods of archaeobotanical materials; main archaeobotanical cultigens present at the sites; animal resources present if known/zooarchaeological analysis present. Adapted from Dal Martello 2020

Site	Chronology	Plant collection method	Plant remains	Faunal remains	References
Thailand					
Non Pa Wai	2470-2200 BCE/ 1000-700 BCE	Flotation	*Setaria italica*/ Second phase: *Setaria italica* *Oryza sativa* *Panicum* sp. *Coix lacryma-jobi*	*Sus scrofa* *Canis familiaris* *Cervus* spp. *Bos* sp. *Bubalus bubalis* *Bos frontalis* (gaur) *Bos indicus* Catfish-*Mystis* sp. Birds (mostly fowl) Turtles snakes & lizards	Weber et al. 2010; Pigott et al. 2006
Khok Phanom Di	2000-1400 BCE	Flotation	*Oryza sativa** *Coix* sp. *Paspalum* sp. *Eragrostis* sp. *Amaranthus* sp. *Eleocharis* sp. *Cyperus sp.* *(rice cultivation regime unclear: decrue?)	*Sus scrofa* *Macaca* sp. *Cervus* sp. *Canis* sp. *Muntiacus muntjak* *Bos* sp. *Bubalus bubalis* Birds Reptiles (including crocodile) Turtles Fish & mollusks	Thompson 1996
Non Mak La	2100-1450 BCE/ 1450-700 BCE	Flotation	*Setaria italica*/ Second phase: *Setaria italica* *Oryza sativa*	-	Weber et al. 2010
Ban Non Wat	Neolithic: 1750-1050 BCE Bronze Age: 1050-420 BCE Iron Age: 420 BCE- 500 CE	Flotation	*Oryza sativa* (initially associated with dryland weed species; later shift from dryland to wetland weeds)	Pig	Castillo 2013; Higham 2004; Higham, Higham 2009; Castillo et al. 2018a
Tha Kae	1700-1100 BCE	Chaff- pottery impressions	Rice	-	Rispoli, Ciarla, Pigott 2013

19 According to the report, rice material inclusions in pottery temper from Lao Pako are sometimes in such a high density that vessels seem unsuitable to be used as containers (Kallen 2004, 204).

Site	Chronology	Plant collection method	Plant remains	Faunal remains	References
Ban Chiang	1650-1050 BCE/ 1050-400 BCE	Flotation	*Oryza sativa*	*Bos* sp *Cervus* sp. *Sus scrofa* *Canis familiaris* *Bubalus bubalis*	Yen 1982; White 1982; Thompson 1996
Nil Kham Haeng	1350-800 BCE/ 800-500 BCE	Flotation	*Setaria italica* Second phase: *Setaria italica* *Oryza sativa*	Turtle	Weber et al. 2010
Ban Na Di	900-500 BCE	Hand-picked	Rice	Cattle Pig Dog Fish Turtle Crocodile Frog	Castillo 2013; Higham et al. 2015
Khao Sam Kaeo	400-100 BCE	Flotation	*Oryza sativa* *Setaria italica* *Vigna umbellata* *Vigna* spp. *Macrotyloma uniflorum* *Citrus* sp. *Gossypium* sp. *Sesamum indicum*		Castillo 2013; Castillo, Fuller 2010; Castillo et al. 2016
Noen U-Loke	450 BCE- 500 CE	Flotation	*Oryza sativa** *(shift from dryland to wetland weeds)		Castillo et al. 2018a
Khao Sek	400-100 BCE	Flotation	*Oryza sativa*		Castillo 2018
Phu Kao Thong	200 BCE- 20 CE	Flotation	*Oryza sativa* *Setaria italica* *Vigna umbellata* *Vigna spp.* *Macrotyloma uniflorum* *Citrus* sp. *Gossypium* sp. *Sesamum indicum*		Castillo 2013; Castillo et al. 2016
Phromtin Thai	500 BCE- 900 CE	Flotation	*Oryza sativa* *Setaria italica* *Vigna* sp. Fabaceae		d'Alpoim Guedes et al. 2018; 2020
Vietnam					
An Son	2300-1200 BCE (wood charcoal, human teeth, food residue)	Pottery impression* (microCT), Phytoliths *from 1800 BCE	*Oryza sativa japonica* chaff (Gene coding)	Mammals: Pig Dog Reptiles: Fish Turtles	Bellwood et al. 2011; Barron et al. 2017
Loc Giang	2000-1300 BCE	Pottery impressions (microCT)	Rice		Barron et al. 2017
Trang Kenh	2000-1000 BCE (wood charcoal, plant fragments)	Starches	Foxtail millet? Rice?		Wang W. et al. 2022
Dong Dau	1400-800 BCE	Pottery impressions/ Flotation	*Oryza sativa*		Nguyen 2002; 2013; 2017
Thanh Den	1700-600 BCE	Pottery impressions/ Flotation	*Oryza sativa*		Nguyen 2017

Site	Chronology	Plant collection method	Plant remains	Faunal remains	References
Rach Nui	1845-1385 BCE	Flotation	*Oryza sativa* *Setaria italica* Both crops imported Large quantities of roots, tubers, and sedges (exploited)	Shellfish and fish: *Geloina coaxans* *Cerithidea obtusa* *Neritina violacea* *Ellobium* sp. Freshwater fish Reptiles: *Batagur* sp. Turtles: *Cuora* sp. *Cyclemys* sp. *Crocodylus porosus* *Varanus* sp. *Macaca* sp. *Sus scrofa* *Canis familiaris* (exploited for meat) Indet. birds *Cervus* sp. Pig Dog	Oxenham et al. 2015; Castillo et al. 2018b
Lo Gach	1100-700 BCE	Flotation (unpubl.)	*Oryza sativa*		C. Castillo, pers. comm., 2018

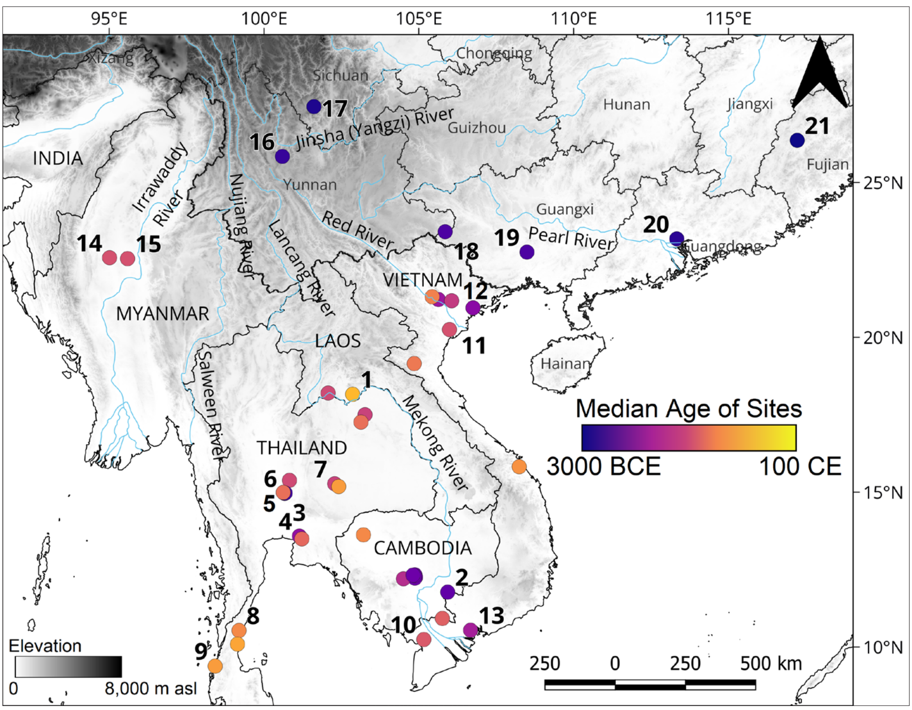

Figure 32 Sites in mainland Southeast Asia and southern China with evidence for domesticated crops, plotted chronologically based on median age of occupation (see Appendix 6). Site mentioned in text. 1. Lao Pako; 2. Krek 52/62 sites; 3. Non Pa Wai; 4. Khok Phanom Di; 5. Non Mak La; 6. Nil Kham Haeng; 7. Ban Non Wat; 8. Khao Sam Kheo; 9. Phu Khao Thong; 10. An Son; 11. Loc Giang; 12. Trang Kenh; 13. Rach Nui; 14. Oakaie; 15. Nyaung'gan; 16. Baiyangcun; 17. Guijiabao; 18. Gantuoyan; 19. Dingshishan; 20. Gancaoling; 21. Nanshan. Made by the Author with QGIS 3.28.5-Firenze, Natural Earth and EROS Digital Elevation basemap, U.S. Geological Survey

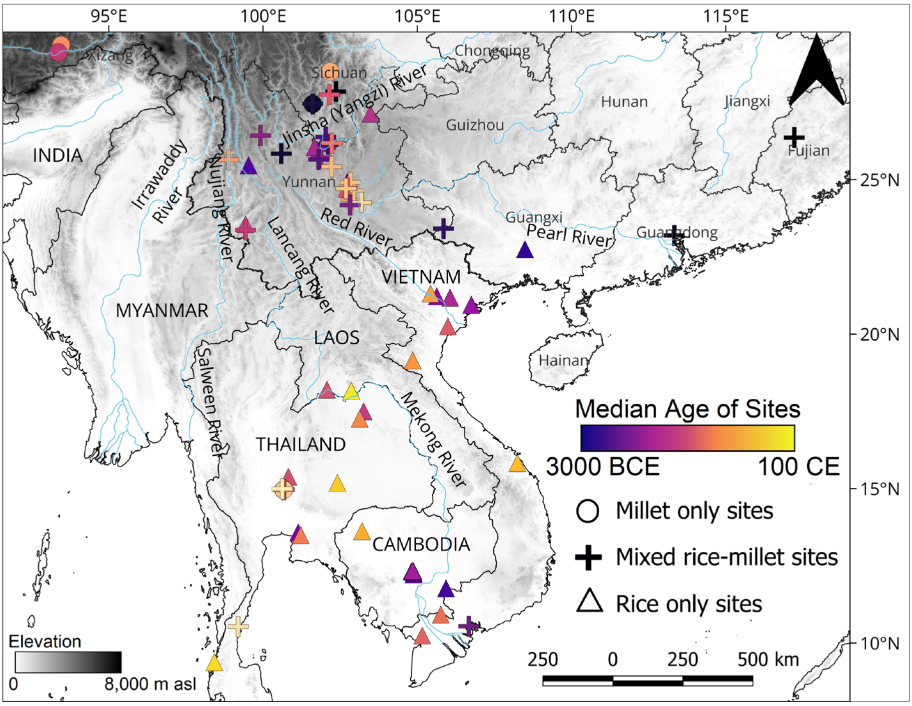

Figure 33 Presence of rice, millet, and mixed farming systems in southern China and mainland Southeast Asia between the late fourth to the first millennium BCE, highlighting potential routes of dispersal of main crop species into and out of Yunnan (sites plotted chronologically based on median age of occupation phase for the first documented appearance of the crops; all sites listed in Appendix 6). Made by the Author with QGIS 3.28.5-Firenze, Natural Earth and EROS Digital Elevation basemap, U.S. Geological Survey

In Cambodia flotation studies from prehistorical sites are lacking, and here, rice chaff inclusions have been reported from circular earthwork sites, including Krek 52/62, Samrong Sen, and Mlu Prei, all located in the Mekong Basin and dating to the second millennium BCE (Vanna 2002) **[fig. 32]**. This kind of rice remains can only indicate the availability of the plant during the occupation of these sites, and do not provide information about its domestication status or role in the economy. Wild rice presence in the area would be expected as mainland Southeast Asia was part of the natural wild rice distribution during these millennia **[fig. 5]**. Recently, microCT (Micro Computed Tomography) scanning has proved to be a useful tool to further investigate this kind of remains, which otherwise do not provide information about the domesticated status of the crop and its role in the overall economy of the site. MicroCT scanning can capture and re-create a 3D microscale morphology of the remains included in the pottery sherds, such as rice husks and spikelets, and allows the researchers to determing whether the rice plants were domesticated or not. However, this type of analysis has been applied only to two sites so far (An Son and Loc Giang in Vietnam; Barron et al. 2017; see below). For these reasons, sites with rice inclusions are not further discussed below.

At present the earliest securely dated evidence for domesticated crops in mainland Southeast Asia comes from Non Pa Wai, in central Thailand, where hundreds of foxtail millet grains have been recovered, and direct radiocarbon dating on one foxtail millet grain furnished a date of 2470-2200 BCE

(Weber et al. 2010). At Non Pa Wai, rice grains are present in much lower quantities than millet and appear at the site only in the first millennium BCE (Weber et al. 2010, tab. 14). The early date of this find is not universally accepted, with some scholars questioning the reliability of the small sample size (only one grain) and more generally pointing to the high level of disturbance at the site (Rispoli, Ciarla, Pigott 2013). However, given the short life cycle of herbaceous Poaceae plants like foxtail millet (within one year), direct dates on charred seeds from these plants provide strong reliability for their chronology, regardless of the sample size.[20] The identification of the seed with *Setaria italica* can also be confirmed through examination of photos and descriptions provided in Weber et al. 2010, thus excluding confusion with local species.

The earliest report of rice grains and domesticated-type spikelet bases is attested from Khok Phanom Di, a site dating to dating to the early second millennium BCE (2000-1400 BCE) and located close to the Gulf of Thailand (Thompson 1996; Higham, Thosarat 2012) **[fig. 32]**. Here, rice is present in the absence of millet. Isotope analyses on human bones have demonstrated that a number of female individuals buried at Khok Phanom Di were not born locally. Based on this, scholars investigating the sites hypothesesed that rice was imported to the region with the arrival of these female individuals (rice farmers?), and it was further suggested that rice was cultivated in seasonally flooded fields located in swamps. However, this hypotheses cannot be substantiated due to the lack of any kind of weedy flora from the plant remains retrieved at the site (see below; Castillo 2017; Thompson 1996).

After ca. 2000 BCE, rice and foxtail millet grains have been found at Non Mak La (2100-700 BCE) and Nil Kham Haeng in central Thailand (1350-800 BCE; Weber et al 2010) **[fig. 32]**. At the two sites, rice quantities from samples dating to the mid-second millennium BCE are initially quite low. Higher quantities of rice remains are reported only from the first millennium BCE (Weber et al. 2010). The soil types of the area are characterised by limestone derived clay, clay loam and silty clay, which are unsuitable for wetland rice cultivation (Pigott et al. 2006). For this reason, scholars suggested that either rice was not locally cultivated or that if it was, people adopted opportunistic cultivation strategies and cultivated rice in a dryland regime, much the same way as foxtail millet, also present at the sites, was cultivated (Castillo 2017, 344). This kind of dryland rice regime has been attested in the late first millennium BCE from Ban Non Wat, in central Thailand, and Khao Sam Kaeo and Phu Kao Thong, in southern Thailand **[fig. 32] [tab. 14]**.[21] At all three sites, rice is associated with seeds of *Acmella paniculata*, a dryland species that indicates rice was cultivated in a rainfed regime (Castillo et al. 2018a; 2016; Castillo 2013). Present day average annual precipitation in central Thailand is around 1,200-1,300 mm; this high level of precipitation would support rainfed rice agriculture **[tab. 3]**. Scholars have also noted the higher presence of wild animal taxa compared to domesticated ones from the early sites in central Thailand (Mudar, Pigott 2003; Pigott et al. 2006). This, together with the

20 For example, direct dates on charred millet grains from sites in Europe demonstrated that the seeds were intrusive to their layer of provenance, demonstrating the importance of directly dating charred grains (Filipović et al. 2020; Motuzaite-Matuzeviciute et al. 2013).

21 Kealhofer, Piperno 1994; Mudar 1995; Weber et al. 2010; Higham 2014; Wohlfarth et al. 2016; Castillo et al. 2016, 2018a; Castillo 2017, 2018.

archaeobotanical data, suggests a low intensity hunting and gathering subsistence supplemented by rainfed farming for the second and early first millennium BCE. Some scholars argue this indicates a persistence of local foragers subsistence traditions (d'Alpoim Guedes et al. 2020). This type of dryland agriculture in central mainland Southeast Asia would support linguistic reconstructions postulated by proponents of the 'Southern Riverine Hypotheses' according to which early Austroasiatic terminology included terms for upland (dry) cultivation, rather than lowland (wet) cultivation (Blench 2005; Sidwell, Blench 2011; see § 2.2.1.1). At Phu Kao Thong, in addition to rice, archaeobotanical flotation documented the appearance of pulse species dispersing from India, including mungbean (*Vigna radiata*), horsegram (*Macrotyloma uniflorum*), pigeon pea (*Cajanus cajan*)[22] and cotton (*Gossypium arboreum*; Castillo 2013; Castillo et al. 2016; Fuller, Castillo 2021). This indicates the establishment of maritime connection routes with India by the early first millennium BCE (Castillo, Fuller 2021).

At Ban Non Wat, dryland weed species decrease through time and wetland weed species, fox example *Diplacrum caricinum,* a typical rice paddy field weed, become predominant only from 100 BCE onward. This indicates that in this region wetland rice cultivation developed in the early first millennium CE (Castillo et al. 2018a; Fuller, Castillo 2021; Miller 2014). Water management practices in this time period have also been inferred from the presence of moats and water reservoirs structures at Noen U-Loke (450 BCE-500 CE) and Non Ban Jak, two sites not far from Ban Non Wat (King et al. 2014). At Noen U-Loke rice has also been reported (Castillo et al. 2018a).

Archaeobotanical remains from Vietnam are scarce. There are numerous reports of rice inclusions in pottery temper from sites in northern Vietnam dating to the second millennium BCE onward (Bellwood et al. 2011), and the transition from gathering to cultivation has been inferred based on the apparent decline in grinding stones at sites in Vietnam after the second millennium BCE. Domesticated rice has been identified at An Son and Loc Giang, in northern Vietnam **[fig. 32]**, through microCT scanning of rice inclusions in pottery temper (Barron et al. 2017). The site is dated to 2000-1300 BCE and at present is among the earliest conclusive evidence for domesticated rice in the region, although it has not been substantiated by direct dating. Recently, a study on starch residues from stone tools has indicated people may have been processing rice and possibly millet at Trang Kenh, in the Red River Basin in northern Vietnam, already in the late third millennium BCE (Wang W. et al. 2022), but this is not substantiated with macro-botanical remains, and the domesticated status of rice cannot be determined from starch grains. Rice and foxtail millet have been found at the site of Rach Nui, in southern Vietnam (1845-1385 BCE). Here, however, the crops are considered traded from inland rather than locally cultivated, in part due to the lack of rice inclusions in the locally produced pottery assemblage as well as the lack of suitable environmental growing conditions for either cereal (Castillo et al. 2018b).

In Myanmar, flotation was conducted at Halin located in the Irrawaddy River Basin in north Myanmar, close to the Yunnan's border (Neolithic occupation ca. 2500 BCE; Bronze Age transition ca. 1100 BCE; see Pryce et al. 2024); however, rice and millet seeds retrieved from the samples were

22 Pigeon pea may predate the arrival of the other species as *Cajanus* seeds have been reported from Non Pa Wai around 1100- 500 BCE (d'Alpoim Guedes et al. 2020).

later intrusions and no seed dated to either the Neolithic or Bronze Age period (D.Q. Fuller, pers. comm. 2025). Some preliminary information on the diet of ancient populations in Myanmar is available from a stable isotope study undertaken at the sites of Oakaie and Nyaung'gan, south from Halin, on the Chindwin River Basin, a tributary of the Irrawaddy. The two sites were occupied from the end of the second to the early first millennium BCE (Willis et al. 2022). Eighteen individuals were sampled from each site and the authors of the study interpreted the results as showing that people had a mixed C_3/C_4 diet ($\delta^{13}C$ values on dental calculus for Oakaie range from –8.6‰ to –4.9‰; Nyaung'gan –7.7‰ to –5.9‰), with some individuals being pure C_3 consumers and some being pure C_4 consumers (Willis et al. 2022, 12). It should be noted that for bone isotopic analyses such a range would indicate a predominately C_4 diet (see for example Liu et al. 2020 for China), but for dental enamel/apatite data such values are seen to be elevated (e.g., Tykot, Merwe, Hammond 1996). Given that as Willis et al. (2022, 11) state "Southeast Asia is largely a C_3 biome", the C_4 element of this diet is likely based on millet species. The authors further state in the conclusion that the sites are located in "the rainshadow of the Rakhine Mountains which is currently mostly not suitable for growing rice" (Willis et al. 2022, 12). Isotopes on pigs and bovids from the site show that pigs had a (according to the authors, mixed) diet similar to that of humans, and thus most likely consumed left over foods, while bovids had a largely C_4 based diet, consistent with grazing local grasslands. Locally available C_4 plants would include local wild Poaceae, job's tear (*Coix lachrymal-jobi*), and potentially foxtail or broomcorn millet if we presume a dispersal from China, possibly Yunnan, where foxtail and millet grains have been attested at Baiyangcun, ca. 2650 BCE, at least one millennium before the occupation of Oakaie and Nyaung'an. This hypothesis, however, cannot be confirmed, due to the lack of macro-botanical remains from Oakaie and Nyaung'gan (Willis et al. 2022).

5.4 Summary

The development of agriculture in Southeast Asia has been described as a "rapid and multi-directional" phenomenon (Oxenham et al. 2015, 310), which arose thanks to the 'greater Mekong' sphere, a network of interactions linking Vietnam, Thailand and Cambodia from at least the 2500 BCE (Bellwood et al. 2011). Archaeobotanical studies in mainland Southeast Asia are scarce and scattered; most of the available data coming from Thailand and dating to after ca. 2000 BCE. Here, the earliest documented agricultural systems were based on the dryland cultivation of foxtail millet. Rice spread to the area is attested later than that of millet, but itself was initially cultivated in a dryland regime, as demonstrated by the examination of the weedy flora associated to rice retrieved at Ban Non Wat, Khao Sam Kaeo and Phu Kao Thong. The most cited hypotheses in relation to the beginning of agriculture in mainland Southeast Asia was a spread from Yunnan in the context of the Austroasiatic languages dispersal (see § 2.2.1.1). The first documented agricultural systems in Thailand contrasts with farming systems attested archaeobotanically from Yunnan, where mixed rice-millet farming was present since the earliest stages of agricultural development.

At Baiyangcun, rice was most likely cultivated in a wetland regime, opposed to the dryland regimes attested in Thailand.

As opposed to a terrestrial route via Yunnan (itself traced back to Sichuan via Gansu, evidence by mixed farming at Guijiabao) **[figs 32-33]**, others have inferred that rainfed rice spread to mainland Southeast Asia through a coastal route via Guangdong/Guangxi (e.g., Castillo 2017; Castillo, Fuller 2010; Fuller et al. 2010). In Guangxi, rice and millet grains have been reported from Gantuoyan 感驮岩 (ca. 3500-1000 BCE; Lu 2009), but according to direct dates on seeds provided in the excavation report, these appear only in the second phase of occupation of the site (2000-800 BCE; Guangxi 2003, 55). Possible broomcorn millet (*Panicum miliaceum*) starch grains have been reported from Dingshishan site, dating to possibly as early as 5000-4000 BCE (Zhang et al. 2022a), but the identification of this find is disputed, and the antiquity of the material cannot be substantiated by direct dating. In Guangdong, recent archaeobotanical studies from the region have found evidence for mixed farming dating back the early third millennium BCE, for example at the site of Gancaoling (Deng et al. 2022a). Here, charred seeds of rice and foxtail millet have been directly dated to 2600 BCE, although the overall archaeobotanical assemblage is dominated by rice and only seven mature and eight immature foxtail millet grains have been retrieved (Deng et al. 2022a). In addition to cereals, other plant species at Gancaoling include *Canarium* sp., *Sambucus* sp., which may have been consumed, and wild weedy taxa indicative of a wetland landscape. The find of a *Canarium* endocarp, a tree nut that has been found at earliest sites in the region, shows a gradual transition to agricultural production rather than an abrupt change (Deng et al. 2019; 2022a). Although the origin for the spread of agriculture in the area is attributed to migrant rice farmers from the Yangzi Valley (via the Jiangxi Mountains), recent ancient DNA studies evidenced a mixture of local groups with Yangzi derived groups, indicating that farmers did not replace local hunter-gatherers but mixed with them (Matsumura et al. 2019; Yang M.A. et al. 2020; Wang et al. 2021). Further east on the Chinese coast, the earliest attested rice and foxtail millet grains have been documented at Nanshan 南山 (Yang et al. 2018; Carson, Hung 2018) from layers dated between 3300-2400 BCE, albeit the chronology was established on radiocarbon dating of charcoal and rice seeds, not millet seeds **[figs 32-33]**. If those millet seeds are not intrusive to their layers of provenance, this would place the spread of millet to this region from at least the mid-third millennium BCE, if not earlier. Other sites with archaeobotanical remains have also been reported in southern China dating to the early second millennium BCE (e.g., Deng et al. 2018; Yang et al. 2017, 2018). Scholars argued that the hilly landscape of Fujian may have been conducive to the development of dryland rice cultivation (Deng et al. 2018); however, this hypotheses has not yet been corroborated by either archaeobotanical weedy flora or phytoliths studies. Further archaeobotanical research might clarify this issue and at present the origin of the development of rainfed rice cultivation is still unanswered. The arrival of millet and later arrival of rice in mainland Southeast Asia indicate successive waves of dispersals or even separate routes of introductions for the two species **[fig. 33]**. Evidence of Indian legumes at Phu Kao Thong after the initial emergence of agriculture in the region indicates continued interactions and multiple waves of dispersal through the millennia. The emergence of metallurgy later than the initial spread of agricultural crops further demonstrates continued connections (Ciarla 2013, 221). Therefore, the history of cultural, agricultural and possibly demographic diffusion from China into mainland Southeast Asia does not appear to have been a single, clearly defined southward dispersal in terms of chronology and geographical direction. Instead, increasing evidence highlights a complex series of overlays that may have followed terrestrial, riverine and coastal routes across several millennia, through which agricultural and technological innovations emerged.

6 Conclusions

Summary 6.1 3,000 Years of Agriculture in Yunnan from the First Villages to the Han Conquest. – 6.2 Agriculture Beyond Yunnan.

6.1 3,000 Years of Agriculture in Yunnan from the First Villages to the Han Conquest

The recent accumulation of archaeobotanical studies coupled with direct radiocarbon dating of charred plant remains has greatly improved our understanding of the timings and geographies relating to the emergence of productive economies in China, including in Southwest China. Yunnan, at the geographical periphery of the early Chinese States, has often been at the margins of archaeological research, despite earlier claims of being the homeland of rice domesticators and the origin point of agricultural dispersal to mainland Southeast Asia, based on linguistics reconstructions (see § 2.2.1.1). After 15 years of systematic archaeobotanical research in China, the beginning of millet agriculture has been individuated in northern China starting by the sixth millennium BCE, while rice systems emerged along the middle and lower Yangzi by the end of the sixth/early fifth millennium BCE, with paddy-like rice fields documented in these areas from the fourth millennium BCE onward (see § 2.3.1.2). The collection of wild millet and wild rice is presumed to have started a few millennia earlier than this. In Yunnan, the first productive economies are mixed farming systems based on the cultivation of domesticated rice and millet. These are attested since the third millennium BCE in northwest Yunnan (as evidenced at least from ca. 2650 BCE at Baiyangcun, in the Jinsha Basin; Dal Martello 2020).

The apparent delay of a few millennia in the arrival of domesticated crops to Yunnan has often been attributed to the plants biological need to evolve

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suitable varieties to local environments.[1] This hypothesis was related to a potential rice farmers dispersal as main driver of agricultural spread into the region, and supported by the low attested presence of hunter-gatherer groups in Southwest China (although this may be biased by the limited available data). Within Southwest China, Yunnan's rugged topography creates a vertical zonation characterised by deep, water rich river basins surrounded by high mountains, which create mild weather valley conditions conducive to agricultural production. This allows for the existence of successive environmental niches that provide suitable growing conditions for the cultivation of plants with diverging requirements, including dryland and wetland crops such as millet and rice. As such, the rugged topography of Yunnan would not have created a barrier to crops spread, instead, the reason for this delay may be individuated in the fact that rice communities are less expansive than millet agriculturalists and major demographic expansions (and thus the spread of agriculture) were possibly linked to the establishment of millet systems (Qin, Fuller 2019; Stevens, Zhuang, Fuller 2024). Mixed farming systems based on the cultivation of rice and millet have been documented along the Yellow River Basin and northern Yangzi tributaries by the late fifth/fourth millennium BCE (see § 5.1). These are considered the result of millet farmers expansions that took up rice cultivation. Such expansions were at the basis of the first agricultural systems in Northwest and broader Southwest China, where mixed millet-rice systems are found in southern Sichuan only a few centuries earlier than in Yunnan, at Guijiabao (3000-2800 BCE; Hao et al. 2022) along the Jinsha Basin, after an earlier phase of millet only agriculture (from ca. 3300 BCE).

While genetic data regarding the origins of farmers at Baiyangcun and Xingyi is not available, data from later periods confirms migrations of millet farmers into Yunnan in the late second millennium BCE (attested at Haimenkou; Tao et al. 2023), which brought with them technological innovations (see below). Whether earlier demographic spreads or cultural connections played a role for the initial emergence of agriculture in Yunnan remains unclarified. At present, an introduction from Sichuan along the Jinsha Basin, driven by demographic expansion after the establishment of mixed farming systems in the area, is the most likely hypothesis. Early rice systems in northwest Yunnan were based on the wetland cultivation of the crop, as demonstrated by the examination of the weedy flora associated to rice at Baiyangcun. In the third millennium BCE, agricultural production in Yunnan continued to be complemented by the collection of local wild resources, albeit these are less well represented in the archaeobotanical assemblages, possibly hinting to diversified consumption patterns of wild resources compared to cereals. The preference of farmers to settle close to water reservoirs, such as along river basins, may have pushed pre-existing

1 It has also been noted that in addition to crop evolution, agricultural adaptation can take the form of cultural innovation with the development of new cultivation technologies and techniques (e.g., Fuller, Lucas 2017). Stevens and Fuller (2017) suggest a three-stage model for the spread of agriculture outside a domestication centre: Stage 1) cultivators moving within the natural distribution range of a wild species cause the replacement of collecting practices with cultivation activities; Stage 2) within the limit of the wild progenitor distribution, not yet fully domesticated plants expand and gradually replace wild ones; in this phase populations grow, and language families may spread with the spread of agriculturalist groups; Stage 3) agriculturalists move outside the natural ecologic limits of the wild progenitor and only in this case the species adapt to new ecosystems.

hunter-gatherer groups higher in the mountains. However, the extent and nature of interactions between hypothesised migrant farmers with local hunter-gatherers in Yunnan is unknown, due to the current limited archaeological research conducted in the province.

A wave of migrations is attested in the mid-second millennium BCE, when wheat and barley become incorporated into the already mixed agricultural systems of Yunnan (attested at Haimenkou by 1450 BCE; Xue et al. 2022). Agricultural change is accompanied by the emergence of metallurgy as attested by the local production of small bronze tools through bivalve stone moulding (Min 2009a; 2009b). Strong cultural affinities in ceramics traditions and now genetic data confirm that this spread derives from interactions and diffusions from Northwest China (Qinghai/Gansu regions). Recent finds of barley, alongside possible pea in southeastern Tibet by the end of the second millennium BCE (such as at Changguogou at 1500-1200 BCE and Qugong at ca. 1400 BCE)[2] may indicate a southern Himalayas connection from India to China by this period, but the lack of data from Northeast India makes it difficult to investigate this issue. However, since wheat and barley enter Yunnan together (and finds from the two regions are roughly contemporaneous), the question of whether barley may have also spread to China separately than wheat via the southern Himalayas remains unclarified (see also § 2.5.2). Barley also never becomes predominant in the early agricultural systems of Yunnan (and neither does in Central China). This may indicate different flavour preferences or that at this time cultural connections between Yunnan and India were not as strong, but further research is needed to clarify the time depth of the southern Himalayas cultural connection routes.

At Haimenkou, the agricultural assemblage evolves to include legumes, fruits, and other economic species, which points to an intensification of the productive strategy. At the same time, *Chenopodium album* may have been cultivated alongside millet and rice in response to a drying environment and uncertain harvests in the early first millennium BCE (Xue et al. 2022). However, drying climatic conditions did not push for the specialisation of the agricultural systems, instead, all species available became incorporated into a highly mixed system that took advantage of the peculiar vertical landscape of Yunnan. Such a system was at the basis of the agricultural production during the Dian Kingdom, when farming intensified through seasonal crop rotation of winter wheat and summer rice/millet cultivation. Sites associated with the Dian Basin show that wheat complemented the production of rice and millet, rather than substituting it (see § 4.5). Rice fields may have been established in the lowlands, close to water reservoirs, while wheat and millet fields may have been planted ascending into the surrounding hills. The fluctuating climate in the first millennium BCE may have had a role in the creation and persistence of this highly mixed regime. Preliminary data from Hebosuo after the Han conquest of the Dian in 109 BCE show continuity in agricultural systems, and an intensification of crop production, possibly through irrigation and the development of fruit trees management (Yang et al. 2023). At present, irrigation is inferred from historical data rather than archaeobotanical data. The continuity in the productive system composition attested at Hebosuo shows that political change did not alter pre-existing

2 Fu 2001; d'Alpoim Guedes et al. 2013a; Gao et al. 2020b; 2021.

farming systems, rather these were intensified to satisfy the larger demand of food derived from a growing population. Some scholars suggested that this was a strategy to prevent social uprising (Yang et al. 2023).

6.2 Agriculture Beyond Yunnan

The current archaeobotanical evidence does not support previous theories indicating a primary role of Yunnan Austroasiatic speakers in the domestication of rice and its dispersal to mainland Southeast Asia (see § 2.2.1.1). The first documented agricultural systems in mainland Southeast Asia differed from those in Yunnan. In mainland Southeast Asia, the first documented farming systems were based on the dryland cultivation of foxtail millet (attested at Non Pa Wai at ca. 2470 BCE; Weber et al. 2010), followed by the dryland cultivation of rice, attested a few centuries later than the millet-based agricultural systems (e.g., Castillo et al. 2018a, 2016; Castillo 2013; see § 5.3). Foxtail millet may have been introduced to central Thailand via riverine routes from Yunnan through the Mekong; however, a route from coastal southern China (via Guangdong/Guangxi) has also been hypothesised. Here, mixed rice-millet farming systems have been reported from Gantuoyan, possibly from the second phase of occupation of the site (2000-800 BCE; Guangxi 2003). Securely dated evidence for mixed farming systems derives from Gancaoling, in Guangdong, from 2600 BCE (Deng et al. 2022a). However, in northern Vietnam (via which millet farming could have spread into central Thailand), rice systems are documented only from the second millennium BCE (e.g., domesticated rice has been identified with microCT scanning of spikelet bases at An Son and Loc Giang, 2000 BCE; Barron et al. 2017), and so far, millet presence there is lacking.

Similarities in incised/impressed ceramic production between Yunnan and mainland Southeast Asia in the third-second millennium BCE, along with the presence of mixed millet-rice systems in the Jinsha Basin from the early third millennium BCE provide a slightly stronger support to a terrestrial route of agricultural spread via Yunnan into mainland Southeast Asia. However, data from mainland Southeast Asia is extremely patchy, and data for farming systems from southern China, be it Yunnan or the southern coast, only date to a few centuries earlier than the first farming systems documented in mainland Southeast Asia. No conclusive evidence has been found so far in either Yunnan or the southern Chinese coast about the possible development of dryland rice cultivation before its appearance in mainland Southeast Asia. The many geographical gaps and the lack of reliable radiocarbon dating and systematic archaeobotanical investigation hinders our understanding of this specific rice cultivation adaptation. The introduction of bronze technology into mainland Southeast Asia at the end of the second millennium BCE was distinct from the earlier dispersal of agricultural crops, but it was possibly facilitated by the network of connections established between southern China and mainland Southeast Asia (Ciarla 2013).This further suggests that the history of cultural contacts and interactions between the two regions was a complex and stratified history of overlays, with multiple geographical and chronological routes of exchange and interactions. Much of this history still needs to be unearthed.

Appendix 1

Major East Asian domesticates and their domestication centres

Northern China section (in Li 1970)				
	Latin name	**Common name**	**Updated region of origin**	**References**
Cereals	*Panicum miliaceum*	broomcorn/ Proso millet *ji* 稷/*shu* 黍[1]	N China	Stevens et al. 2020; Fuller et al. 2016; Fuller 2014
	Setaria italica	foxtail millet *su* 粟	N China	Fuller et al. 2016; Fuller 2014; Stevens, Fuller 2017
Root and tuber crops	*Stachys affinis*	Chinese artichoke *ganluzi* 甘露子	S China- Yangzi	Simmons 1990
Legumes	*Glycine max*	Soybean *dadou* 大豆	China, Japan, maybe Korea	Fuller et al. 2014; Stevens, Fuller 2017; Obata, Nasu 2011; Lee et al. 2011
Edible oil crops	*Glycine max*	Soybean	China, Japan, maybe Korea	Takahashi et al. 2023; Fuller et al. 2014; Lee et al. 2011

1 Common Chinese names are indicated following the "Chinese Plant Names" of the Flora of China, available online at http://www.efloras.org/flora_page.aspx?flora_id=3.

Northern China section (in Li 1970)				
	Latin name	**Common name**	**Updated region of origin**	**References**
Vegetables	*Allium sativum*	Garlic *suan* 蒜	Central Asia	Simmons 1990
	Allium fistulosum	Schallion *cong* 葱	China	Simmons 1990
	Allium ramosum	Chinese chives *yejiu* 野韭	Central Asia	Simmons 1990
	Brassica rapa var. *chinensis*	Chinese cabbage (bok choy) *qingcai* 青菜 (*xiaobaicai* 小白菜)	Western Eurasia (maybe China?)	Smartt, Simmonds 1995
	Brassica rapa var. *pekinensis*	celery cabbage *manjing* 蔓菁 (*dabaicai* 大白菜)	Western Eurasia (maybe China?)	Smartt, Simmonds 1995
Fruit trees	*Prunus persica* (syn. *Amygdalus persica*)	Peach *tao* 桃	China (Yangzi?)	Zheng, Crawford, Chen 2014; Dal Martello et al. 2023a
	Prunus salicina	Japanese plum *li* 李	N China	Simmons 1990
	Prunus armeniaca (syn. *Armeniaca vulgaris*)	Apricot *xing* 杏	N/NE China	Stevens et al. 2016; Weisskopf, Fuller 2014a
	Prunus mume (syn. *Armeniaca mume*)	Japanese apricot *mei* 梅	N China	Simmons 1990
	Prunus pseudocerasus	Chinese Cherry *yingtao* 樱桃	China	Simmons 1990
	Pyrus pyrifolia	Pear *shali* 沙梨	China? Central Asia?	Silva et al. 2015
	Malus prunifolia	Apple *qiuzi* 楸子	China	Simmons 1990
	Crataegus pinnatifida	Chinese hawthorn *shanzha* 山楂	N China	Simmons 1990
	Diospyros kaki	Persimmon *shi* 柿	E Asia	Simmons 1990
	Ziziphus jujuba	Chinese jujube *zao* 枣	N China	Simmons 1990

Southern China section (in Li 1970)				
	Latin name	**Common name**	**Updated region of origin**	**References**
Root and tuber crops	*Dioscorea polystachya*	Chinese yam *shuyu* 薯蓣	Insular SE Asia New Guinea?	Denham 2011; Barton 2020
	Sagittaria trifolia (syn. *Sagittaria sagittifolia*)	Chinese arrowhead *cigu* 慈姑	China	Simmons 1990
Legumes	*Vigna angularis*	adzuki bean *chidou* 赤豆	Japan	Takahashi et al. 2023

Southern China section (in Li 1970)				
	Latin name	**Common name**	**Updated region of origin**	**References**
Edible oil crops	*Brassica rapa* (var. *oleifera*)	Rapeseed (canola) *yuntai* 芸苔	Western Eurasia (maybe China?)	Crawford 2011b
Vegetables	*Lilium lancifolium* (syn. *Lilium tigrinum*)	Lily *juandan* 卷丹	China	Simmons 1990
	Zizania latifolia	Manchurian wild rice *gu* 菰	Manchuria?	Smartt, Simmonds 1995
	Brassica oleracea	Brassica *ganlan* 甘蓝	Western Eurasia	Smartt, Simmonds 1995
	Brassica juncea	Brown mustard *jiecai* 芥菜	possibly China/ Indus Valley	Smartt, Simmonds 1995
	Oenanthe javanica	Water drop-wort *shuiqin* 水芹	Indo-Malaysia?	Li 1970
	Brasenia schreberi	Water shield *chuncai* 莼菜	multiple: S China- Yangzi	Simmons 1990
	Ipomoea aquatica	Water morning glory *wengcai* 蕹菜	Tropical and subtropical Eurasia and Africa	Simmons 1990
	Glebionis coronaria (syn. *Chrysanthemum coronarium*)	Edible chrysanthemum *tonghao* 茼蒿	Mediterranean to Asia and Arabian Peninsula	Simmons 1990
	Allium chinense	Chinese onion *tou* 头	China	Simmons 1990
Fruit trees	*Citrus x aurantium*	Bitter orange *kucheng* 苦橙	S China	Fuller et al. 2017
	Citrus sinensis	Sweet orange *cheng* 橙	China	Fuller et al. 2017
	Citrus reticulata	Mandarin orange/ tangerine *ju* 橘/桔	S China	Fuller et al. 2017
	Citrus japonica (syn. *Fortunella japonica, Fortunella margarita*)	Kumquat *jinju* 金桔	S China	Weisskopf, Fuller 2014b
	Clausena lansium	Wampee *huangpi* 黄皮	S China to Yangzi	Simmons 1990; De Bruijn 1992
	Eriobotrya japonica	Loquat *pipa* 枇杷	S China	Simmons 1990
	Myrica rubra	Chinese strawberry/ bayberry *yangmei* 杨梅	China	Simmons 1990
	Litchi chinensis	Litchi *lizhi* 荔枝	S China	Simmons 1990

Southern China section (in Li 1970)				
	Latin name	**Common name**	**Updated region of origin**	**References**
	Dimocarpus longan (syn. *Euphoria longana*)	Longan *longyan* 龙眼	S China	Ke et al. 2000
	Canarium pimela	Canarium *wulan* 乌榄	S China or SE Asia	Simmons 1990
Beverages and masticatories	*Camellia sinensis*	Tea *cha* 茶	S China	Lu et al. 2016
Fibers	*Boehmeria nivea*	Ramie *zhuma* 苎麻	Yangzi	Fuller, Qin, Harvey 2008
	Abutilon theophrasti (syn. *Abutilon avicennae*)	Chinese jute *qingma* 苘麻	South China/ SE Asia	Li 1970
	Pueraria montana	Kudzu *ge* 葛	South China/ SE Asia	Simmons 1990
Other industrial crops	*Camellia oleifera*	Tea oil cammelia *youcha* 油茶	South China/ SE Asia	Li 1970
	Triadica sebifera	Chinese tallow *wujiu* 乌桕	South China/ SE Asia	Li 1970
	Vernicia montana	Wood-oil tree *muyoutong* 木油桐	South China/ SE Asia	Li 1970
	Vernicia fordii	Tung tree *youtong* 油桐	South China/ SE Asia	Li 1970

Southern Asia section (in Li 1970)				
	Latin name	**Common name**	**Updated region of origin**	**References**
Cereals	*Oryza sativa*	Rice *dao* 稻	China: Yangzi basin	Fuller et al. 2016
	Coix-lacryma jobi	Job's tear *yiyi* 薏苡	S China? SE Asia? Assam? Tropical Asia?	Simmons 1990; Weber, Fuller 2008; Arora 1977
	Echinochloa colona (listed as *E. colonum* in FoC; from *E. frumentacea*)	Sawa millet *guangtoubai* 光头稗	India	De Wet et al. 1983; Weber, Fuller 2008

Appendix 1

Southern Asia section (in Li 1970)				
	Latin name	**Common name**	**Updated region of origin**	**References**
Roots and tuber crops	*Colocasia esculenta*	Taro *yu* 芋	SE Asia	Denham 2011; Matthews et al. 2014
	Alocasia macrorrhizos	Giant taro *haiyu* 海芋	Insular SE Asia New Guinea?	Denham 2011
	Dioscorea alata	Greater yam *shenshu* 参薯	New Guinea	Denham 2011
	Dioscorea esculenta	Yam *ganshu* 甘薯	Insular SE Asia New Guinea?	Denham 2011
	Eleocharis dulcis	Chinese water chestnut *biqi* 荸荠	S China?	Simmons 1990
Vegetables	*Amaranthus tricolor*	Tampala *xian* 苋	India? SE Asia?	Simmons 1990
	Momordica charantia	Bitter gourd *kugua* 苦瓜	Hymalayas (India/ Nepal), Yunnan	Marr, Mei, Bhattarai 2004
	Benincasa hispida	Winter melon *donggua* 冬瓜	S China (Yunnan) maybe E India?	Matthews 2003
	Trichosanthes cucumerina	wild snake gourd *guaxiegualou* 瓜叶栝楼	India, China, SE Asia	Walters 1989; Chomicki, Shaefer, Renner 2020
	Luffa acutangula	Ridged loffah *guangdongsigua* 广东丝瓜	India	Marr, Bhattarai, Xia 2005
Fruit tree	*Citrus maxima*	Pomelo *you* 柚	SE Asia	Weisskopf, Fuller 2014b; Fuller et al. 2017
Beverages and masticatories	*Areca catechu*	Areca palm *binglang* 槟榔	SE Asia	Zumbroich 2009
Spices and condiments	*Piper nigrum*	Pepper *hujiao* 胡椒	multiple: SE Asia, SW India	Simmons 1990; Cappers 2006
	Cinnamomum cassia	Chinese cinnamom *rougui* 肉桂	S China	Simmons 1990
Fibers	*Gossypium arboreum*	Cotton tree *shumian* 树棉	Indus region	Fuller 2008; Smartt, Simmonds 1995
	Gossypium herbaceum	Levant cotton *caomian* 草棉	Africa	Fuller 2008
	Corchorus capsularis	White jute *huangma* 黄麻	India	Cappers 2006

Southern Island section (in Li 1970)				
	Latin name	**Common name**	**Updated region of origin**	**References**
Roots and tuber crops	*Colocasia esculenta*	Taro *yu* 芋	SE Asia	Denham 2011; Matthews et al. 2014
	Alocasia macrorrhizos	Giant taro *haiyu* 海芋	Insular SE Asia New Guinea?	Denham 2011

Southern Island section (in Li 1970)				
	Latin name	**Common name**	**Updated region of origin**	**References**
Fruit trees	*Artocarpus altilis* (syn. *Artocarpus communis*)	Breadfruit *mianbaoshu* 面包树	SE Asia, Pacific	Denham 2011
	Artocarpus integer	Cempedak *xiaoboluomi* 小波罗蜜	SE Asia	Simmons 1990
	Averrhoa carambola	Starfruit *yangtao* 阳桃	SE Asia	Simmons 1990
	Averroha bilimbi	Bilimbi (*sanlian* 三敛)	SE Asia	Simmons 1990
	Cocos nucifera	Coconut *yezi* 椰子	SE Asia	Gunn, Baudouin, Olsen 2011
	Citrus aurantiifolia (Citrus x aurantiifolia)	Lime *suancheng* 酸橙	SE Asia	Simmons 1990
	Garcinia mangostana	Mangosteen *mangjishi* 莽吉柿	SE Asia	Simmons 1990
	Nephelium lappaceum	Rambutan *hongmaodan* 红毛丹	SE Asia	Simmons 1990
	Lansium domesticum	Langsat/ lanzones *langsemu* 榔色木	SE Asia	Simmons 1990; Blench 2008
	Durio zibethinus	Durian *liulian* 榴莲	SE Asia	Simmons 1990
	Syzygium samarangense (syn. *Eugenia javanica*)	Java apple *yangputao* 洋蒲桃	SE Asia	Panggabean 1992; Whistler, Elevitch 2005
	Terminalia catappa	Sea-almond *lanrenshu* 榄仁树	India	Asouti, Fuller 2008
Other special food crops	*Musa x paradisiaca*	Banana/ plantains *dajiao* 大蕉	SE Asia	Denham 2011; Castillo, Fuller 2015
	Saccharum officinarum	Sugarcane *ganzhe* 甘蔗	Insular SE Asia New Guinea?	Denham 2011; 2014; Grivet et al. 2004; Daniels, Daniels 1993-94
Spices and condiments	*Zingiber officinale*	Ginger *jiang* 姜	India? SE Asia? S China	Simmons 1990
	Curcuma longa (syn. *Curcuma domestica*)	Turmeric *jianghuang* 姜黄	S Asia	Sopher 1964; Kashyap, Weber 2013
	Piper nigrum	Pepper *hujiao* 胡椒	SW India	Cappers 2006
	Myristica fragrans	Nutmeg *roudoukou* 肉豆蔻	SE Asia	Simmons 1990
	Syzygium aromaticum (syn. *Eugenia caryophyllata*)	Clove *dingjiang* 丁香	SE Asia	Simmons 1990

Additional species not originally included in Li 1970

	Latin name	Common name	Updated region of origin	References
Crops	*Fagopyrum esculentum*	Buckwheat *qiaomai* 荞麦	Yunnan or Southwest Sichuan	Ohnishi 1998; Ohnishi 2004; Weisskopf, Fuller 2014c
	Chenopodium album	Chenopod *li* 藜	Possible multiple domestication: China, Himalaya, Europe?	Partap, Kapoor 1985a; 1985b; 1987; Fogg 1983; Smartt, Simmonds 1995
	Echinochloa crus-galli (from *E. utilis Yabuno)*	Barnyard millet *bai* 稗	NE China, Japan, Korea	Weber, Fuller 2008; Crawford 2011b
Fruit trees	*Cucumis melo*	Melon *tiangua* 甜瓜	Probable multiple domestication: 1) Lower Yangzi; 2) Egypt; 3) Indus Valley; 4) Japan/ East Asia	Tanaka et al. 2016; Fuller et al. 2014; Zohary, Hopf, Weiss 2012
	Cucumis sativus	Cucumber *huanggua* 黄瓜	Indian Subhimalayan region	Fuller 2003
	Broussonetia papyrifera	Paper mulberry *goushu* 构树	China	Crawford 2011b
	Artocarpus heterophyllus	Jackfruit *muboluo* 木波罗	S India	Asouti, Fuller 2008
Acorn	*Castanea mollissima*	Chestnut *banli* 板栗	China	Crawford 2011b

Appendix 2

Archaeological finds of wheat and barley in Central, East and South Asia between the sixth and second millennia BCE, illustrated in figures 9-10

Legend

1-0	indicates presence (1) and absence (0) of plant species
?	Indicates the presence of plant species is unclear

Dating method is indicated as

AMS	direct radiocarbon dating on seeds
C14	radiocarbon dating on other material
assoc.	dating via cultural association
-	data not available

T	*Triticum aestivum/durum* – free-threshing wheat
H	*Hordeum vulgare* – barley
O	*Oryza sativa* – rice
P	*Panicum miliaceum* – broomcorn millet
S	*Setaria italica* – foxtail millet

under species column, w indicates possible wild species

Data compiled consulting Chen F.H. et al. 2015; He et al. 2022a; Liu et al. 2016; 2017; Stevens, Fuller 2017; Stevens, Zhuang, Fuller 2014; Stevens et al. 2016.

Site	Country	Lat.	Long.	Start Date BCE	End Date BCE	Est. Median Date BCE	Dating method	T	H	O	P	S	References
Monjukly Depe	Turkmenistan	36.849	60.418	6375	5900	6138	C14	0	1	0	0	0	Miller 2011
Djeitun	Turkmenistan	38.312	58.219	6200	5800	6000	AMS	0	1	0	0	0	Charles, Bogaard 2010
Mehrgarh	Pakistan	29.417	67.583	7000	4500	5750	C14	?	1	0	0	0	Costantini 1983; Costantini, Biasini 1985
Chagylly Depe	Turkmenistan	36.722	60.514	5700	4500	5100	assoc.	1	1	0	0	0	Miller 1999; Berdiev 1966
Monjukly Depe	Turkmenistan	36.849	60.418	5000	4500	4750	C14	1	1	0	0	0	Miller 2011
Anau North	Turkmenistan	37.941	58.549	4500	3000	3750	C14	1	1	0	0	0	Miller 1999
Miri Qalat	Pakistan	26.034	63.013	4000	3500	3750	C14	1	0	0	0	0	Tengberg 1999
Shahi Tump	Pakistan	26.001	63.019	4000	3000	3500	C14	1	1	0	0	0	Tengberg 1999
Sheri Khan Tarakai	Pakistan	32.851	70.471	3800	2900	3350	C14	1	1	0	0	0	Khan, Knox, Thomas 1990
Miri Qalat	Pakistan	26.034	63.013	3500	3000	3250	C14	1	1	0	0	0	Tengberg 1999
Tongtian Cave	China	43.888	82.443	-	-	3200	C14	0	1	0	1	0	Zhou et al. 2020
Tongtian Cave	China	43.888	82.443	-	-	3000	-	1	1	0	1	0	Zhou et al. 2020
Kunal	India	29.626	75.658	3000	2850	2925	C14	0	1	0	0	0	Saraswat, Pokharia 2003
Harappa	Pakistan	30.628	72.867	3200	2600	2900	-	1	1	0	0	0	Weber 2003; Pennington, Weber 2004; Weber et al. 2010
Shortugai	Afghanistan	36.989	68.351	3800	2000	2900	AMS	1	1	0	0	0	Willcox 1991
Kanispur	India	34.226	74.425	3498	2204	2851	C14	1	1	0	0	0	Pokharia et al. 2017
Buziping	China	35.459	104.467	2940	2760	2850	assoc.	0	1	0	1	1	An et al. 2014; Jia et al. 2013; Lee et al. 2007
Kunal	India	29.626	75.658	2850	2600	2725	C14	1	1	1	0	0	Saraswat, Pokharia 2003
Rohira	India	30.633	75.833	2900	2500	2700	assoc.	0	1	1	0	0	Saraswat 1988
Masudpur VII	India	29.209	75.960	2870	2470	2670	assoc.	1	1	1	0	0	Bates 2015
Tasbas [1]	Kazakhstan	45.134	79.368	2840	2490	2665	assoc.	1	0	0	0	0	Spengler et al. 2014
Ledu Liuwan	China	36.454	102.556	3300	2000	2650	C14	1	0	0	0	1	Jin unpublished
Banawali	India	29.598	75.392	3000	2300	2650	C14	1	1	1	0	0	Saraswat 2002a
Dabli vas Chugta	India	29.527	74.170	2700	2400	2550	-	1	1	0	0	0	Bates 2015
Sohr Damb/ Nal	Pakistan	27.678	66.273	2700	2400	2550	C14	1	1	0	0	0	Benecke and Neef 2005
Xishanping	China	34.579	105.727	2700	2350	2525	assoc.	1	1	1	1	1	Flad et al. 2010
Siswal	India	29.219	75.508	2820	2200	2510	C14	0	1	0	0	0	Willcox 1992
Burj	India	29.657	75.641	2700	2300	2500	-	0	1	0	0	0	Bates 2015

Site	Country	Lat.	Long.	Start Date BCE	End Date BCE	Est. Median Date BCE	Dating method	T	H	O	P	S	References
Mehrgarh	Pakistan	29.417	67.583	3000	2000	2500	C14	1	1	0	0	0	Costantini 1983; Costantini, Biasini 1985
Balu	India	29.671	76.388	2800	2200	2500	assoc.	1	1	1	0	0	Saraswat 2002b
Shuinan	China	35.249	111.152	3000	2000	2500	assoc.	1	0	0	1	1	Song 2011
Zhaojiazhuang	China	36.050	119.788	2600	2300	2450	C14	1	1	1	1	1	Jin et al. 2011
Qinglongquan	China	32.640	111.410	2500	2200	2350	-	1	0	1	1	1	Zhongguo 1991
Hutuohe	China	38.97	112.80	-	-	2350	C14	1	0	1	1	1	Jiang 2011
Anau South	Turkmenistan	37.897	58.546	3000	1700	2350	AMS	1	1	0	0	0	Miller 1999
Farmana	India	29.039	76.306	2500	2200	2350	AMS	1	1	1	0	0	Shinde, Osada, Humar 2011; Weber et al. 2010
Laohuzui	China	35.950	107.117	2464	2210	2337	-	1	0	0	0	0	Dong et al. 2015
Zhizhushan	China	41.800	121.424	2466	2147	2307	assoc.	1	0	0	0	1	Jin unpublished
Liangchengzhen	China	35.579	119.572	2600	2000	2300	-	1	0	1	1	1	Crawford et al. 2015
Damdama	India	25.869	82.182	2600	2000	2300	-	1	0	1	0	0	Saraswat 2004b; 2005; Kajale 1990
Sarazm	Tajikistan	39.512	67.443	2600	2000	2300	-	1	1	0	0	0	Spengler, Willcox 2013
Kalibangan	India	29.474	74.131	2600	2000	2300	-	1	1	0	0	0	Vishnu-Mittre, Savithri 1982
Chanhudaro	Pakistan	36.135	68.323	2600	2000	2300	-	1	1	0	0	0	Vishnu-Mittre, Savithri, 1982
La Phob	China	30.07	95.59	2800	1800	2300	assoc.	1	1	0	1	1	Wang Y.R. et al. 2024
Shilipubei	China	35.04	115.64	-	-	2282	C14	1	0	1	1	1	Guo et al. 2019
Zhaojialai	China	34.301	108.125	2600	1950	2275	-	1	0	0	0	1	cited in Flad et al. 2010
Nausharo	Pakistan	29.367	67.583	2500	2000	2250	-	1	1	0	0	0	Costantini 1990
Allahdino	Pakistan	24.953	67.310	2500	2000	2250	-	1	1	0	0	0	Fairservis 1982
Bobantai	China	35.53	118.98	-	-	2250	assoc.	1	0	1	0	1	Jin et al. 2009a
Balakot	Pakistan	25.447	66.727	2500	2000	2250	-	0	1	0	0	0	McKean 1983
Mundigak	Afghanistan	31.964	65.511	2500	2000	2250	assoc.	1	1	0	0	0	Petrie, Schaffer 2019
Hetapatti	India	25.29	81.553	2500	2000	2250	C14	0	1	1	0	0	Pokharia et al. 2016
Rohira	India	30.633	75.833	2500	2000	2250	C14	1	1	1	0	0	Saraswat 1986
Senuwar	India	24.932	83.937	2500	2000	2250	assoc.	1	1	1	0	0	Saraswat 2004a
Lahuradewa	India	26.768	82.945	2500	2000	2250	C14	1	1	1	0	0	Saraswat, Pokharia 2004; Tewari et al 2006; 2008
Tarakai Qila	Pakistan	32.956	70.483	2500	2000	2250	assoc.	1	1	0	0	0	Thomas 1983a; 1983b

Site	Country	Lat.	Long.	Start Date BCE	End Date BCE	Est. Median Date BCE	Dating method	T	H	O	P	S	References
Mohenjodaro	Pakistan	27.325	68.137	2500	2000	2250	C14	1	1	0	0	0	Vishnu-Mittre, Savithri 1982
Yuhuicun	China	32.883	117.2	-	-	2250	assoc.	1	0	1	0	1	Yin 2011
Xinzhai	China	34.507	113.416	2500	2000	2250	assoc.	1	0	1	1	1	Zhong et al. 2015
Burthana	India	28.919	75.960	2470	2000	2235	assoc.	0	1	0	0	0	Willcox 1992
Xijincheng	China	35.106	113.108	2500	1900	2200	-	1	0	1	1	1	Chen, Wang, Wang 2010
Ghalegay	Pakistan	34.700	72.267	2500	1900	2200	-	1	0	?	0	0	Costantini 1987
Yueru	China	39.000	112.785	2500	1900	2200	-	1	1	0	1	1	Jiang 2011
Dingjiazhai	China	38.968	112.790	2500	1900	2200	assoc.	1	0	0	1	1	Jiang 2011
Hucun	China	35.496	111.368	-	-	2200	C14	1	0	1	1	1	Song et al. 2017
Xiawanggang	China	33.017	111.367	-	-	2200	C14	1	0	1	1	1	Tang 2014
Tigrana	India	28.919	75.960	2500	1900	2200	-	0	1	0	0	0	Willcox 1992
Masudpur I	India	29.241	75.991	2300	2040	2170	-	1	1	1	0	0	Bates 2015
Begash	Kazakhstan	45.006	78.144	2280	2030	2155	-	1	0	0	1	0	Spengler 2015; Frachetti et al. 2010
Sigeda	China	33.631	113.644	-	-	2150	C14	1	0	1	1	1	Cheng Z. 2016
Mahorana	India	30.489	75.949	2300	2000	2150	C14	1	1	0	0	0	Vishnu-Mittre, Shama, Chancala 1986
Zhouyuan	China	34.414	107.896	2500	1800	2150	C14	1	0	1	1	1	Zhao, Xu 2004
Dongpan	China	34.92	118.75	-	-	2100	C14	1	0	1	1	1	Wang, Liu, Jin 2012
Dalaidian	China	36.233	114.467	-	-	2100	-	1	0	1	1	1	Wu 2016
Taosi	China	35.87	111.5	-	-	2100	-	1	0	1	1	1	Zhao 2006b
Chengyao	China	34.294	113.051	-	-	2100	-	1	0	1	1	1	Zhong et al. 2018
Balathal	India	24.723	74.010	2350	1800	2075	C14	1	1	0	0	0	Kajale 1996
Dingjiazhai	China	35.903	102.653	2117	1893	2050	C14	0	1	0	1	1	Chen et al. 2015
Burzahom	India	34.167	73.900	2400	1700	2050	-	1	1	0	0	0	Lone, Khan, Buth 1993
Xiasunjiazhai	China	36.744	101.758	2140	1955	2048	assoc.	0	1	0	1	0	Chen et al. 2015
Dinggong	China	36.952	117.853	-	-	2017	assoc.	1	0	1	1	1	Wu W et al. 2018
Huoshiliang	China	40.533	98.148	2135	1895	2015	-	1	?	0	1	1	Dodson et al. 2013
Pingliangtai	China	33.708	114.924	-	-	2006	-	1	0	1	1	1	Hu et al. 2022
Gongshijia	China	35.903	102.653	2117	1893	2005	C14	0	1	0	1	1	Chen et al. 2015

Site	Country	Lat.	Long.	Start Date BCE	End Date BCE	Est. Median Date BCE	Dating method	T	H	O	P	S	References
Baligang	China	32.690	112.132	2200	1800	2000	AMS	1	0	1	1	1	Deng et al. 2015; Weisskopf 2014
Alandskoe	Russia	52.227	59.797	2200	1800	2000	-	?	0	0	1	0	Gadyuchenko 2002
Wadian	China	34.187	113.405	2200	1800	2000	-	1	0	1	1	1	Liu, Fang 2010
Jhusi	India	25.426	81.900	2500	1500	2000	-	1	1	1	0	0	Pokharia, Pal, Srivastava 2009; Misra et al. 2009
Wadian2009	China	34.192	113.412	-	-	1986	-	1	0	1	1	1	Liu, Fang 2010
Lingyuntai	China	33.677	113.867	-	-	1975	-	1	0	1	1	1	Cheng Z. 2016
Jiaochangpu	China	36.920	102.539	2021	1891	1960	-	1	0	0	1	1	Chen et al. 2015: Zhao 2005; d'Aploim Guedes et al. 2015
Changning	China	36.135	102.394	2020	1880	1950	C14	0	1	0	0	0	Liu et al. 2017
Gonur Tepe	Turkmenistan	38.212	62.034	2200	1700	1950	C14	1	1	0	0	0	Miller 1993
Djarkutan	Uzbekistan	37.668	67.083	2200	1700	1950	C14	1	1	0	0	0	Miller 2009
Ahirua Rajarampur	India	27.151	79.497	2500	1300	1900	-	0	1	1	0	0	Chanchala 2005
Fangjinzhai	China	34.828	113.391	-	-	1900	AMS	1	0	1	1	1	Zhengzhou 1997
Malhar	India	24.995	83.267	2200	1600	1900	assoc.	0	1	1	0	0	Tewari et al. 2000
Shenna	China	36.655	101.756	2150	1650	1900	-	1	1	0	0	0	Wang 1995
Wanggedang	China	34.632	112.466	-	-	1900	assoc.	1	0	1	1	1	Zhong et al. 2020
Huangniangniangtai	China	37.935	102.605	2043	1746	1895	C14	1	1	0	1	1	Dodson et al. 2013
Ganggangwa	China	39.366	99.992	2026	1759	1893	assoc.	0	1	0	1	1	Dodson et al. 2013; Zhao et al. 2012
Jinchankou	China	36.920	102.539	2021	1681	1851	-	0	1	0	1	1	Chen et al. 2015
Adji Kui 1	Turkmenistan	36.753	62.673	2400	1300	1850	AMS	1	1	0	1	0	Spengler et al. 2018
Gumugou	China	40.676	88.923	1885	1765	1825	assoc.	1	0	0	0	?	Zhang et al. 2015
Xintala	China	42.196	86.969	2005	1620	1813	C14	1	1	0	1	0	Debaine-Francfort 1988; Dodson et al. 2013; Zhao et al. 2012
Bahola	India	29.806	76.788	1900	1700	1800	-	1	1	1	0	0	Bates 2015
Ghalegay	Pakistan	34.700	72.267	1900	1700	1800	AMS	0	1	?	0	0	Costantini 1987
Xinzhai	China	34.43	113.55	-	-	1795	assoc.	1	0	1	1	1	Zhong et al. 2015
Huoshaogou	China	39.950	97.709	1885	1620	1753	assoc.	1	1	0	1	1	Dodson et al. 2013
Pirak	Pakistan	29.437	67.819	1950	1550	1750	-	1	1	1	1	0	Costantini 1979
Heishuigou	China	39.032	100.222	1880	1620	1750	assoc.	1	1	0	0	0	Liu et al. 2017
Atranjikhera	India	27.702	78.743	2000	1500	1750	-	0	1	1	0	0	Saraswat 1980

Site	Country	Lat.	Long.	Start Date BCE	End Date BCE	Est. Median Date BCE	Dating method	T	H	O	P	S	References
Wangchenggang	China	34.38	113.12	-	-	1750	C14	1	0	1	1	0	Zhao, Fang 2007
Erlitou	China	34.703	112.717	1900	1600	1750	-	1	0	1	1	1	Zhao 2007
Wayaotai	China	36.230	103.072	1865	1623	1744	-	0	1	0	1	0	Chen et al. 2015; Dong et al. 2014
Shaoguoliang	China	39.442	97.315	1875	1533	1704	assoc.	1	0	0	0	0	Dodson et al. 2013
Ganggangwa	China	34.473	113.858	1900	1500	1700	C14	1	0	0	1	1	Chen 2010
Guchengzhai	China	34.473	113.858	1900	1500	1700	AMS	1	0	0	1	1	Chen, Zhang, Cang 2012
Liujiazhuang	China	35.257	119.301	-	-	1700	assoc.	1	0	1	0	1	Chen X. 2016
Yangpu	China	34.060	117.118	-	-	1700	C14	1	0	1	1	1	Cheng Z et al. 2016
Koldihwa	India	24.910	82.049	1900	1500	1700	-	1	1	1	0	0	Harvey et al. 2005; Harvey 2007
Donghuishan	China	39.366	99.992	1900	1500	1700	-	1	1	0	1	1	Dodson et al. 2013
Ropar	India	30.957	76.522	1900	1500	1700	-	1	0	1	0	0	Vishnu-Mittre, Savithri 1979a, 1979b
Wangchenggang	China	34.398	113.125	1900	1500	1700	-	1	0	0	1	1	Zhao 2007; Yuan, Campbell 2009; Flad et al. 2010
Zhaogezhuang	China	37.370	121.616	1800	1600	1700	assoc.	1	0	1	1	1	Zhao et al. 2008; An et al. 2013; d'Alpoim Guedes et al. 2015
Mitathal	India	28.892	76.170	1960	1400	1680	-	1	1	1	0	0	Willcox 1992
Qasim Bagh	India	34.224	74.497	2050	1300	1675	AMS	1	1	0	1	0	Spate et al. 2017
Zaojiaoshu	China	34.649	112.401	1740	1590	1665	-	1	0	1	1	1	Zhao 2005
Mahagara	India	24.913	82.051	1800	1500	1650	assoc.	1	1	1	0	0	Harvey 2007; Harvey, Fuller 2005
Zhaogezhuang	China	37.37	121.62	-	-	1650	assoc.	1	0	1	1	1	Jin et al. 2009d
Imlidh-Khurd	India	26.508	83.201	2000	1300	1650	AMS	1	1	1	0	?	Saraswat 1993a
Sanghol	India	30.787	76.390	1900	1400	1650	C14	1	1	1	0	0	Saraswat 1997
Chamdo Karuo [Qamdo Karuo]	China	31.061	97.209	1770	1500	1635	C14	1	1	0	1	1	d'Alpoim Guedes et al. 2013; Song et al. 2021
Dongzhao	China	34.793	113.506	-	-	1625	assoc.	1	0	1	1	1	Yang et al. 2017
Erlitou	China	34.7	112.68	-	-	1625	assoc.	1	0	1	1	1	Zhao 2007
Mogou	China	35.434	103.006	1689	1528	1609	assoc.	0	1	0	0	0	Liu et al. 2017
Nanwa	China	34.667	113.233	-	-	1607	-	1	0	1	1	1	Wu, Zhang, Jin 2014
Taradih	India	24.514	84.720	2000	1200	1600	-	1	1	0	0	0	Kajale 1991
Qäwrighul=Gumugou	China	40.337	88.564	1725	1425	1600	AMS	1	0	0	1	0	Qiu et al. 2014

Site	Country	Lat.	Long.	Start Date BCE	End Date BCE	Est. Median Date BCE	Dating method	T	H	O	P	S	References
Site 1211/1219	Turkmenistan	37.988	62.166	1700	1500	1600	-	1	1	0	1	0	Spengler et al. 2014
Ojakly	Turkmenistan	38.249	62.164	1690	1500	1595	C14	1	1	0	1	0	Spengler et al. 2014; Rouse, Cerasetti 2014
Ojakly	Turkmenistan	38.249	62.164	1690	1500	1595	-	1	1	0	1	0	Spengler et al. 2014; Rouse, Cerasetti 2014
Karuo	China	31.061	97.209	1665	1518	1592	AMS	1	0	0	0	0	Liu et al. 2017
Xiaohe Cemetry	China	40.337	88.564	1725	1425	1575	AMS	1	0	1	1	1	Qiu et al. 2014
Lanzhouwanzi	China	43.581	92.978	1740	1400	1570	C14	1	0	0	0	0	Debaine-Francfort 1989; Lee at al. 2007; Flad et al. 2010
Nansa	China	34.275	108.641	1663	1450	1557	C14	1	0	0	0	0	Dodson et al. 2013
Loebanhr 3	Pakistan	34.752	72.407	1700	1400	1550	-	1	1	1	0	0	Costantini 1987; d'Alpoim Guedes et al. 2013
Bir-Kot-Ghwandai	Pakistan	34.683	72.200	1700	1400	1550	C14	1	1	1	0	0	Costantini 1987
Hulas	India	29.700	77.367	1800	1300	1550	AMS	1	1	1	0	?	Saraswat 1993b; Fuller 2003
Yueyabao	China	34.473	113.858	1600	1450	1525	C14	1	0	0	1	1	Chen, Zhang, Cang 2012
Lal Qila	India	28.507	78.253	1800	1200	1500	-	1	1	1	0	0	Kajale, Deotare 1993
Karuo	China	31.034	97.122	-	-	1500	-	1	0	0	0	0	Song et al. 2021
Klu lding	China	94.382	29.191	1800	1200	1500	-	1	1	0	1	1	Wang Y.R. et al. 2024
Jiaoridang	China	35.733	102.435	1513	1413	1463	-	0	1	0	0	0	Chen et al. 2015
Tasbas [2]	Kazakhstan	45.134	79.368	1450	1250	1450	assoc.	1	1	0	0	0	Spengler et al. 2014
Yinxu [Anyang]	China	36.121	114.324	1766	1122	1444	assoc.	1	0	0	0	0	Flad et al. 2010
Tawendaliha	China	36.227	97.311	1442	1306	1400	-	0	1	0	1	0	Chen et al. 2015
Ashaonao	China	33.257	103.919	-	-	1400	AMS	1	0	0	0	0	d'Alpoim Guedes et al. 2015
Qugong	China	29.701	91.128	1500	1250	1375	assoc.	1	1	0	1	1	Gao et al. 2020b
Tokwa	India	24.906	83.366	1800	950	1375	-	0	1	1	0	0	Pokharia 2008
Qiezha	China	36.387	111.343	1413	1265	1340	-	0	1	0	0	0	Chen et al. 2015
Hongshanzuinanpo	China	36.982	36.982	1415	1267	1340	assoc.	0	1	0	0	1	Chen et al. 2015
Lagalamaerma	China	37.331	100.128	1410	1260	1340	AMS	0	1	0	0	0	Chen et al. 2015
Jingyanggang	China	34.727	112.642	-	-	1331	-	1	0	1	1	1	Zhang, Xia, Zhang 2014
Tianposhuiku	China	34.645	112.950	1400	1250	1325	-	1	0	1	1	1	Flad et al. 2010
Xiaoshuangqiao	China	34.852	113.566	-	-	1323	-	1	0	1	1	1	Zhong et al. 2018
Luowalinchang	China	35.928	101.874	1419	1211	1320	-	1	1	0	1	1	Chen et al. 2015

Site	Country	Lat.	Long.	Start Date BCE	End Date BCE	Est. Median Date BCE	Dating method	T	H	O	P	S	References
Sidaogou	China	43.795	87.511	1500	1130	1315	-	1	0	0	0	?	Reported by Debaine- Francfort 1988; 1989. Cited in Dodson et al. 2013; Jia et al. 2011
Shuang'erdong(ping)	China	36.444	102.512	1390	1210	1300	-	1	1	0	1	1	Chen et al. 2015; Dong et al. 2014
Daxinzhuang	China	36.7	117.1	-	-	1300	-	1	0	1	1	1	Chen, Fang 2008
Ojiyana	India	25.541	74.208	1800	800	1300	-	1	1	1	0	1	Pokharia, Saraswat 2004; Pokharia 2007; 2008
Chirand	India	25.750	84.833	2100	500	1300	-	1	1	1	0	0	Vishnu-Mittre 1972; Vishnu-Mittre, Savithri 1976
Zhonghaiguojishequ	China	30.691	104.052	1500	1000	1250	-	1	0	0	1	1	Chengdu 2010
Haimenkou 2	China	26.433	99.917	1400	1100	1250	-	1	1	1	1	1	d'Alpoim Guedes, Butler 2014; Xiao 1995; Xue 2010
Dalitaliha	China	36.439	96.455	1500	1000	1250	-	1	0	0	0	0	Flad et al. 2010
Xiaoenda	China	31.159	97.128	1550	850	1200	-	1	0	0	1	1	Lu 2023; Zhang et al. 2019
Raja-Nala-Ka-Tila	India	24.701	83.311	1700	700	1200	-	1	1	1	0	0	Saraswat 2005
Fengzhai	China	34.714	113.158	1300	1000	1150	-	1	0	0	0	1	Flad et al. 2010
Changguogou	China	29.248	91.772	1450	800	1125	-	1	1	0	0	1	Fu 2001
Yongfucun	China	30.726	103.899	1200	1000	1100	-	1	0	1	?	?	d'Alpoim Guedes 2013
Yantangcun	China	30.797	104.115	1200	1000	1100	-	1	0	1	?	?	d'Alpoim Guedes 2013

Appendix 3

List of direct radiocarbon dates of sites with archaeobotanical data from Yunnan, China

Site	Lab Code	Archaeological Context	Dating Material	Stratigraphic information	h. l. 5730	h. l. 5568	68.20%	95.40% cal BCE	Dating method	References
Haidong	BK89079	n/a	Human bone	n/a	4235±150	4115±150	2890-2490	3090-2200	LSC?	Xiao 2001; Yao 2010
	BK89080	n/a	Human bone	n/a	3865±100	-	-	-	-	Ma et al. 2024 (Yuan et al. 1994)
Baiyangcun	ZK-0220	n/a	Charcoal	F3 posthole2	3770±85	3663±85	2200-1920	2300-1770	LSC	Yunnan 1981; Beijing 1978
	ZK-0330	n/a	Charcoal	Unno. posthole in trench 7	3675±85	3571±85	2030-1770	2190-1690	LSC	Yunnan 1981; Beijing 1978
	Beta-501547	2013YBB (5)	Rice	Layer 5	-	3480±30	1880-1750	1890-1690	AMS	Dal Martello 2020
	OxA-33286	2013YBBT2(8)c S4	Rice	Layer 8	-	3743±29	2210-2060	2280-2030	AMS	Dal Martello et al. 2018
	OxA-33290	2013YBBT2(8)c S4	Rice	Layer 8	-	3764±28	2280-2130	2290-2040	AMS	Dal Martello et al. 2018
	OxA-33291	2013YBBT2(9)c S3	Rice	Layer 9	-	3718±29	2200-2040	2210-2030	AMS	Dal Martello et al. 2018
	OxA-33327	2013YBBT2(9)c S3	Rice	Layer 9	-	3689±35	2140-2030	2200-1960	AMS	Dal Martello et al. 2018
	OxA-33328	2013H118	Rice	H118 (sealed by layer 15)		3731±30	2200-2040	2270-2030	AMS	Dal Martello et al. 2018
	OxA-33293	2013H118	Rice	H118		3735±29	2200-2050	2270-2030	AMS	Dal Martello et al. 2018
	OxA-33287	2013YBBT2(17) S4	Rice	Layer 17	-	3916±29	2470-2340	2480-2290	AMS	Dal Martello et al. 2018
	OxA-33292	2013YBBT2(17) S3	Rice	Layer 17	-	3898±29	2470-2340	2470-2290	AMS	Dal Martello et al. 2018
	SUERC-73806	2013YBBT2(20)	Millet	Layer 20	-	3929±23	2480-2340	2490-2330	AMS	Dal Martello 2020

Site	Lab Code	Archaeological Context	Dating Material	Stratigraphic information	h. l. 5730	h. l. 5568	68.20%	95.40% cal BCE	Dating method	References
Baiyangcun	OxA-33288	2013YBBT2(21)c S4	Rice	Layer 21	-	3958±30	2570-2410	2570-2340	AMS	Dal Martello et al. 2018
	OxA-33289	2013YBBT2(21)c S4	Rice	Layer 21	-	4035±28	2580-2490	2630-2470	AMS	Dal Martello et al. 2018
	SUERC-73802	2013YBBT2(24) S3	Millet	Layer 24		4110±34	2860-2580	2879-2570	AMS	Dal Martello 2020
	LZU211164	M17	Human bone	-	-	4210±30	-	-	-	Ma et al. 2022a
	Beta-547365	M1-2	Human bone	-	-	3200±30	-	-	-	Ma et al. 2022a
	Beta-547367	M3	Human bone	-	-	3400±30	-	-	-	Ma et al. 2022a
	Beta-547368	M4	Human bone	-	-	3280±30	-	-	-	Ma et al. 2022a
	Beta-547369	M11	Human bone	-	-	3270±30	-	-	-	Ma et al. 2022a
	Beta-547366	W1	Human bone	-	-	3200±30	-	-	-	Ma et al. 2022a
Xinguang	BK94072	T1104F5	Peat	F5	4030±80	3658±70	2140-1940	2280-1780	LSC	Yunnan 2002
	BK94073	T1104I2	Peat	I2	3830±70	3668±70	2140-1940	2290-1880	LSC	Yunnan 2002
	BK94074	T1105(8)	Peat	Layer 8	3775±70	3721±70	2280-1980	2350-1920	LSC	Yunnan 2002
	BK94075	T1105(6)	Peat	Layer 6	3765±70	3916±80	2560-2280	2620-2140	LSC	Yunnan 2002
Dadunzi	ZK-0229	n/a	Charcoal	F5 posthole 12	3210±90	3119±90	-	-	LSC?	Yunnan 1977; Zhongguo 1974
	n/a	2010MDT18-2-S1	Rice	Layer 2	-	3385±30	1740-1630	1750-1610	AMS	Li et al. 2016
	n/a	2010MDT18-H3-2-S1	Rice	H3	-	3420±20	1750-1690	1870-1650	AMS	Li et al. 2016
	n/a	2010MDT18-4-S1	Rice	Layer 4	-	3540±35	1940-1780	1970-1750	AMS	Li et al. 2016
	n/a	2010MDT18-5-S1	Rice	Layer 5	-	3555±25	1950-1880	2010-1770	AMS	Li et al. 2016
	n/a	2010MDT18-7-S1	Rice	Layer 7	-	3555±25	1950-1880	2010-1770	AMS	Li et al. 2016
	n/a	2010MDT18-8-S1	Rice	Layer 8	-	3685±25	2140-2030	2190-1970	AMS	Li et al. 2016
	n/a	2010MDT18-9-S1	Foxtail millet	Layer 9	-	3665±40	2140-1970	2200-1920	AMS	Li et al. 2016

Site	Lab Code	Archaeological Context	Dating Material	Stratigraphic information	h. l. 5730	h. l. 5568	68.20%	95.40% cal BCE	Dating method	References
Xingyi	LZU20651	-	Charcoal	-	-	3480±20	-	-	-	Ma et al. 2024
	LZU20652	-	Charcoal	-	-	3900±20	-	-	-	Ma et al. 2024
	LZU211118	-	Rice	-	-	3060±30	-	-	-	Ma et al. 2024
	LZU211119	-	Foxtail millet	-	-	3110±30	-	-	-	Ma et al. 2024
	Beta-587328	-	Deer bone	-	-	5540±30	-	-	-	Ma et al. 2024
	LZU21669	-	Deer bone	-	-	3100±20	-	-	-	Ma et al. 2024
	LZU20629	-	Human bone	-	-	3220±20	-	-	-	Ma et al. 2024
	LZU20631	-	Human bone	-	-	3300±20	-	-	-	Ma et al. 2024
	LZU20648	-	Human bone	-	-	3310±20	-	-	-	Ma et al. 2024
	LZU20647	-	Human bone	-	-	3340±20	-	-	-	Ma et al. 2024
	Beta-580276	-	Human bone	-	-	3370±30	-	-	-	Ma et al. 2024
	LZU20645	-	Human bone	-	-	3390±20	-	-	-	Ma et al. 2024
	LZU20630	-	Human bone	-	-	3410±20	-	-	-	Ma et al. 2024
	LZU20632	-	Human bone	-	-	3410±20	-	-	-	Ma et al. 2024
	Beta-580277	-	Human bone	-	-	3420±30	-	-	-	Ma et al. 2024
	Beta-580278	-	Human bone	-	-	3440±30	-	-	-	Ma et al. 2024
	LZU20642	-	Human bone	-	-	3470±20	-	-	-	Ma et al. 2024
	LZU20649	-	Human bone	-	-	3540±20	-	-	-	Ma et al. 2024
	Beta-580275	-	Human bone	-	-	3860±30	-	-	-	Ma et al. 2024
	LZU20644	-	Human bone	-	-	3920±20	-	-	-	Ma et al. 2024
	LZU20646	-	Human bone	-	-	3940±20	-	-	-	Ma et al. 2024
	LZU20634	-	Human bone	-	-	3950±20	-	-	-	Ma et al. 2024
	LZU21670	-	Human bone	-	-	3960±20	-	-	-	Ma et al. 2024
	LZU20639	-	Human bone	-	-	3980±20	-	-	-	Ma et al. 2024
	LZU20633	-	Human bone	-	-	4030±20	-	-	-	Ma et al. 2024
	Beta-580280	-	Human bone	-	-	4040±30	-	-	-	Ma et al. 2024
	Beta-580279	-	Human bone	-	-	4130±30	-	-	-	Ma et al. 2024
	LZU20638	-	Human bone	-	-	4210±20	-	-	-	Ma et al. 2024
	Beta-459786	-	Human bone	-	-	4260±30	-	-	-	Ma et al. 2024
	LZU20641	-	Human bone	-	-	4360±20	-	-	-	Ma et al. 2024
	LZU20643	-	Human bone	-	-	4390±20	-	-	-	Ma et al. 2024
	LZU20636	-	Human bone	-	-	4570±20	-	-	-	Ma et al. 2024
	Beta-580274	-	Human bone	-	-	6110±30	-	-	-	Ma et al. 2024
	LZU21668	-	Pig bone	-	-	3180±20	-	-	-	Ma et al. 2024
	LZU211125	-	Pig bone	-	-	3260±30	-	-	-	Ma et al. 2024
	LZU211126	-	Pig bone	-	-	3270±30	-	-	-	Ma et al. 2024
	LZU22133	-	Charcoal	-	-	9550±50	-	-	-	Ma et al. 2024
	LZU22134	-	Charcoal	-	-	9530±40	-	-	-	Ma et al. 2024
	LZU22132	-	Charcoal	-	-	9360±40	-	-	-	Ma et al. 2024
	LZU22249	-	Charcoal	-	-	5550±40	-	-	-	Ma et al. 2024
	LZU22126	-	Charcoal	-	-	5200±40	-	-	-	Ma et al. 2024
	LZU22127	-	Charcoal	-	-	5120±40	-	-	-	Ma et al. 2024
	LZU22131	-	Charcoal	-	-	5000±40	-	-	-	Ma et al. 2024
	LZU22256	-	Charcoal	-	-	3850±60	-	-	-	Ma et al. 2024
	LZU22255	-	Charcoal	-	-	3290±30	-	-	-	Ma et al. 2024
	LZU22254	-	Charcoal	-	-	3260±40	-	-	-	Ma et al. 2024
	LZU22128	-	Charcoal	-	-	3800±30	-	-	-	Ma et al. 2024
	LZU22130	-	Charcoal	-	-	3610±40	-	-	-	Ma et al. 2024
	LZU22129	-	Charcoal	-	-	3580±30	-	-	-	Ma et al. 2024
	LZU22248	-	Charcoal	-	-	3280±30	-	-	-	Ma et al. 2024
	LZU22252	-	Foxtail millet	-	-	3060±30	-	-	-	Ma et al. 2024

Site	Lab Code	Archaeological Context	Dating Material	Stratigraphic information	h. l. 5730	h. l. 5568	68.20%	95.40% cal BCE	Dating method	References
Haimenkou	ZK2335	CH T2 (4)	Charcoal	Layer 4	2595±75	2520±75	800-540	810-420	LSC	Cui, Li 1990
	not provided	T1005-4-s1	Rice	Layer 4	-	2400±20	490-400	540-400	AMS	Li, Min 2014
	not provided	T1003-4-s2	Wheat	Layer 4	-	2405±35	520-400	750-390	AMS	Li, Min 2014
	not provided	T100454-s6	Foxtail millet	Layer 4	-	2435±03	730-410	760-400	AMS	Li, Min 2014
	not provided	T1003-5-s2	Wheat	Layer 5	-	2445±35	740-410	760-400	AMS	Li, Min 2014
	not provided	T1005-6-s4	Rice	Layer 6	-	2960±25	1220-1120	1270-1050	AMS	Li, Min 2014
	not provided	T1003-6-s2	Wheat	Layer 6	-	2975±45	1270-1120	1390-1040	AMS	Li, Min 2014
	not provided	T1003-6-s1	Wheat	Layer 6	-	3000±35	1290-1130	1390-1120	AMS	Li, Min 2014
	not provided	T1004-6-s3	Soybean	Layer 6	-	3045±40	1390-1230	1400-1220	AMS	Li, Min 2014
	not provided	T1004-6-s3	Foxtail millet	Layer 6	-	3050±30	1390-1260	1410-1120	AMS	Li, Min 2014
	not provided	T1003-7-s2	Wheat	Layer 7	-	3060±35	1400-1270	1420-1220	AMS	Li, Min 2014
	not provided	T1004-7-s6	Rice	Layer 7	-	3075±35	1400-1290	1430-1230	AMS	Li, Min 2014
	not provided	T1005-7-s2	Wheat	Layer 7	-	3095±30	1420-1300	1430-1270	AMS	Li, Min 2014
	not provided	T1005-7-s1	Wheat	Layer 7	-	3125±30	1440-1310	1500-1290	AMS	Li, Min 2014
	not provided	T1004-7-s3	Foxtail millet	Layer 7	-	3210±30	1510-1440	1600-1410	AMS	Li, Min 2014
	not provided	T1003-7-s2	Rice	Layer 7	-	3240±40	1610-1450	1620-1430	AMS	Li, Min 2014
	not provided	T1005-8-s2	Wheat	Layer 8	-	3105±25	1420-1300	1440-1290	AMS	Li, Min 2014
	not provided	T1005-8-s2	Rice	Layer 8	-	3250±35	1610-1460	1620-1440	AMS	Li, Min 2014
	not provided	T1003-8-s2	Foxtail millet	Layer 8	-	3275±35	1610-1460	1620-1450	AMS	Li, Min 2014
	not provided	T1003-9-s2	Foxtail millet	Layer 9	-	3230±40	1600-1440	1620-1420	AMS	Li, Min 2014
	not provided	T1003-9-s2	Rice	Layer 9	-	3275±35	1610-1500	1640-1450	AMS	Li, Min 2014
	not provided	T1003-10-s1	Rice	Layer 10	-	3380±25	1730-1630	1750-1620	AMS	Li, Min 2014
	BA081094	2008JHAT1304(5)	Seed	Layer 5	-	3000±35	1290-1130	1390-1120	AMS	Min 2013
	BA081095	2008JHAT2121(5)	Rhizome	Layer 5	-	2200±35	360-200	380-170	AMS	Min 2013
	BA081096	2008JHAT2002(6)	Wheat	Layer 6	-	2435±35	730-410	760-400	AMS	Min 2013
	BA081097	2008JHDT1005(6)	Charred grain	Layer 6	-	3020±35	1380-1210	1400-1120	AMS	Min 2013
	BA081098	2008JHDT1304(6)	Fiber	Layer 6	-	3075± 35	1400-1290	1430-1230	AMS	Min 2013
	BA081099	2008JHAT2003(6)	Rice	Layer 6	-	2930±35	1200-1050	1230-1010	AMS	Min 2013
	BA081100	2008JHAT2003(6)	Millet	Layer 6	-	2940±35	1220-1080	1260-1020	AMS	Min 2013
	BA081101	2008JHDT2003(7)	Millet	Layer 7	-	3550±40	1950-1780	2020-1750	AMS	Min 2013
	BA081102	2008JHAT2505(7)	Rhizome	Layer 7	-	3205±35	1510-1430	1610-1410	AMS	Min 2013
	BA081103	2008JHDT1205(8)	Charcoal	Layer 8	-	3605±40	2030-1560	2130-1830	AMS	Min 2013
Haimenkou	BA081104	2008JHDT1005(9)	Charcoal	Layer 9	-	3345±35	1690-1560	1740-1530	AMS	Min 2013
	BA081105	2008JHDT1004(9)	Charcoal	Layer 9	-	4210±35	2900-2700	1740-1530	AMS	Min 2013
	BA081106	2008JHDT1003(10)	Rhizome	Layer 10	-	4485±35	3340-3090	3350-3030	AMS	Min 2013

Site	Lab Code	Archaeological Context	Dating Material	Stratigraphic information	h. l. 5730	h. l. 5568	68.20%	95.40% cal BCE	Dating method	References
Shifodong	ZK-3198	2003GST13(4)D	Charcoal	Layer 4D	-	2977±59	1290-1110	1400-1020	C14	CASS 2005
	ZK-3199	2003GST13(4)D	Charcoal	Layer 4D	-	2998±47	1370-1120	1400-1050	C14	CASS 2005
Shizhaishan	BA 091158	n/a	Seed	Layer 6	-	n/a	n/a	779-488	AMS?	Yao, Jiang 2012
Hebuosuo	Beta 312944	n/a	n/a	n/a	-	n/a	n/a	410-38	AMS?	Yao et al. 2015
	Beta 312945	n/a	n/a	n/a	-	n/a	n/a	200 BCE-40 CE	AMS?	Yao et al. 2015
	Beta 405371	n/a	n/a	n/a	-	n/a	n/a	734-400	AMS?	Yao et al. 2015
	Beta405368	-	Seed	Layer 3	-	2520 ± 30	-	674-539	-	Yao et al. 2020
	UCI152059	-	Seed	Layer 3a	-	2565 ± 20	-	681-563	-	Yao et al. 2020
	Beta405369	-	Seed	Layer 4	-	2510 ± 30	-	690-583	-	Yao et al. 2020
	Beta405370	-	Seed	Layer 4a	-	2490 ± 30	-	716-602	-	Yao et al. 2020
	Beta405371	-	Seed	Layer 5	-	2410 ± 30	-	750-645	-	Yao et al. 2020
	Beta488060	-	Seed	Layer 5	-	2510 ± 30	-	781-627	-	Yao et al. 2020
	Beta488061	-	Seed	Layer 6	-	2530 ± 30	-	798-741	-	Yao et al. 2020
	UCI152061	-	Seed	Layer 6a	-	2870 ± 20	-	1104-945	-	Yao et al. 2020
	Beta405373	-	Seed	Layer 7	-	2920 ± 30	-	1186-1013	-	Yao et al. 2020
Shangxihe	Beta488056	-	Seed	Layer 4	-	2200 ± 30	-	391-275	-	Yao et al. 2020
	Beta488057	-	Seed	Layer 5	-	2470 ± 30	-	591-416	-	Yao et al. 2020
	Beta472799	-	Seed	Layer 5A	-	2530 ± 30	-	678-542	-	Yao et al. 2020
	Beta472800	-	Seed	Layer 5A	-	2580 ± 30	-	677-551	-	Yao et al. 2020
	Beta472801	-	Seed	Layer 6	-	2500 ± 30	-	766-604	-	Yao et al. 2020
	Beta472802	-	Seed	Layer 6	-	2490 ± 30	-	764-605	-	Yao et al. 2020
	Beta472803	-	Seed	Layer 6	-	2530 ± 30	-	776-595	-	Yao et al. 2020
	Beta472805	-	Seed	Layer 7	-	2520 ± 30	-	789-668	-	Yao et al. 2020
	Beta472807	-	Seed	Layer 8	-	2540 ± 30	-	801-752	-	Yao et al. 2020
	Beta472808	-	Seed	Layer 8	-	2590 ± 30	-	812-767	-	Yao et al. 2020
	Beta472810	-	Seed	Layer 9	-	2780 ± 30	-	976-840	-	Yao et al. 2020
	Beta472809	-	Seed	Layer 10A	-	2540 ± 30	-	804-778	-	Yao et al. 2020
	Beta472811	-	Seed	Layer 10A-1	-	2930 ± 30	-	1092-1019	-	Yao et al. 2020
	Beta472812	-	Seed	Layer 10A-1	-	2960 ± 30	-	1094-1024	-	Yao et al. 2020
	Beta472813	-	Seed	Layer 10A-2	-	2850 ± 30	-	1052-932	-	Yao et al. 2020
	Beta472816	-	Seed	Layer 10A-2	-	2840 ± 30	-	1050-926	-	Yao et al. 2020
	Beta472817	-	Seed	Layer 12	-	2920 ± 30	-	1116-1057	-	Yao et al. 2020
	Beta472818	-	Seed	Layer 12	-	2860 ± 30	-	1112-1060	-	Yao et al. 2020
	Beta472819	-	Seed	Layer 13	-	3150 ± 30	-	1500-1311	-	Yao et al. 2020
	Beta472820	-	Seed	Layer 13	-	2800 ± 30	-	1126-1071	-	Yao et al. 2020
Gucheng	BA091155	-	Seed	Layer 2	-	-	-	810-530	-	Yao, Jiang 2012
	BA091156	-	Seed	Layer 3	-	-	-	900-760	-	Yao, Jiang 2012

Site	Lab Code	Archaeological Context	Dating Material	Stratigraphic information	h. l. 5730	h. l. 5568	68.20%	95.40% cal BCE	Dating method	References
Anjiang	Beta 312943	n/a	n/a	Layer 6	-	n/a	n/a	770-650	AMS?	Yao et al. 2015
	Beta 312942	n/a	n/a	Layer 5	-	n/a	n/a	730-590	AMS?	Yao et al. 2015
	BA 091156	n/a	n/a	Layer 3	-	n/a	n/a	640-430	C14?	Yao et al. 2015
Shilinggang	LZU1468	n/a	Rice	Layer 4	-	2375±30	490-390	710-390	AMS	Li et al. 2016
	LZU1469	n/a	Rice	Layer 5	-	2480±30	760-540	780-430	AMS	Li et al. 2016
Dayingzhuang	Beta-501549	2017YHD 2	Wheat	Layer 2	-	100±30	modern	modern	AMS	Dal Martello 2020
	Beta-051550	2017YHD 4	Wheat	Layer 4	-	2380±30	485-400	727-393	AMS	Dal Martello 2020
	Beta-051549	2017 YHD 5	Wheat	Layer 5	-	2430±30	726-414	750-405	AMS	Dal Martello 2020
Xiwangmiao	Beta-472 801-472803	-	-	Layer 6	-	-	-	775-546	-	Yao et al. 2019
	Beta-472805	-	-	Layer 7	-	-	2520± 3 0	795-542	-	Yao et al. 2019
	Beta-4728 07-427808	-	-	Layer 8	-	-	-	804-756	-	Yao et al. 2019
	Beta-472809-16	-	-	Layer 10	-	-	-	1007-923	-	Yao et al. 2019
	Beta-472817-472818	-	-	Layer 12	-	-	-	1128-1003	-	Yao et al. 2019
	Beta-472819	-	-	Layer 13	-	3150±30	-	1261-1125	-	Yao et al. 2019
Xiaogucheng	Beta 407119	-	-	-	-	-	-	800-670	-	Yao et al. 2020

Appendix 4

Counts of main plant species shown in relative proportion in Figure 28

Site ID [fig. 19]	Site	Chronology	O[1]	S	P	T	H	Other economic species	Weeds	Total plant remains[2]	References
1	Baiyangcun Phase I	2650-2450 BCE	4131	1338	95	-	-	675	619	6858	Dal Martello 2020
1	Baiyangcun Phase II	2200-2000 BCE	2817	1899	80	-	-	977	1002	6775	Dal Martello 2020
2	Dadunzi	2200-1610 BCE	3598	1136	228	-	-	17	90	5069	Jin H.T. et al. 2014a; 2014b
5	Xingyi	1800-1300 BCE	195	923	272	18	-	4	179	1591	Ma et al. 2024
1	Baiyangcun Phase III	2000-1700 BCE	1006	379	15	-	-	369	396	2165	Dal Martello 2020
6	Haimenkou Phase I *systematic flotation*	1600-1450 BCE	1810	2990	46	-	-	6363	1559	12768	Xue et al. 2022
6	Haimenkou Phase II *systematic flotation*	1450-1100 BCE	1122	735	12	52	6	1890	3418	7235	Xue et al. 2022
6	Haimenkou Phase II *handpicked*	1450-1100 BCE	220	81941	43	262	2	1712	72	84252	Xue et al. 2022
11	Shifodong	1400-1100 BCE	7482	239	5	-	-	-	-	7726	Zhao 2010b
16	Hebosuo- Dian	800-109 BCE	2860	6	-	37	-	247	71	3221	Yang et al. 2023
18	Anjiang	770-430 BCE	11	1	-	34	5	-	-	51	Yao et al. 2015
19	Dayingzhuang	750-390 BCE	150	37	26	413	18	53	375	1072	Dal Martello, Li, Fuller 2021
21	Xueshan	700-300 BCE	3787	209	50	9247	7	337	1735	15372	Yang, Jiang, Chen 2020

Site ID [fig. 19]	Site	Chronology	O[1]	S	P	T	H	Other economic species	Weeds	Total plant remains[2]	References
22	Xiaogucheng	700-300 BCE	101	1	-	-	-	-	2163	2265	Yao et al. 2015
23	Guangfentou	700-300 BCE	430	253	4	789	8	5336	1980	8800	Li, Liu 2016
27	Jiangxifen	900-400 BCE	118	8	3	-	-	-	2	131	Lu et al. 2021
28	Yubeidi	700-300 BCE	2962	229	-	8	-	34	72	3305	Yang, Jiang, Chen 2020
6	Haimenkou Phase III *systematic flotation*	800-300 BCE	30	216	1	605	7	50	1243	2152	Xue et al. 2022
6	Haimenkou Phase III *handpicked*	800-300 BCE	2577	239	-	17	1	7493	15	10342	Xue et al. 2022
31	Shilinggang	723-339 BCE	34	9	-	-	-	-	-	43	Li et al. 2016
16	Hebosuo- Han	109 BCE-220 CE	61388	13	-	130	-	2679	410	64620	Yang et al. 2023

[1] including spikelet bases

[2] This indicates the total reported individual plant remains according to original archaeobotanical reports, including unidentified remains which are not discussed here.

O = *Oryza sativa* – rice

P = *Panicum miliaceum* – broomcorn millet

S = *Setaria italica* – foxtail millet

T = *Triticum aestivum* – free-threshing wheat

H = *Hordeum vulgare* – barley

Appendix 5

Archaeological sites in China with evidence for (foxtail and/or broomcorn) millet and rice grains dating to between the sixth and second millennia BCE, illustrated in Figure 29

Legend

1-0	indicates presence (1) and absence (0) of plant species
?	Indicates the presence of plant species is unclear
w	indicates wild species
O	*Oryza sativa* – rice
P	*Panicum miliaceum* – broomcorn millet
S	*Setaria italica* – foxtail millet

Data compiled consulting Stevens, Fuller 2017; Stevens, Zhuang, Fuller 2024; Stevens et al. 2016; He et al. 2022a.

Site	Chinese name	Province	Lat.	Long.	Start Date BCE	End Date BCE	Est. Median Date BCE	O	P	S	Notes	References
Jiahu	贾湖	Henan	33.620	113.674	6660	5510	6085	w	0	?	-	Zhao, Zhang 2009; Zhang, Wang 1998; Zhang, Cui 2013; Zhang, Hung 2013; Cheng 2016; Hu, Ambrose, Wang 2006
Xihe	西河	Shandong	36.706	117.630	6070	5900	5985	?w	0	1	-	Jin G.Y. et al. 2014; Jin 2006; 2007; Wu et al. 2013
Zhuzhai	朱寨	Henan	34.825	113.305	5974	5823	5899	?w	1	1	-	Bestel et al. 2018; Wang C. et al. 2018
Yuezhuang	月庄	Shandong	36.620	116.829	5880	5710	5795	1	1	1	-	Crawford, Cheng, Wang 2016; Crawford et al. 2013; 2016
Beiliu	0	Shaanxi	34.222	109.324	5700	5400	5550	1	1	1	-	Zhou, Wang, Zhao 2024
Gouwan	沟湾	Henan	33.093	111.502	5050	4650	4889	1	1	1	-	Wang Y.Q. et al. 2011
Guanqiaocunnan	官桥村南	Shandong	34.928	117.220	4400	4000	4200	1	1	1	-	Jin et al. 2020
Didongbei (North Didong)	底董北	Henan	34.563	110.458	4400	4000	4200	1	1	1	-	Wei 2014; Li Y.P. et al. 2021
Chengtoushan	城头山	Hunan	29.693	111.656	4450	3850	4150	1	0	1	-	Pei 1998; Nasu et al. 2007
Yuhuazhai	鱼化寨	Shaanxi	34.241	108.855	4300	4000	4150	1	1	1	-	Zhao 2017
Dongpan	东盘	Shandong	34.926	118.750	4030	3820	3925	1	1	1	-	Wang, Liu, Jin 2012; d'Alpoim Guedes, Jin, Bocinsky 2015; Jin et al. 2016
Nanjiaokou	南交口	Henan	34.870	111.425	3950	3850	3900	1	1	1	-	Qin, Fuller 2009
Anle	安乐	Zhejiang	30.655	119.695	3980	3790	3885	1	0	1	-	Tang, Marston, Fang 2022
Dawenkou	大汶口	Shandong	35.944	117.080	4200	3500	3850	1	1	1	-	Wu 2018; Guo, Jin 2019
Dongyang	东杨	Shaanxi	34.626	110.064	4200	3500	3850	1	1	1	-	Zhao 2019
Yuancun	袁村	Henan	34.388	113.032	3950	3700	3825	1	1	1	rice could be intrusive	Fuller, Zhang 2007
Huiduipo (905)	灰堆坡	Shaanxi	34.568	109.028	3950	3700	3825	1	1	1	-	Yang et al. 2016
Xianghuazhai	香花寨	Henan	32.996	111.892	3990	3530	3760	1	1	1	-	Huan et al. 2022b
Xinglefang	兴乐坊	Shaanxi	34.543	109.984	4000	3500	3750	1	1	1	-	Liu et al. 2011; 2013

Site	Chinese name	Province	Lat.	Long.	Start Date BCE	End Date BCE	Est. Median Date BCE	O	P	S	Notes	References
Nanjiaokou	南交口	Henan	34.870	111.425	4400	3000	3700	1	1	1	-	Qin, Fuller 2009
Baligang	八里岗	Henan	32.690	112.132	4300	3000	3650	1	1	1	-	Deng et al. 2015; Deng 2015; Weisskopf 2014
Lixian 6 (LX06)	礼县 6	Gansu	34.189	105.178	3750	3550	3650	1	1	1	-	Li et al. 2015; Li et al. 2015; An et al. 2014; 2010
Dingdian	丁店	Shanxi	35.394	111.258	4000	3300	3650	1	1	1	-	Song 2011; Song, Wang, Fuller 2019
Xihanshui	西汉水	Gansu	34.180	105.170	3700	3500	3600	1	1	1	-	Ji 2009
Huitupo	灰土坡	Henan	32.686	112.083	4000	3000	3500	1	1	1	-	Fuller, Qin [unpublished]; Deng 2015
Lixian 3 (LX03)	礼县 3	Gansu	34.130	105.113	4000	3000	3500	1	1	1	-	Li et al. 2015
Xipo	西坡	Henan	34.499	110.702	4000	3000	3500	1	1	1	-	Ma 2005; Weisskopf 2014; Zhong et al. 2020
Cha'an	茶庵	Henan	33.065	111.833	3620	3370	3495	1	1	1	-	Huan et al. 2022b
Anguocheng	安国城	Henan	33.038	112.242	3520	3460	3490	1	1	1	-	Huan et al. 2022b
Zhongshangsi	冢上寺	Henan	33.083	112.048	3520	3360	3440	1	1	1	-	Huan et al. 2022b
Hunanguo	湖南郭	Henan	33.667	113.701	3750	3050	3400	1	1	1	-	Cheng 2016; Yang et al. 2016
Miaopo	庙坡	Henan	33.432	112.456	3600	3200	3400	1	1	1	-	Huan et al. 2022b
Zhaishang	寨上	Henan	33.618	112.471	3600	3200	3400	1	1	1	-	Huan et al. 2022b
Beiqian	北阡	Shandong	36.600	120.739	3760	2900	3330	1	1	1	-	Zhao 2009; Jin et al. 2013; Wang F. et al. 2011; Jin et al. 2016
Baitoushan	白头山	Fujian	26.131	119.155	3500	3100	3300	1	1	1	-	Dai et al. 2021
Cangdi	蒼帝	Shanxi	35.473	111.368	4000	2600	3300	1	0	1	-	Song 2011; Song, Wang, Fuller 2019
Diantoubao	店頭堡	Shanxi	35.337	111.317	4000	2600	3300	1	1	1	-	Song 2011; Song, Wang, Fuller 2019
Diantoubao (North)	店頭堡 (北)	Shanxi	35.338	111.317	4000	2600	3300	1	1	1	-	Song 2011
Shangshaowang	上邵王	Shanxi	35.359	111.254	4000	2600	3300	1	1	1	-	Song 2011; Song, Wang, Fuller 2019
Wanggou	汪沟	Henan	34.825	113.411	3550	3050	3300	1	1	1	-	Yang et al. 2016
Anle	安乐	Zhejiang	30.655	119.695	3500	3020	3260	1	1	1	-	Tang, Marston, Fang 2022
Li County: unnamed site	礼县: 未命名的遗址	Gansu	34.074	105.134	3500	3000	3250	1	1	1	-	An et al. 2010

Site	Chinese name	Province	Lat.	Long.	Start Date BCE	End Date BCE	Est. Median Date BCE	O	P	S	Notes	References
Lixian 17 (LX17)	礼县 17	Gansu	34.172	105.156	3500	3000	3250	1	1	1	-	Ji 2009; An et al. 2010; Li et al. 2015
Xihanshui	西汉水	Gansu	34.180	105.170	3500	3000	3250	1	1	1	-	Ji 2009
Zhaocheng	赵城	Henan	34.564	112.886	3500	3000	3250	1	0	1	-	Lee et al. 2007
Xiangjiawan	向家湾	Shaanxi	32.820	107.620	3500	3000	3250	1	?	?	-	Liu, Jin, Kong 2008; Shang et al. 2012
Yejiamiao	叶家庙	Hubei	30.879	113.894	3500	3000	3250	1	0	1	-	Wu, Liu, Zhao 2010
Quanhu (Yuanjunmiao)	泉护村 (元君庙)	Shaanxi	34.532	109.861	3500	3000	3250	1	0	1	-	Yan 1982; Liu, Jin, Kong 2008
Yuhuazhai	鱼化寨	Shaanxi	34.241	108.855	3500	3000	3250	1	1	1	rice could be intrusive	Zhao 2017
Licun	李村	Henan	33.223	112.625	3370	3100	3235	1	1	1	-	Huan et al. 2022b
Zhuzhai	朱寨	Henan	34.825	113.305	3310	3130	3220	1	1	1	-	Bestel et al. 2018; Wang C. et al. 2018
Agangsi	阿岗寺	Henan	33.601	113.613	3400	3000	3200	1	1	1	-	Cheng 2016; Yan et al. 2016
Mashangen	马山根	Henan	32.933	111.400	3400	3000	3200	1	1	1	-	Deng 2015
Gouwan	沟湾	Henan	33.093	111.502	3500	2900	3200	1	1	1	-	Wang Y.Q. et al. 2011
Xishanping	西山坪	Gansu	34.564	105.545	3348	3032	3190	1	1	1	-	Chen et al. 2020; Li et al. 2007; Sheng, Allen, Wang 202302024
Zhongwa	冢洼	Henan	33.054	112.044	3360	2920	3140	1	1	1	-	Huan et al. 2022b
Xishanping	西山坪	Gansu	34.564	105.545	3363	2891	3127	1	1	0	-	Chen et al. 2020; Li et al. 2007; Sheng, Allen, Wang 2023024
Luchengzi	芦城孜	Anhui	33.481	116.957	3500	2600	3050	1	0	1	-	Wang et al. 2016; Anhui 2016
Xinjie	新街	Shaanxi	34.244	109.158	3500	2600	3050	1	1	1	-	Zhong et al. 2015; 2020
Xishanping	西山坪	Gansu	34.564	105.545	3500	2500	3000	1	1	1	-	Barton 2009; Li et al. 2007; Sheng, Allen, Wang 2023
Lixian 5 (LX05)	礼县 5	Gansu	34.189	105.178	3500	2500	3000	1	1	1	-	Ji 2009; An et al. 2010; Li et al. 2015
Huizui	灰嘴	Henan	34.652	112.741	3090	2910	3000	1	1	1	rice could be intrusive	Lee, Bestel 2007; Lee et al. 2007; Weisskopf 2014

Site	Chinese name	Province	Lat.	Long.	Start Date BCE	End Date BCE	Est. Median Date BCE	O	P	S	Notes	References
Hulou	胡楼	Henan	34.057	113.600	3100	2900	3000	1	1	1	-	Stevens et al. 2021
Zhunagbianshan	庄边山	Fujian	26.108	119.137	3010	2910	2960	1	1	0	-	Dai et al. 2021
Nanshan	南山	Fujian	26.356	117.218	3023	2895	2959	1	1	1	-	Deng et al. 2022; Yang et al. 2018
Qinglongquan	青龙泉	Hubei	32.640	111.410	3400	2500	2950	1	1	1	-	Zhongguo 1991; Guo et al. 2011
Huanglianshu (=Longshangang)	黄楝树	Henan	32.980	111.328	3300	2600	2950	1	0	1	-	Liu, Jin, Kong 2008; Flad, Chen 2013
Longgangsi	龙岗寺	Shaanxi	33.072	106.977	3030	2870	2950	1	1	1	-	Tang et al. 2020
Anban	案板村	Shaanxi	34.353	107.914	3000	2800	2900	1	1	1	-	Liu 2014
Yuanqiao	袁桥	Henan	34.389	112.996	3100	2678	2889	1	1	1	-	Fuller, Zhang 2007; Zhang et al. 2010
Zhoujiazhuang	周家庄	Shanxi	35.481	111.477	2900	2800	2850	1	1	1	rice could be intrusive	Song 2011; Song, Wang, Fuller 2019
Yuchisi	尉迟寺	Anhui	33.358	116.750	3000	2600	2800	1	0	1	-	Liu, Jin, Kong 2008; Wang, Wu 1998; Zhao 2007
Hougong II (Hougongdong)	后宫II (后宫东)	Shanxi	35.364	111.412	3000	2600	2800	1	1	1	-	Song 2011; Song, Wang, Fuller 2019
Xiawanggang	下王岗	Henan	33.020	111.366	3000	2600	2800	1	1	1	-	Tang 2024
Yangpu	杨堡	Anhui	34.002	117.073	3000	2500	2750	1	1	1	-	Cheng et al. 2016a; Yang et al. 2016; Zhang J. et al. 2018
Xujiacun	胥家村	Shandong	35.448	119.423	3000	2500	2750	1	1	1	-	d'Alpoim Guedes, Jin, Bocinsky 2015; Chen 2007
Baligang	八里岗	Henan	32.690	112.132	3000	2500	2750	1	1	1	-	Deng et al. 2015; Deng 2015; Weisskopf 2014
Jinying	金营	Henan	33.016	111.284	3000	2500	2750	1	0	1	-	Deng 2015
Henglanshan	横欄山	Sichuan	27.845	102.364	2850	2650	2750	1	1	1	rice dominant	Deng et al. 2022b; Jiang et al. 2016; Huan et al. 2022c
Gushuihe (GSH)	谷水河	Henan	34.227	113.347	3000	2500	2750	1	1	1	-	Fuller, Zhang 2007; Zhang et al. 2010
Maoshan	茅山	Zhejiang	30.432	120.263	2900	2600	2750	1	0	?	-	Zhang, Ding, French 2014

Site	Chinese name	Province	Lat.	Long.	Start Date BCE	End Date BCE	Est. Median Date BCE	O	P	S	Notes	References
Diantoubao (North)	店頭堡 (北)	Shanxi	35.338	111.317	2900	2600	2750	1	1	1	-	Song 2011
Fengcun Northwest	汾村	Shanxi	35.353	111.313	2900	2600	2750	1	1	1	-	Song 2011
Hougong	后宫	Shanxi	35.356	111.402	2900	2600	2750	1	1	1	-	Song 2011; Song, Wang, Fuller 2019
Suncun	孙村	Shanxi	35.356	111.299	2900	2600	2750	1	1	1	-	Song 2011; Song, Wang, Fuller 2019
Tangpo	唐坡	Henan	34.365	111.599	3000	2500	2750	1	1	1	-	Stevens et al. 2021
Gouwan	沟湾	Henan	33.093	111.502	3000	2500	2750	1	1	1	-	Wang Y.Q. et al. 2011
Juxian/ Jiaozhou	莒县/胶州	Shandong	36.270	120.044	3000	2400	2700	1	0	1	-	Jin et al. 2009c; d'Alpoim Guedes, Jin, Bocinsky 2015; Jia 2012; Jin et al. 2009c
Guodishan	锅底山	Jiangxi	27.500	116.304	2880	2490	2685	1	0	1	-	Deng et al. 2022b; Deng et al. 2020
Nantunling	南屯岭	Shandong	35.366	119.453	2800	2500	2650	1	1	1	-	Chen 2007
Tanshishan	曇石山	Fujian	26.147	119.151	2840	2460	2650	1	1	0	-	Deng et al. 2022; Dai et al. 2021
Nanshan	南山	Fujian	26.356	117.218	3000	2300	2650	1	1	1	-	Deng et al. 2022b; Yang et al. 2018
Suncun I	孙村 I	Shanxi	35.362	111.312	2800	2500	2650	1	1	1	-	Song, Wang, Fuller 2019
Suncun V	孙村 V	Shanxi	35.362	111.312	2800	2500	2650	1	1	1	-	Song, Wang, Fuller 2019
Diaotoubao	店头堡	Shanxi	35.343	111.329	2800	2500	2650	1	1	1	-	Song, Wang, Fuller 2019
Houguancun	后官寨	Gansu	35.683	107.583	2800	2500	2650	1	1	1	-	Zhou et al. 2011
Shanyawei (Shanyanwei?)	山岩尾	Zhejiang	28.483	118.492	3000	2200	2600	1	1	1	-	Deng et al. 2022b
Xishanping	西山坪	Gansu	34.564	105.545	2700	2350	2525	1	1	1	-	Barton 2009; Li et al. 2007; Dodson et al. 2013; Long et al. 2018; Sheng, Allen, Wang 202302024
Yuangjiaquan (Yangjiaquan)	楊家圈遺址	Shandong	37.207	120.781	3000	2000	2500	1	1	1	-	Crawford et al. 2005; Luan 1997
Baitoushan	白头山	Fujian	26.131	119.155	3000	2000	2500	1	1	0	-	Dai et al. 2021
Shijiahe (Sanfangwan, Tanjialing)	石家河遺址	Hubei	30.761	113.081	2800	2200	2500	1	0	1	-	Deng et al. 2013
Duanjiahe	段家河	Shandong	35.528	118.985	3000	2000	2500	1	0	1	-	Liu, Jin, Kong 2008; Qi et al. 2017

Site	Chinese name	Province	Lat.	Long.	Start Date BCE	End Date BCE	Est. Median Date BCE	O	P	S	Notes	References
Guojiacun	大连郭家村	Liaoning	38.759	121.152	3000	2000	2500	1	1	1	-	Liu, Jin, Kong 2008; Robbeets et al. 2021
Xilou	西楼村	Shandong	35.501	118.999	3000	2000	2500	1	0	1	-	Liu, Jin, Kong 2008; Qi et al. 2017
Chenjiazhuang	程家庄	Shanxi	35.406	111.276	3000	2000	2500	1	0	1	-	Qi et al. 2017
Fengcun Northwest	汾村	Shanxi	35.353	111.313	2600	2400	2500	1	1	1	-	Song 2011
Hougong	后宫	Shanxi	35.356	111.402	2600	2400	2500	1	1	1	-	Song 2011; Song, Wang, Fuller 2019
Suncun (South)	孙村 (南)	Shanxi	35.356	111.299	2600	2400	2500	1	1	1	-	Song 2011; Song, Wang, Fuller 2019
Tonglin	桐林	Shandong	36.894	118.226	3000	2000	2500	1	1	1	-	Song 2011; Song 2007
Baiyangcun	白羊村	Yunnan	25.840	100.594	2600	2300	2450	1	1	1	-	Dal Martello et al. 2018; Yunnan 1981
Laoyuan	老园	Guangdong	24.534	114.935	2700	2200	2450	1	0	1	-	Deng et al. 2022b; Yang et al. 2018
Weifenhe	蔚汾河	Shanxi	38.469	111.134	3000	1900	2450	1	1	1	rice could be intrusive	Jiang et al. 2019
Zhaojiazhuang	赵家庄	Shandong	36.050	119.788	2600	2300	2450	1	1	1	-	Jin et al. 2009b; Jin et al. 2011b; Song, Wang, Fuller 2019
Beiniu (8010 material reworked in 1)	北牛	Shaanxi	34.473	109.320	2780	2120	2450	1	1	1	-	Yang et al. 2016; Sheng et al. 2019
Gancaoling	甘草岭	Guangdong	23.304	113.548	2800	2000	2400	1	0	1	-	Deng et al. 2022a
Guijiabao	皈家堡	Sichuan	27.450	101.608	3050	1750	2400	1	1	1	-	Deng et al. 2022b; Huan et al. 2022c
Zhoujiazhuang	周家庄	Shanxi	35.481	111.477	2500	2300	2400	1	1	1	-	Gao et al. 2022; Jiang et al. 2019
Gaoshan	高山	Sichuan	30.440	103.557	2550	2250	2400	1	0	1	-	Wang B. et al. 2023
Bianjiashan	边家山	Zhejiang	30.373	119.988	2500	2300	2400	1	0	1	-	Zheng, Crawford, Chen 2014
Xiazhai	下寨	Henan	33.017	111.270	2500	2250	2375	1	1	1	-	Deng 2015
Liujiazhuang (Rizhao)	刘家庄	Shandong	35.257	119.301	2800	1900	2350	1	0	1	-	Chen 2016; Wei et al. 2019; Gong 2016
Baodun	宝墩	Sichuan	30.434	103.759	2700	2000	2350	1	0	1	-	d'Alpoim Guedes 2013; d'Alpoim Guedes, Butler 2014; d'Alpoim Guedes et al. 2013
Chujiacun [Zhujiacun]	褚家村	Sichuan	30.837	104.224	2700	2000	2350	1	?	?	Unspecified millet species	d'Alpoim Guedes 2013; Chengdu, Xindu 2010

Site	Chinese name	Province	Lat.	Long.	Start Date BCE	End Date BCE	Est. Median Date BCE	O	P	S	Notes	References
Huayuan	花园 ?花源街道	Sichuan	30.485	103.883	2700	2000	2350	1	1	1	-	d'Alpoim Guedes 2013; Shi, Jiang, Jie 2020
Sanxingcun	国光村	Sichuan	30.875	104.207	2700	2000	2350	1	?	?	Unspecified millet species	d'Alpoim Guedes 2013
Yongfucun	永福村	Sichuan	30.726	103.899	2700	2000	2350	1	?	?	Unspecified millet species	d'Alpoim Guedes 2013
Baligang	八里岗	Henan	32.690	112.132	2500	2200	2350	1	1	1	-	Deng et al. 2015; Deng 2015; Weisskopf 2014
Qinglongquan	青龙泉	Hubei	32.640	111.410	2500	2200	2350	1	1	1	-	Zhongguo 1991; Guo et al. 2011
Wangjiazui	王家嘴	Shaanxi	34.480	107.600	2700	2000	2350	1	1	1	-	Zhao, Xu 2004
Shilipubei	十里铺北	Shandong	35.044	115.639	2700	1900	2300	1	1	1	-	Guo et al. 2019
Baobantai	薄板台村	Shandong	35.530	118.980	2700	1900	2300	1	0	1	-	Jin et al. 2009a
Zhaojiazhuang	赵家庄	Shandong	36.050	119.788	2400	2200	2300	1	1	1	-	Jin et al. 2009a; Jin, Yan, Liu 2008; Long et al. 2018
Xuejiazhuang	薛家庄	Shandong	35.941	119.245	2600	2000	2300	1	1	1	-	Jin et al. 2009b; d'Alpoim Guedes, Jin, Bocinsky 2015; Jin, Wang, Lan 2009
Xiawanggang	下王岗	Henan	33.020	111.366	2600	2000	2300	1	1	1	-	Tang 2024
Houyangguanzhuang (also Guanzhuang)	后杨官庄	Shandong	34.883	118.200	2400	2200	2300	1	1	1	-	Wang, He, Jin 2013; d'Alpoim Guedes et al. 2015
Gouwan	沟湾	Henan	33.093	111.502	2500	2000	2300	1	1	1	-	Wang Y.Q. et al. 2011
Dinggongcun	丁公村	Shandong	36.952	117.853	2600	2000	2300	1	1	1	-	Wu et al. 2018
Chengjiazhuang	程家庄	Shanxi	35.406	111.276	2400	2150	2275	1	1	1	rice could be intrusive	Song 2011; Song, Wang, Fuller 2019; Gao et al. 2022
Wutai	午台	Shandong	37.446	121.428	2600	1900	2250	1	1	1	-	Chen et al. 2019; Guo, Jin 2019
Liangchengzhen	两城镇	Shandong	35.579	119.572	2600	1900	2250	1	1	1	-	Crawford et al. 2005
Shantaisi	山台寺	Henan	34.117	115.183	2600	1900	2250	1	1	1	-	Crawford, Leng, Lee 2001; Murowchik, Cohen 2001
Chengyao	程窑	Henan	34.398	113.083	2500	2000	2250	?	1	1	-	Fuller, Zhang 2007; Zhong et al. 2018

Site	Chinese name	Province	Lat.	Long.	Start Date BCE	End Date BCE	Est. Median Date BCE	O	P	S	Notes	References
Fangjia	芳家	Shandong	36.778	118.026	2600	1900	2250	1	1	1	-	Jin et al. 2011b; d'Alpoim Guedes, Jin, Bocinsky 2015; Jin et al. 2011b
Lilou	李楼	Henan	34.156	112.669	2500	2000	2250	1	0	1	-	Liu, Jin, Kong 2008; Lu 1999
Wangjiacun	王家村遗址	Liaoning	39.162	122.352	2500	2000	2250	1	1	1	-	Ma Y.C. et al. 2015
Shangyukou	上峪口	Shanxi	35.432	111.403	2600	1900	2250	1	1	1	-	Song, Wang, Fuller 2019; Gao et al. 2022
Quanjiu	0	Henan	34.517	110.400	2550	1950	2250	1	1	1	-	Wei 2014
Yangjiaquan	杨家圈	Shandong	37.208	120.774	2600	1900	2250	1	0	1	-	Yan et al. 1984; Luan, Jin, Wang 2007
Zaojiaoshu	皂角树	Henan	34.649	112.401	2600	1900	2250	1	1	1	-	Ye 2000; Craford et al. 2005
Xinzhai	新砦	Henan	34.507	113.416	2500	2000	2250	1	1	1	-	Zhao 2007; 2013; Yuan, Campbell 2009; Zhong et al. 2016; An 2021
Xijincheng	西金城	Henan	35.106	113.108	2500	1900	2200	1	1	1	-	Chen, Wang, Wang 2010; Gao et al. 2022
Dingjialiugou	丁家柳沟	Shandong	35.541	119.233	2500	1900	2200	1	0	1	-	Chen et al. 2009
Donghaiyu	东海峪	Shandong	35.222	119.313	2500	1900	2200	1	0	1	-	Chen et al. 2009
Sigeda	寺疙瘩	Henan	33.631	113.644	2250	2150	2200	1	1	1	-	Cheng 2016; Li et al. 2021; Yang L. et al. 2020
Yadi	崖底	Shanxi	38.672	112.623	2500	1900	2200	1	1	1	-	Jiang 2011
Wenjiatun	闻家屯村	Liaoning	42.301	124.439	2400	2000	2200	1	1	1	-	Obata 2019; Miyamoto 2009
Dongpan	东盘	Shandong	34.926	118.750	2500	1900	2200	1	1	1	-	Wang, Liu, Jin 2011; Long et al. 2018
Dalaidian	大赉店	Henan	35.740	114.280	2500	1900	2200	1	1	1	rice could be intrusive	Wu, Guo, Jin 2017
Yuhuicun (Yuhui)	禹会村 (禹会)	Anhui	32.926	117.344	2500	1900	2200	1	0	1	-	Yin 2011; 2013; Guo, Jin 2019
Taosi	陶寺	Shanxi	35.675	111.401	2300	2100	2200	1	1	1	-	Zhao, Fang 2007; Zhao 2007; He 2013; Gao et al. 2022
Qianshuichegou	前水车沟	Shandong	35.169	119.292	2400	1900	2150	1	0	1	-	Chen et al. .2009
Fengshidao (Xifandian?)	西范店	Henan	34.362	112.882	2400	1900	2150	1	1	1	-	Fuller, Zhang 2007
Wuwan	吴湾	Henan	34.398	113.125	2400	1900	2150	1	1	1	-	Fuller, Zhang 2007

Site	Chinese name	Province	Lat.	Long.	Start Date BCE	End Date BCE	Est. Median Date BCE	O	P	S	Notes	References
Chengzhuang	程庄	Henan	34.371	113.471	2400	1900	2150	1	0	1	-	Jia 2011
Jindiancun	?金殿村	Henan	34.456	113.639	2400	1900	2150	1	1	1	-	Jia 2011
Hutuohe	滹沱河	Shanxi	38.974	112.796	2400	1900	2150	1	1	1	-	Jiang et al. 2019; Jiang 2011
Hucun	湖村	Shanxi	35.490	111.357	2400	1900	2150	1	1	1	-	Song 2011; Song, Wang, Fuller 2019; Gao et al. 2022
Xiayukou	下峪口	Shanxi	35.432	111.392	2400	1900	2150	1	1	1	-	Song 2011
Luchengzi	芦城孜	Anhui	33.481	116.957	2500	1800	2150	1	1	1	-	Wang et al. 2016; Anhui 2016
Houzidong	猴子洞	Sichuan	26.145	102.107	2250	2050	2150	1	1	1	-	Wang B. et al. 2023; Liu et al. 2023; Wang 2021
Zhouyuan	周原	Shaanxi	34.414	107.896	2500	1800	2150	1	1	1	-	Zhao, Xu 2004
Jiaochangpu	教场铺	Shandong	36.409	116.261	2400	1900	2150	?	1	1	-	Zhao 2004c; d'Alpoim Guedes, Jin, Bocinsky 2015; Jin et al. 2009a; Ma, Jin 2017
Liantang	莲塘	Sichuan	26.376	102.027	2210	2010	2110	1	1	1	-	Wang B. et al. 2023
Qiaocun	桥村	Gansu	35.152	107.500	2350	1850	2100	1	1	1	-	An et al. 2014; Chen et al. 2019
Baiyangcun	白羊村	Yunnan	25.840	100.594	2200	2000	2100	1	1	1	-	Dal Martello et al. 2018; Yunnan 1981
Haojiatai	郝家台	Henan	33.594	114.034	2300	1900	2100	1	1	1	rice could be intrusive	Deng, Qin 2017; Deng et al. 2021
Xiawu	下毋	Henan	34.227	113.381	2200	1970	2085	1	1	1	-	Fuller, Zhang 2007
Buziping	堡子坪	Gansu	35.459	104.467	2180	1930	2055	1	1	1	-	An et al. 2014; Jia et al. 2013; Lee et al. 2007
Xiazhai	下寨	Henan	33.017	111.270	2200	1900	2050	1	1	1	-	Deng 2015
Pingliangtai	平粮台	Henan	33.708	114.924	2150	1950	2050	1	1	1	-	Deng, Qin 2017; Zhao, Cao, Jin 2019
Wadian009	瓦店009	Henan	34.192	113.412	2150	1950	2050	1	1	1	-	Liu, Zhao, Fang 2018
Taosi	陶寺	Shanxi	35.675	111.401	2100	2000	2050	1	1	1	-	Zhao, Fang 2007; Zhao 2007; He 2013; Gao et al. 2022
Qiaocun	桥村	Gansu	35.148	107.497	2300	1800	2050	1	1	1	-	Zhou et al. 2011; Chen et al. 2019
Zhonghai	中海	Sichuan	30.719	103.980	2210	1800	2005	1	1	1	-	Yan, Zhou, Jiang 2014; d'Alpoim Guedes 2013
Lingyuntai	凌云台	Henan	33.677	113.867	2050	1950	2000	1	1	1	-	Cheng 2016; Yang et al. 2016

Site	Chinese name	Province	Lat.	Long.	Start Date BCE	End Date BCE	Est. Median Date BCE	O	P	S	Notes	References
Baligang	八里岗	Henan	32.690	112.132	2200	1800	2000	1	1	1	-	Deng et al. 2015; Deng 2015; Weisskopf 2014
Xifandian	西范店	Henan	34.405	113.085	2200	1800	2000	1	1	1	-	Fuller, Zhang 2007; Zhang et al. 2010
Youfangtou	油坊头	Henan	34.379	113.028	2200	1800	2000	1	1	1	-	Fuller, Zhang 2007; Zhang et al. 2010
Zhuanglixi	庄里西	Shandong	35.055	117.054	2100	1900	2000	1	?	?	Unspecified millet species	Kong, Liu, Zhang 1999; Crawford et al. 2005
Huizui	灰嘴	Henan	34.652	112.741	2200	1800	2000	1	1	1	-	Lee, Bestel 2007; Lee et al. 2007; Weisskopf 2014; Zhao, Xia, Zhang 2014
Dinggong	丁公	Shandong	36.948	117.848	2100	1900	2000	1	1	1	-	Wu et al. 2018
Wangchenggang	王城岗	Henan	34.398	113.125	2200	1800	2000	1	1	1	-	Zhao, Fang 2007; Yuan Campbell 2009; Flad et al. 2010

Appendix 6

Archaeological sites in China and mainland Southeast Asia mentioned in Ch. 5, illustrated in figures 30, 32, 33

Legend

1-0	indicates presence (1) and absence (0) of plant species
?	Indicates the presence of plant species is unclear

Dating method is indicated as

AMS	direct radiocarbon dating on seeds
C14	radiocarbon dating on other material
assoc.	dating via cultural association
-	data not available

S	*Setaria italica* – foxtail millet
P	*Panicum miliaceum* – broomcorn millet
O	*Oryza sativa* – rice
T	*Triticum aestivum/durum* – free-threshing wheat
H	*Hordeum vulgare* – barley

Data compiled consulting He et al. 2022a; Stevens, Fuller 2017; Stevens, Zhuang, Fuller 2024; Stevens et al. 2016.

Site	Local script name	Country	Province	Latitude-Longitude	Start-End Date BCE/CE	Est. Median Date BCE	Dating method	S	P	O	T	H	Other crops	Notes	References
Liujiazhai	刘家寨	China	Sichuan	31.783333-101.533333	3350-2750 BCE	3050	assoc.	1	0	0	0	0	-	-	Chen et al. 2021; Chen et al. 2022
Yingpanshan	营盘山	China	Sichuan	31.67-103.84	3350-2700 BCE	3025	AMS	1	1	0	0	0	-	-	Zhao, Chen 2011; Huan et al. 2022
Nanshan	南山	China	Fujian	26.355555-117.217527	3023-2895 BCE	2959	AMS	1	1	1	0	0	-	-	Carson, Hung 2018, 810; Yang et al. 2018
Haxiu	哈休	China	Sichuan	32.17412-102.145469	3200-2700 BCE	2950	assoc.	1	1	0	0	0	-	-	Wang B. et al. 2023; d'Alpoim Guedes 2011; Zhao, Chen 2011; Aba et al. 2007; 2008
Guiyuanqiao	桂圆桥	China	Sichuan	31.131733-104.184032	3050-2700 BCE	2875	assoc.	1	1	0	0	0	-	-	d'Alpoim Guedes, Butler 2014
Henglanshan	横欄山	China	Sichuan	27.845054-102.3644042	2850-2650 BCE	2750	assoc.	1	1	1	0	0	-	Rice dominant	Luo et al.2018; Liu, Hao 2007
Nanshan	南山	China	Fujian	26.359642-117.189027	3000-2300 BCE	2650	assoc.	1	1	1	0	1	Soybean	-	Carson, Hung 2018, 810; Yang et al. 2018
Gancaoling	甘草岭?	China	Guangdong	23.185-113.3253	-	2600	AMS	1	0	0	0	0	-	-	Deng et al. 2022a
Baiyangcun	白羊村	China	Yunnan	25.840397-100.593691	2600-2300 BCE	2450	AMS	1	1	1	0	0	-	-	Dal Martello et al. 2018
Chamdo Karuo [Qamdo Karuo]	昌都卡若	China	Tibet	31.060907-97.209364	2800-2100 BCE	2450	-	1	1	0	0	0	-	-	d'Alpoim Guedes et al. 2013; Song et al. 2021
Xiaoenda	小恩达	China	Tibet	31.158854-97.127769	2850-2050 BCE	2450	-	1	1	0	0	0	-	-	Lu 2023; Zhang et al. 2019
Gaoshan	高山	China	Sichuan	30.439781-103.557161	2550-2250 BCE	2400	AMS	1	0	1	0	0	-	-	Lee et al. 2019

Site	Local script name	Country	Province	Latitude-Longitude	Start-End Date BCE/CE	Est. Median Date BCE	Dating method	S	P	O	T	H	Other crops	Notes	References
Guijiabao	皈家堡	China	Sichuan	27.450494-101.608453	3050-1750 BCE	2400	AMS	1	1	1	0	0	-	-	Hao et al. 2022
Lao Pako	–	Laos	-	18.16419-102.86308	2600-2200 BCE	2400	assoc.	0	0	1	0	0	-	-	d’Alpoim Guedes et al.2019
Baodun	宝墩	China	Sichuan	30.434442-103.759096	2700-2000 BCE	2350	AMS	1	0	1	0	0	-	-	d’Alpoim Guedes, Butler 2014; d’Alpoim Guedes 2013; d’Alpoim Guedes et al. 2013
Hedongtian	河东田	China	Sichuan	26.168902-102.114361	2850-1850 BCE	2350	-	1	1	0	0	0	-	-	Liu et al. 2023
Hetoudi	河头地	China	Sichuan	26.17368-102.11525	2850-1850 BCE	2350	-	1	1	0	0	0	-	-	Liu et al. 2023
Sanxingcun	国光村	China	Sichuan	30.874935-104.206611	2700-2000 BCE	2350	-	0	0	1	0	0	Millet?	-	d’Alpoim Guedes 2013
Yongfucun	永福村	China	Sichuan	30.726259-103.89862	2700-2000 BCE	2350	-	0	0	1	0	0	Millet?	-	d’Alpoim Guedes 2013
Non Pa Wai	–	Thailand	-	14.9711-100.678	2470-2200 BCE	2335	AMS Foxtail millet	1	0	0	0	0	-	-	Nguyen 1998
La Phob	拉颇	China	Tibet	30.07-95.59	2800-1800 BCE	2300	AMS	1	1	0	0	0	Pea, *Sambucus*, *Chenopodium*	-	Wang Y. et al. 2024
Dingshishan	–	China	Guangxi	22.74826-108.49469	2500-2000 BCE	2250	C14	0	0	1	0	0	-	-	Zhang et al. 2022a
Gantouyan	感驮岩	China	Guangxi	23.412673-105.848778	3500-1000 BCE	2250	C14	1	0	1	0	0	-	-	Guangxi 2003; Lu 2009
Guiyuanqiao	桂圆桥	China	Sichuan	31.131733-104.184032	2700-1700 BCE	2200	assoc.	1	1	0	0	0	-	-	d’Alpoim Guedes, Butler 2014

Site	Local script name	Country	Province	Latitude-Longitude	Start-End Date BCE/CE	Est. Median Date BCE	Dating method	S	P	O	T	H	Other crops	Notes	References
Houzidong	猴子洞	China	Sichuan	26.144692-102.106535	2250-2050 BCE	2150	AMS	1	1	1	0	0	-	-	Wang B. et al. 2023; Wang 2021
Krek 52/62	–	Cambodia	Kampong Cham	11.77254-105.92527	2600-1700 BCE	2150	assoc.	0	0	1	0	0	-	-	Weber et al. 2010
Liena	列那	China	Tibet	29.12-93.36	2400-1900 BCE	2150	optical dating	1	0	0	0	0	-	-	Wang Y. et al. 2024
Haidong	海东	China	Yunnan	24.924163-102.734562	2500-1750 BCE	2125	assoc.	0	0	?	0	0	-	-	Zhang, Hung 2010
Xinguang	新光	China	Yunnan	25.460559-99.525447	2500-1750 BCE	2125	-	0	0	1	0	0	-	-	Yunnan 2002
Liantang	莲塘	China	Sichuan	26.376404-102.027251	2210-2010 BCE	2110	-	1	1	1	0	0	-	-	Wang B. et al. 2023
Baiyangcun	白羊村	China	Yunnan	25.840397-100.593691	2200-2000 BCE	2100	AMS	1	1	1	0	0	-	-	Dal Martello et al. 2018
Zhongba	中坝	China	Chongqing	30.28457-108.032	2500-1500 BCE	2000	assoc.	0	0	1	0	0	-	-	d'Alpoim Guedes 2013
Kien Lies	–	Cambodia	Kampong Thom/ Chhnang	12.32673-104.86674	2200-1800 BCE	2000	assoc.	0	0	1	0	0	-	-	Pigott et al. 2006; Weber et al. 2010
Kok Trabaek	–	Cambodia	Kampong Thom	12.25197-104.88845	2200-1800 BCE	2000	assoc.	0	0	1	0	0	-	-	Pigott et al. 2006; Weber et al. 2010
Kop Ches	–	Cambodia	Kampong Thom/ Chhnang	12.22231-104.86919	2200-1800 BCE	2000	assoc.	0	0	1	0	0	-	-	Weber et al. 2010
Po Prok	–	Cambodia	Kampong Thom/ Chhnang	12.30164-104.85647	2200-1800 BCE	2000	assoc.	0	0	1	0	0	-	-	Källén 2004; Bowdery 1999

Site	Local script name	Country	Province	Latitude-Longitude	Start-End Date BCE/CE	Est. Median Date BCE	Dating method	S	P	O	T	H	Other crops	Notes	References
Toul Leas	–	Cambodia	Kampong Chhnang	12.32439-104.80719	2200-1800 BCE	2000	assoc.	0	0	1	0	0	-	-	Vanna 2001
Nil Kham Haeng	นิลกำแหง	Thailand	Lopburi	14.95675-100.65593	2300-1600 BCE	1950	assoc.	1	0	0	0	0	-	-	Castillo 2013; Weber et al. 2010
Non Pa Wai	โนนป่าหวาย	Thailand	Lopburi	14.9711-100.678	2300-1600 BCE	1950	C14	1	0	0	0	0	-	-	Pigott et al. 2006; Weber et al. 2010
Mopanshan	磨盘山	China	Yunnan	25.65-101.8	-	1800	assoc.	1	0	1	0	0	-	-	Kan 2013
Non Mak La	–	Thailand	Lopburi	14.96395-100.67486	2100-1450 BCE	1775	assoc.	1	0	0	0	0	-	-	Nguyen 1998
Zhonghai	中海	China	Sichuan	30.719447-103.980353	2210-1250 BCE	1730	assoc.	1	1	1	0	0	-	-	Chengdu 2012; Yan, Zhou, jiang 2014
Trang Kenh, TK69	–	Vietnam	Hải Phòng	20.950163-106.749922	1960-1450 BCE	1705	C14	0	0	1	0	0	Soybean?, Mungbean?	-	Vanna 2001; 2002
Khok Phanom Di	–	Thailand	-	13.58457-101.14089	2000-1400 BCE	1700	C14	0	0	1	0	0	-	-	Pigott et al. 2006; Weber et al. 2010
Dông Dâu	–	Vietnam	-	21.22387-105.62976	1770-1550 BCE	1660	-	0	0	1	0	0	-	-	Oxenham et al. 2015
Jinsha	金沙	China	Sichuan	30.683333-104.010833	2700-600 BCE	1650	-	1	1	1	0	0	-	-	Jiang et al. 2011
Chamdo Karuo [Qamdo Karuo]	昌都卡若	China	Tibet	31.060907-97.209364	1770-1500 BCE	1635	-	1	1	0	1	?	-	-	d'Alpoim Guedes et al. 2013; Song et al. 2021
Rach Nui	–	Vietnam	Long An	10.539017-106.672517	1845-1385 BCE	1615	AMS	1	0	1	0	0	Sedges	-	Källén 2004; Bowdery 1999
Rach Nui	–	Vietnam	Long An	10.539017-106.672517	1845-1385 BCE	1615	AMS	1	0	1	0	0	-	-	Vanna 2001; 2002
Loc Giang	–	Vietnam	-	20.950391-106.749755	1800-1400 BCE	1600	AMS	0	0	1	0	0	-	-	Barron et al. 2017

Site	Local script name	Country	Province	Latitude-Longitude	Start-End Date BCE/CE	Est. Median Date BCE	Dating method	S	P	O	T	H	Other crops	Notes	References
Gantouyan	感驮岩	China	Guangxi	23.412673-105.848778	1900-1200 BCE	1550	assoc.	1	0	0	0	0	-	-	Guangxi 2003; Lu 2009
Samrong Sen	-	Cambodia	Kampong Chhnang	12.34343-104.84507	1700-1400 BCE	1550	assoc.	0	0	1	0	0	-	-	Vanna 2001; 2002
Xingyi	兴义	China	Yunnan	24.18-102.82	1800-1300 BCE	1550	AMS	1	1	1	0	0	Soybean, Buckwheat	-	Ma et al. 2024
Haimenkou 1	海门口	China	Yunnan	26.43333-99.91667	1600-1400 BCE	1500	C14	1	1	1	0	0	-	-	Xue et al. 2022
Klu lding	立定	China	Tibet	29.15-92.65	1800-1200 BCE	1500	AMS	1	1	0	1	1	*Chenopodium*	-	Wang Y. et al. 2024
Klu ding/Liding	立定	China	Tibet	29.35-93.45	2000-1000 BCE	1500	assoc.	1	1	0	0	0	-	-	Ma et al. 2022; Dong et al. 2022
Dadunzi	大墩子	China	Yunnan	25.71283-101.8821	1550-1400 BCE	1475	-	1	1	1	0	0	-	-	Jin H.T. et al. 2014a; 2014b
Gepa Serul	阿里	China	Tibet	31.566666-79.8	1505-1396 BCE	1450,5	-	0	0	0	0	1	-	-	Tang et al. 2019
Mopandi	磨盘地	China	Yunnan	26.053485-101.668087	1600-1200 BCE	1400	assoc.	0	0	1	0	0	-	-	Zhao 2003
Tù Son	-	Vietnam	-	21.1839-106.056	1550-1250 BCE	1400	assoc.	0	0	1	0	0	-	-	Vanna 2001; 2002
Qugong	曲贡	China	Tibet	29.700944-91.128361	1500-1250 BCE	1375	AMS	1	1	0	1	1	-	-	Gao et al. 2020b
Wujiadaping	-	China	Guizhou	27.1325-103.4822	1521-1216 BCE	1368,5	C14	0	0	1	0	0	-	-	Guizhou 2006
Ban Chiang	-	Thailand	-	17.50262-103.25591	1650-1050 BCE	1350	C14	0	0	1	0	0	-	-	Yen 1982; White 1982
Non Pa Wai	โนนป่าหวาย	Thailand	Lopburi	14.9711-100.678	1500-1200 BCE	1350	C14	1	0	1	0	0	-	-	Pigott et al. 2006; Weber et al. 2010

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Haimenkou 2	海门口	China	Yunnan	26.43333-99.91667	1400-1100 BCE	1250	AMS	1	1	1	1	1	*Fagopyrum esculentum*, *Chenopodium*	-	Xue et al. 2022
Zhonghai	中海	China	Sichuan	30.719447-103.980353	1500-1000 BCE	1250	assoc.	1	1	1	1	0	-	-	Chengdu 2012; Yan, Zhou, jiang 2014
Kuoxiong	廓雄	China	Tibet	29.29-88.45	1393-1052 BCE	1222,5	AMS	0	0	0	0	1	-	-	Tang et al. 2021
Mianxiangaopo	–	China	Sichuan	28.5-102.18	1400-1000 BCE	1200	assoc.	1	1	0	0	0	-	-	Luo et al. 2018; Deng 2022
Ashaonao	阿梢垴	China	Sichuan	33.256978-103.919155	1400-1000 BCE	1200	AMS wheat	1	0	0	1	1	-	-	d'Alpoim Guedes et al. 2015
Xiaoenda	小恩达	China	Tibet	31.158854-97.127769	1550-850 BCE	1200	-	0	1	0	1	0	-	-	Lu 2023; Zhang et al. 2019
Bangtangbu	邦唐布	China	Tibet	29.16-91.15	1263-1056 BCE	1159,5	AMS	1	1	0	1	1	-	-	Tang et al. 2021
Boluocun	菠萝村	China	Sichuan	30.818084-103.882946	1400-890 BCE	1145	assoc.	1	1	1	0	0	-	-	Chengdu 2012
Changguogou	昌果沟	China	Tibet	29.24802-91.771522	1450-800 BCE	1125	AMS	1	0	0	1	1	Pea, Oat?	-	Fu 2001
Nanbiqiao	南碧桥	China	Yunnan	23.5459-99.42761	1250-970 BCE	1110	assoc.	0	0	1	0	0	-	-	Zhao 2010b
Chujiacun [Zhujiacun]	褚家村	China	Sichuan	30.837387-104.224019	1200-1000 BCE	1100	-	0	0	1	0	0	Millet?	-	d'Alpoim Guedes 2013
Gaopo	高坡	China	Sichuan	28.469152-102.1680353	1350-850 BCE	1100	-	0	1	1	0	0	-	rice dominant	Deng et al. 2022
Khok Charoen	–	Thailand	-	15.38266-100.82245	1400-800 BCE	1100	assoc.	0	0	1	0	0	-	-	Pigott et al. 2006

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Phu Lon	–	Thailand	-	18.19871-102.07045	1200-1000 BCE	1100	assoc.	0	0	1	0	0	-	-	Nguyen 1998
Shifodong	石佛东	China	Yunnan	23.365095-99.432395	1200-1000 BCE	1100	assoc.	1	1	1	0	0	-	-	d'Alpoim Guedes, Butler 2014; Zhao 2010b
Yantangcun	燕塘村	China	Sichuan	30.796634-104.115102	1200-1000 BCE	1100	-	0	0	1	1	0	Soybean, Millet?	-	d'Alpoim Guedes 2013
Yongfucun	永福村	China	Sichuan	30.726259-103.89862	1200-1000 BCE	1100	-	0	0	1	1	0	Millet?	-	d'Alpoim Guedes 2013
Shangxihe	上西河	China	Yunnan	24.71-102.71	-	1100	AMS	0	0	1	1	0	Fruits	-	Yao A. et al. 2020
Nil Kham Haeng	นิลกำแหง	Thailand	Lopburi	14.95675-100.65593	1350-800 BCE	1075	assoc.	1	0	0	0	0	-	-	Weber et al. 2010
Non Mak La	โนนหมากลา	Thailand	Lopburi	14.96395-100.67486	1450-700 BCE	1075	assoc.	1	0	0	0	0	-	-	Nguyen 1998
Sanguantang	三官堂遗址	China	Sichuan	30.53619-103.899843	1200-950 BCE	1075	assoc.	1	0	1	0	0	-	-	Jiang et al. 2013
Boluocun [Bolocun]	波罗村	China	Sichuan	30.818084-103.882946	1200-800 BCE	1000	assoc.	1	1	1	0	0	Peach	-	d'Alpoim Guedes 2013
Cho Ghênh	–	Vietnam	-	20.24694-105.99033	1500-500 BCE	1000	-	0	0	1	0	0	-	-	Castillo, Fuller 2010; Castillo, Fuller, Bellina 2016
Huayuan	花园 ?花源街道	China	Sichuan	30.485244-103.883192	1200-800 BCE	1000	-	0	0	1	0	0	Millet?	-	d'Alpoim Guedes 2013
Sanhehuayuan	三河花园	China	Sichuan	30.7812802-104.133621	1200-800 BCE	1000	-	1	1	1	0	0	Peach	-	d'Alpoim Guedes 2013
Taipingcun	太平村	China	Sichuan	30.860278-104.003671	1200-800 BCE	1000	-	0	0	1	0	0	Millet?	-	d'Alpoim Guedes 2013

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An Son	–	Vietnam	-	10.24202-105.15581	1100-800 BCE	950	C14	0	0	1	0	0	-	-	Weber et al. 2010
Shapingzhan	沙坪站	China	Sichuan	27.750542-102.1512996	1050-850 BCE	950	-	1	0	1	0	0	-	rice dominant	Deng et al. 2022
Sanguantang	三官堂遗址	China	Sichuan	30.53619-103.899843	1045-771 BCE	908	assoc.	1	1	1	0	0	-	-	Jiang et al. 2013
Zongzan	宗咱	China	Yunnan	28.71-98.75	1045-771 BCE	908	assoc.	0	0	0	0	0	Buckwheat	-	Yang 2014
Lo Gach	–	Vietnam	-	10.915772-105.763955	1100-700 BCE	900	AMS	0	0	1	0	0	Wild job's tear?	-	C. Castillo pers. comm. 2018
Loc Gach	–	Vietnam	-	10.915772-105.763955	1100-700 BCE	900	AMS	0	0	1	0	0	-	-	Vincent 2002
Zhengjiaba	郑家坝	China	Sichuan	31.618333-105.946667	1200-600 BCE	900	assoc.	1	1	1	0	1	-	-	Yan et al. 2013
Non Pa Wai	–	Thailand	-	14.9711-100.678	1000-700 BCE	850	-	1	0	1	0	0	-	-	Nguyen 1998
Nong Nor	–	Thailand	-	13.48619-101.22253	1100-600 BCE	850	C14	0	0	1	0	0	-	-	Nguyen 1998
Gucheng	古城	China	Yunnan	24.72-102.74	900-530 BCE	715	AMS	1	0	1	1	0	-	-	Yao, Jiang 2012
Ban Na Di	–	Thailand	-	17.25612-103.13399	900-500 BCE	700	-	0	0	1	0	0	-	-	Castillo 2013; Higham et al. 2015
Zhongba	中坝	China	Chongqing	30.28457-108.032	1100-200 BCE	650	assoc.	1	1	1	0	0	-	-	d'Alpoim Guedes 2013
Nil Kham Haeng	นิลกำแหง	Thailand	Lopburi	14.95675-100.65593	800-500 BCE	650	-	1	0	1	0	0	-	-	O'Reilly 2007; Higham 2002
Jiangxifen	江西坟	China	Yunnan	26.18-102.23	900-400 BCE	650	C14	1	0	1	0	0	-	-	Lu et al. 2021
Banga	?崩嘎	China	Tibet	29.087236-91.720933	1055-211 BCE	633	AMS	0	0	0	1	1	-	-	Tang et al. 2021

Site	Local script name	Country	Province	Latitude-Longitude	Start-End Date BCE/CE	Est. Median Date BCE	Dating method	S	P	O	T	H	Other crops	Notes	References
Shizhaishan	石寨山	China	Yunnan	24.709996-102.693002	780-490 BCE	600	-	1	0	1	1	0	-	-	Yao, Jiang 2012
Haimenkou 3	海门口	China	Yunnan	26.43333-99.91667	750-400 BCE	575	AMS	1	1	1	1	1	*Chenopodium*	-	Xue et al. 2022
Guanfentou	光坟头	China	Yunnan	24.338333-102.863333	700-400 BCE	550	assoc.	1	1	1	1	1	-	-	Li 2016
Làng Vac	–	Vietnam	-	19.14837-104.84546	600-500 BCE	550	-	0	0	1	0	0	-	-	d'Alpoim Guedes et al. 2019
Shilinggang	石岭岗	China	Yunnan	25.643529-98.883886	723-339 BCE	531	AMS	1	0	1	0	0	-	-	Li et al. 2016
Anjiang	–	China	Yunnan	24.771577-102.783353	730-430 BCE	530	-	1	1	1	1	1	*Chenopodium*	-	Yao et al. 2015
Ka Ding	–	China	Tibet	30.08-95.59	-	500	assoc.	1	0	0	0	0	-	-	Ma et al. 2022
La Phob	拉颇	China	Tibet	30.07-95.59	700-300 BCE	500	AMS wheat/ barley	1	1	0	1	1	Pea, *Sambucus*, *Chenopodium*	-	Wang Y. et al. 2024
Xueshan	学山	China	Yunnan	24.641137-102.942584	700-300 BCE	500	assoc.	1	1	1	1	1	-	-	Wang 2014
Xiaogucheng	小古城	China	Yunnan	24.905978-102.829989	700-300 BCE	500	-	1	0	1	1	0	-	-	Yao et al. 2015
Yubeidi	玉碑地	China	Yunnan	25.42-102.22	700-300 BCE	500	-	1	1	1	1	0	-	-	Yang, Jiang, Chen 2019
Xiwangmiao	西王庙	China	Yunnan	24.71-102.69	800-109 BCE	454,5	assoc.	1	0	1	1	0	Soybean	-	Yao A. et al. 2020
Rdo phug	都普	China	Tibet	29.78-93.83	600-300 BCE	450	AMS	0	0	0	0	1	Pea	-	Wang Y. et al. 2024; Wang et al. 2021
Jialama	加拉马	China	Tibet	29.76-94.01	700-60 BCE	380	AMS	0	0	0	1	1	-	-	Wang Y. et al. 2024; Wang et al. 2021

Site	Local script name	Country	Province	Latitude-Longitude	Start-End Date BCE/CE	Est. Median Date BCE	Dating method	S	P	O	T	H	Other crops	Notes	References
Baolun yuan/ Dongsun	寶輪院/冬筍	China	Sichuan	32.2321-105.374932	475-221 BCE	348	-	0	0	0	0	0	Peach	-	Zheng, Crawford, Chen 2014
Hebosuo	河泊所	China	Yunnan	24.26-103.18	730 BCE-40 CE	345	-	1	1	1	1	1	-	-	Yang et al. 2023
Ashaonao	阿梢垴	China	Sichuan	33.256978-103.919155	400-200 BCE	300	-	1	0	0	1	1	Possible flax?	-	d'Alpoim Guedes et al.2015
Kha ldìng	卡定	China	Tibet	30.04-95	700 BCE-100 CE	300	AMS	1	0	0	1	1	-	-	Wang Y. et al. 2024; Wang et al. 2021
Làng Ca	-	Vietnam	-	21.3079-105.42624	400-200 BCE	300	-	0	0	1	0	0	-	-	Weber et al. 2010
Jinshashan	金砂山	China	Yunnan	24.72-102.72	800 BCE-200 CE	300	assoc.	0	0	0	1	0	-	-	Yunnan Kaogu 2015; 2017
Jiweng	吉翁	China	Tibet	31.4042-79.464534	390-210 BCE	300	AMS Barley	0	0	0	0	1	-	-	Tang et al. 2022
Piyang	皮央	China	Tibet	31.41049-79.475146	390-210 BCE	300	AMS Barley	0	0	0	0	1	-	-	Tang et al. 2022
Khao Sam Kheo	-	Thailand	-	10.5283-99.185	400-100 BCE	250	AMS/C14	1	0	1	0	0	-	-	Pigott et al. 2006
Phum Snay	-	Cambodia	Banteay Meanchey	13.62397-103.20653	500-1 BCE	250	assoc.	0	0	1	0	0	-	-	Nguyen 1998
Tra Kieu	-	Vietnam	-	15.82278-108.24019	400-1 BCE	200	assoc.	0	0	1	0	0	-	-	O'Reilly 2003
Dingdong	丁东	China	Tibet	30.92-82.52	348 BCE-70 CE	139	AMS	0	0	0	0	1	-	-	Lu 2007
Thung Tako	-	Thailand	Chumphon	10.086527-99.135555	210-40 BCE	125	-	0	0	0	0	0	-	-	Vincent 2003a
Phromtin Tai (Prominthin Tai)	วรหมทินใต้	Thailand	Lopburi	14.990556-100.62139	200 BCE-100 CE	50	-	1	0	1	0	0	-	-	Nguyen 1998

Site	Local script name	Country	Province	Latitude-Longitude	Start-End Date BCE/CE	Est. Median Date BCE	Dating method	S	P	O	T	H	Other crops	Notes	References
Phu Khao Thong	–	Thailand	Ranonq	9.38066-98.4221	175 BCE-125 CE	25	AMS	0	0	1	0	0	Sesame, *Cajanus*, Mungbean, Horsegram, Cotton	-	Nguyen 1998
A sgang rong	阿岗绒	China	Tibet	30.15-94.66	100 BCE-100 CE	1	AMS	0	0	0	0	1	-	-	Wang et al. 2021; 2024
Baguorao	巴果绕	China	Tibet	29.76-94.01	100 BCE-100 CE	1	AMS	0	0	0	1	0	-	-	Wang et al. 2021; 2024
Lao Pako	–	Laos	-	18.16419-102.86308	200 BCE-300 CE	50	assoc.	0	0	1	0	0	-	-	Vincent 2002
Nying khri	尼池村	China	Tibet	29.51-94.41	-	100	AMS	0	0	0	0	1	-	-	Wang et al. 2021; 2024
Phromtin Tai (Prominthin Tai)	วรหมทินใต้	Thailand	Lopburi	14.990556-100.62139	400-550 CE	475	-	1	0	1	0	0	-	-	Higham 2002

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Bibliography

Aba Zangzu Qiangzu Zizhizhou Wenwu Guanlisuo 阿坝藏族羌族自治州文物管理所 et al. (2006). “Sichuan Ma’erkang Xian Haxiu Yizhi 2003, 2005 Nian Diaocha Jianbao 四川马尔康县哈休遗址 2003-2005 年调查简报 (Report on the 2003, 2005 surveys carried out at the site of Haxiu in Ma’erkang, Sichuan Province)”. *Chengdu Kaogu Faxian* 成都考古发现 (Archaeological Discoveries in Chengdu). Chengdu: Science Press, 1-14.

Aba Zangzu Qiangzu Zizhizhou Wenwu Guanlisuo 阿坝藏族羌族自治州文物管理所 et al. (2007). “Sichuan Maerkang Haxiu Yizhi Diaocha Jianbao 四川马尔康县哈休遗址调查简报 (A report on the survey at the site of Haxiu in Ma’erkang)”. *Sichuan Wenwu*, 4, 8-15, 101.

Albrecht, G. et al. (2000). “Circular Earthwork Krek 52/62: Recent Research on the Prehistory of Cambodia”. *Asian Perspectives*, 39(1), 20-46. https://doi.org/10.1353/asi.2000.0002

Alenius, T.; Mökkönen, T.; Lahelma, A. (2012). “Early Farming in the Northern Boreal Zone: Reassessing the History of Land Use in Southeastern Finland through High-Resolution Pollen Analysis”. *Geoarchaeology*, 28(1), 1-24. https://doi.org/10.1002/gea.21428

Allaby, R.G. (2014). s.v. “Domestication Syndrome in Plants”. *Encyclopedia of Global Archaeology*. Cham: Springer. https://doi.org/10.1007/978-1-4419-0465-2_2416

Allaby, R.G. (2015). “Barley Domestication: the End of a Central Dogma?”. *Genome Biology*, 16, 176. https://doi.org/10.1186/s13059-015-0743-9

Allaby, R.G. et al. (2017). “Geographic Mosaics and Changing Rates of Cereal Domestication”. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 372(1735), 20160429. https://doi.org/10.1098/rstb.2016.0429

Allaby, R.G. et al. (2022). “Emerging Evidence of Plant Domestication as a Landscape-level Process”. *Trends in Ecology & Evolution*, 37(3), 268-79. https://doi.org/10.1016/j.tree.2021.11.002

Allard, F. (1998). “Stirring at the Periphery: History, Archaeology, and the Study of Dian”. *International Journal of Historical Archaeology*, 2(4), 321-41. https://doi.org/10.1023/a:1022663925598

Allard, F. (1999). “The Archaeology of Dian: Trends and Tradition”. *Antiquity*, 73(279), 77-85. https://doi.org/10.1017/s0003598x00087858

Allard, F. (2006). “Frontiers and Boundaries: The Han Empire from its Southern Periphery”. Stark, M.T. (ed.), *Archaeology of Asia*. Malden (MA); Oxford; Carlton: Blackwell Publishing Inc.; 233-54. Blackwell Studies in Global Archaeology Series.

Ammerman, A.J.; Cavalli-Sforza, L.L. (1971). “Measuring the Rate of Spread of Early Farming in Europe”. *Man*, 6(4), 674. https://doi.org/10.2307/2799190

An, C.B. et al. (2010). "Evolution of Prehistoric Agriculture in Central Gansu Province, China: A Case Study in Qin'an and Li County". *Chinese Science Bulletin*, 55, 1925-30. https://doi.org/10.1007/s11434-010-3208-2

An, C.B. et al. (2014). "How Prehistoric Humans Use Plant Resources to Adapt to Environmental Change: A Case Study in the Western Chinese Loess Plateau during Qijia Period". *The Holocene*, 24(4), 512-17. https://doi.org/10.1177/0959683613520259

An, Jiaping. (2021). *Archaeobotanical Investigations on the Role of Agriculture in Social Changes: Case studies of the Central Plain and Haidai Region, China, from the Late Neolithic to the Early Bronze Age* [PhD dissertation]. Kiel: Kiel University.

An, Z.M. (1980). "The Neolithic Archaeology of China a Brief Survey of the Last Thirty Years". Chang, K.C. (transl.) *Early China*, 5, 34-5. https://doi.org/10.1017/s036250280000612x

An Zhimin 安志敏 (1999). "Zhongguo Daozuo Wenhua de Qihua he Dongchuan 中国稻作文化的起源和东传 (The origin and eastward spread or rice-planting culture of China)". *Wenwu*, 2, 63, 70-92.

Andersson, J.G. (1934). *Children of the Yellow River. Studies in Prehistoric China.* New York: Macmillan.

Anhui Sheng Wenwu Kaogu Yanjiusuo 安徽省文物考古研究所, Suzhou Shi Wenwu Guanliju 宿州市文物管理局 (eds) (2016). *Suzhou Luchengzi* 宿州芦城孜. Suzhou: Suzhou Municipal Museum: Cultural Relics Publishing House.

Arora, R.K. (1977). "Job's-Tears (*Coix lacryma-jobi*) – A Minor Food and Fodder Crop of Northeastern India". *Economic Botany*, 31(3), 358-66. https://doi.org/10.1007/bf02866887

Arranz-Otaegui, A. et al. (2016). "Regional Diversity on the Timing for the Initial Appearance of Cereal Cultivation and Domestication in Southwest Asia". *Proceedings of the National Academy of Sciences* (*PNAS*), 113, 14001-6. https://doi.org/10.1073/pnas.1612797113

Arranz-Otaegui, A.; Roe, J. (2023). "Revisiting the Concept of the 'Neolithic Founder Crops' in Southwest Asia". *Vegetation History and Archaeobotany*, 32(5), 475-99. https://doi.org/10.1007/s00334-023-00917-1

Asouti, E. (2013). "Evolution, History and the Origin of Agriculture: Rethinking the Neolithic (Plant) Economies of South-west Asia". *Levant*, 45(2), 210-18. https://doi.org/10.1179/0075891413z.00000000025

Asouti, E.; Fuller, D.Q. (2008). *Trees and Woodlands of South India*: *Archaeological Perspectives.* Walnut Creek: Left Coast Press.

Bagley, R. (1988). "Sacrificial Pits of the Shang Period at Sanxingdui in Guanghan County, Sichuan Province". *Arts Asiatiques*, 43(1), 78-86. https://doi.org/10.3406/arasi.1988.1237

Bakels, C.C. (1979). "Linearbandkeramische Früchte und Samen aus den Niederlanden". *Archaeo-Physika (Festschrift Maria Hopf),* 8,147-63.

Barrau, J. (1966). "The Indo-Pacific Area as a Centre of Origin of Plant Cultivation and Domestication". *Symposium on Ethnobotany During the Centennial Celebrations at the Peabody Museum of Natural History* (New Haven, Yale University, October 1966).

Barron, A. et al. (2017). "MicroCT Reveals Domesticated Rice (*Oryza sativa*) within Pottery Sherds from Early Neolithic Sites (4150-3265 cal BP) in Southeast Asia". *Scientific Reports*, 7(1). https://doi.org/10.1038/s41598-017-04338-9

Barton, H. (2012). "The Reversed Fortunes of Sago and Rice, *Oryza sativa*, in the Rainforests of Sarawak, Borneo". *Quaternary International*, 249, 96-104. https://doi.org/10.1016/j.quaint.2011.03.037

Barton, H. (2020). s.v. "Yams: Origins and Development". Smith, C. (ed.), *Encyclopedia of Global Archaeology.* Cham: Springer. https://doi.org/10.1007/978-3-030-30018-0_2193

Barton, L.W. (2009). *Early Food Production in China's Western Loess Plateau* [PhD dissertation]. Los Angeles: University of California.

Barton, L. et al. (2009). "Agricultural Origins and the Isotopic Identity of Domestication in Northern China". *Proceedings of the National Academy of Science (PNAS)*, 106(14), 5523-8. https://doi.org/10.1073/pnas.0809960106

Bassi, D.; Monet, R. (2008). "Botany and Taxonomy". *The Peach: Botany, Production and Uses*. Wallingford: CABI. 1-36. https://doi.org/10.1079/9781845933869.0001

Bates, J. (2015). *Social Organisation and Change in Bronze Age South Asia: a Multi-proxy Approach to Urbanisation, Deurbanisation and Village Life through Phytolith and Macrobotanical Analysis* [PhD dissertation]. Cambridge: Cambridge University.

Bates, J. (2022). "The Fits and Starts of Indian Rice Domestication: How the Movement of Rice Across Northwest India Impacted Domestication Pathways and Agricultural Stories". *Frontiers in Ecology and Evolution*, 10. https://doi.org/10.3389/fevo.2022.924977

Bates, J.; Petrie, C.A.; Singh, R.N. (2017). "Approaching Rice Domestication in South Asia: New Evidence from Indus Settlements in Northern India". *Journal of Archaeological Science*, 78, 193-201. https://doi.org/10.1016/j.jas.2016.04.018

Beijing Daxue Lishixi Kaogu Zhuanye Tanshisi Shiyan 北京大学历史系考古专业碳十四实验室 (1978). "Tan Shisi Niandai Ceding Baogao (Xuyi) 碳十四年代测定报告(续 –) (Radiocarbon dates in Chinese archaeology (Cont. One))". *Wenwu*, 5, 75-6.

Bellwood, P. (1995). "Austronesian Prehistory in Southeast Asia: Homeland, Expansion, and Transformation". Bellwood, P.; Fox, J.; Tryon, D. (eds), *The Austronesians: Historical and Comparative Perspectives.* Canberra: Canberra Australian National University, 96-111.

Bellwood, P. (1996). "The Origins and Spread of Agriculture in the Indo-Pacific Region". Harris, D. (ed.), *The Origins and Spread of Agriculture and Pastoralism in Eurasia*. London: University College Press, 465-98.

Bellwood, P. (2001). "Early Agriculturalist Population Diasporas? Farming, Languages, and Genes". *Annual Review of Anthropology*, 30(1), 181-207. https://doi.org/10.1146/annurev.anthro.30.1.181

Bellwood, P. (2005). *First Farmers: The Origins of Agricultural Societies*. Oxford: Blackwell.

Bellwood, P. (2006). "Asian Farming Diasporas? Agriculture, Languages, and Genes in China and Southeast Asia". Stark, M.T. (ed.), *Archaeology of Asia*. Malden: Blackwell Publishing, 96-118. https://doi.org/10.1002/9780470774670.ch6

Bellwood, P. (2011). "The Checkered Prehistory of Rice Movement Southwards as a Domesticated Cereal – From the Yangzi to the Equator". *Rice*, 4, 93-103. https://doi.org/10.1007/s12284-011-9068-9

Bellwood, P. et al. (2011). "An Son and the Neolithic of Southern Vietnam". *Asian Perspectives*, 50(1/2),144-75.

Bellwood, P.; Renfrew, C. (eds) (2003). *Examining the Farming/Language Dispersal Hypothesis*. Cambridge: McDonald Institute for Archaeological Research.

Benedict, P. (1999). "Austric: An 'Extinct' Proto-Language". Davidson, J. (ed.), *Austroasiatic languages: Essays in Honour of H.L. Shorto*. London: School of Oriental and African Studies, University of London, 7-11.

Benecke, N.; Neef, R. (2003). "Faunal and Plant Remains from Sohr Damb/Nal: a Prehistoric Site (c. 3500-2000 B.C.) in Central Balochistan (Pakistan)". Franke-Vogt, U.; Weisshaar, H.-J. (eds), *South Asian Archaeology 2003 = Proceedings of the European Association for South Asian Archaeology Conference* (Bonn, Germany, 7-11 July 2003). Aachen: Linden Soft, 81-91.

Berdiev, O.K. (Бердиев, О.К.) (1966). "Çagylly Depe. Novii pamyatnik neoliticheskoi Djeitunskoi kul'turi Чагыллы Депе, Новый Памятник Неолитической Джейтунской Культуры (Chagylly Depe, a new site of the Jeitun [Dzheytunskoy] Neolithic Culture". Kislyakov, N.A.; Vorob'yeva, M.G.(Кисляков, Н.А.; Воробьева, М.Г.) (eds), *Material'naya kul'tura narodoye Sredneyi Azii i Kazakhstana* Материальная Культура Народов Средней Азии и Казахстана (The material culture and peoples of Central Asia and Kazakhstan). Москва (Moscow): Nauka, 3-28.

Bestel, S. et al. (2014). "The Evolution of Millet Domestication, Middle Yellow River Region, North China: Evidence from Charred Seeds at the Late Upper Paleolithic Shizitan Locality 9 Site". *The Holocene*, 24(3), 261-5. https://doi.org/10.1177/0959683613518595

Bestel, S. et al. (2018). "Wild Plant Use and Multi-Cropping at the Early Neolithic Zhuzhai Site in the Middle Yellow River Region, China". *The Holocene*, 28, 195-207. https://doi.org/10.1177/0959683617721328

Bettinger, R.L. et al. (2010). "The Transition to Agriculture at Dadiwan, People's Republic of China". *Current Anthropology*, 51(5), 703-14. https://doi.org/10.1086/655982

Betts, A. (2019). "The Neolithic of West Asia: A Journey to the East". Nakamura, S.; Adachi, T.; Abe, M. (eds), *Decades in Deserts: Essays on Near Eastern Archaeology in Honour of Sumio Fujii*. Tokyo: Rokuichi Syobou, 323-7.

Betts, A.; Jia, P.W.; Dodson, J. (2014). "The Origins of Wheat in China and Potential Pathways for its Introduction: A Review". *Quaternary International*, 348, 158-68. https://doi.org/10.1016/j.quaint.2013.07.044

Billings, T.N. et al. (2022). "Agriculture in the Karakum: An Archaeobotanical Analysis from Togolok 1, Aouthern Turkmenistan (ca. 2300-1700 B.C.)". *Frontiers in Ecology and Evolution*, 10. https://doi.org/10.3389/fevo.2022.995490

Blench, R. (2008)". A History of Fruits on the Southeast Asian Mainland". Osada, T.; Uesugi, A. (eds), *Linguistics, Archaeology and the Human Past. Occasional Paper*, 4, 115-37.

Blench, R. (2015). "Reconstructing Austroasiatic prehistory". Jenny, M.; Sidwell, P. (eds), *Handbook of the Austroasiatic Languages*. Leiden: Brill.

Blench, R.M. (2005). "From the Mountains to the Valleys: Understanding Ethnolinguistic Geography in SE Asia". Sagart, L.; Blench, R.M.; Sanchez-Mazas, A. (eds), *The Peopling of East Asia: Putting Together Archaeology, Linguistics and Genetics.* London: Routledge, 31-50.

Blench, R.; Post, M.W. (2014). "Rethinking Sino-Tibetan Phylogeny from the Perspective of North East Indian Languages". Hill, N.W.; Owen-Smith, T. (eds), *Trans-Himalayan Linguistics*. Berlin: Mouton de Gruyter, 71-104.

Blust, R.A. (1996). "Beyond the Austronesian Homeland: The Austric Hypothesis and Its Implications for Archaeology". *Transactions of the American Philosophical Society*, 86(5), 117. https://doi.org/10.2307/1006623

Blust, R.A. (2013). *The Austronesian Languages*. Canberra: Pacific Linguistics.

Boaretto, E. et al. (2009). "Radiocarbon Dating of Charcoal and Bone Collagen Associated with Early Pottery at Yuchanyan Cave, Hunan Province, China". *Proceedings of the National Academy of Sciences (PNAS)*, 106(24), 9595-600. https://doi.org/10.1073/pnas.0900539106

Boesi, A. (2014). "Traditional Knowledge of Wild Food Plants in a few Tibetan Communities". *Journal of Ethnobiology ans Ethnomedicine*, 10, 75. https://doi.org/10.1186/1746-4269-10-75

Bogaard, A. et al. (2017). "Agricultural Innovation and Resilience in a Long-Lived Early Farming Community: the 1,500-Year Sequence at Neolithic to Early Chalcolithic Çatalhöyük, Central Anatolia". *Anatolian Studies*, 67, 1-28. https://doi.org/10.1017/s0066154617000072

Boivin, N.; Fuller, D.Q.; Crowther, A. (2012). "Old World Globalization and the Columbian Exchange: Comparison and Contrast". *World Archaeology*, 44(3), 452-69. https://doi.org/10.1080/00438243.2012.729404

Bourguiba, H. et al. (2020). "Genetic Structure of a Worldwide Germplasm Collection of *Prunus armeniaca* L. Reveals Three Major Diffusion Routes for Varieties Coming From the Species' Center of Origin". *Frontiers in Plant Science*, 11. https://doi.org/10.3389/fpls.2020.00638

Boutton, T.W.; Lynott, M.J.; Bumsted, M.P. (1991). "Stable Carbon Isotopes and the Study of Prehistoric Human Diet". *Critical Reviews in Food Science and Nutrition*, 30(4), 373-85. https://doi.org/10.1080/10408399109527548

Bradley, D. (2011). "Proto-Tibeto-Burman Grain Crops". *Rice*, 4, 134-41. https://doi.org/10.1007/s12284-011-9074-y

Bray, F. (1984). *Science and Civilisation in China.* Vol. 6, *Biology and Biological Technolog*y. Part 2, *Agriculture*. Cambridge: Cambridge University Press.

Brenner, M. et al. (1991). "Paleolimnology of Qilu Hu, Yunnan Province, China". Smith, J.P. et al. (eds), *Environmental History and Palaeolimnology*. Dordrecht: Springer, 333-40.

Brindley, E.F. (2015). *Ancient China and the Yue. Perceptions and Identities on the Southern Frontier, c.400 BCE-50 CE.* Cambridge: Cambridge University Press.

Browman, D.L. (1999). "Necrology: Hugh Carson Cutler". *Bulletin of the History of Archaeology*, 9(1), 1-6. https://doi.org/10.5334/bha.09102

Brown, A. et al. (2017). "Plant Macrofossil, Pollen and Invertebrate Analysis of a Mid-14th Century Cesspit from Medieval Riga, Latvia (the Eastern Baltic): Taphonomy and Indicators of Human Diet". *Journal of Archaeological Science: Reports*, 11, 674-82. https://doi.org/10.1016/j.jasrep.2017.01.016

Brown, T.A. et al. (2009). "The Complex Origins of Domesticated Crops in the Fertile Crescent". *Trends in Ecology Evolution*, 24(2), 103-9. https://doi.org/10.1016/j.tree.2008.09.008

Bruno, M.C. (2006). "A Morphological Approach to Documenting the Domestication of Chenopodium in the Andes". Zeder, M.A. et al. (eds) *Documenting Domestication: New Genetic and Archaeological Paradigms.* Berkeley: University of California Press, 32-45.

Brunori, A. et al. (2005). "The Yield of Five Buckwheat (*Fagopyrum esculentum* Moench) Varieties Grown in Central and Southern Italy". *Fagopyrum*, 22, 98-102.

Calo, A. (2014). *Trails of Bronze Drums Across Early Southeast Asia: Exchange Routes and Connected Cultural Spheres*. Singapore: Institute of Southeast Asian Studies (ISEAS).

Cao, K. et al. (2014). "Comparative Population Genomics Reveals the Domestication History of the Peach, *Prunus persica*, and Human Influences on Perennial Fruit Crops". *Genome Biology*, 15, 415. https://doi.org/10.1186/s13059-014-0415-1

Cao, K.Y. et al. (2024). "Natural and Anthropogenic Forcing Of Ecological and Environmental Changes at Lake Qilu, SW China, since the Last Deglaciation". *Palaeogeography, Palaeoclimatology, Palaeoecology*, 655, 112514. https://doi.org/10.1016/j.palaeo.2024.112514

Cappers, R.T. (2006). *Roman Foodprints at Berenike: Archaeobotanical Evidence of Subsistence and Trade in the Eastern Desert of Egypt*. Los Angeles: Cotsen Institute of Archaeology at UCLA, University of California.

Carlstein, T. (1980). *Time Resources, Society and Ecology: On the Capacity for Human Interaction in Space and Time Part 1: Preindustrial Societies*. Lund: The Royal University of Lund.

Carson, M.T.; Hung, H.C. (2018). "Learning from Paleo-Landscapes: Defining the Land-Use Systems of the Ancient Malayo-Polynesian Homeland". *Current Anthropology*, 59(6), 790-813. https://www.journals.uchicago.edu/doi/abs/10.1086/700757

Castillo, C.C. (2013). *The Archaeobotany of Khao Sam Kaeo and Phu Khao Thong: the Agriculture of Late Prehistoric Southern Thailand* [PhD dissertation]. London: UCL (University College London).

Castillo, C.C. (2017). "Development of Cereal Agriculture in Prehistoric Mainland Southeast Asia". *Man In India*, 95(4), 335-52.

Castillo, C.C. (2018). "The Archaeobotany of Khao Sek". *Archaeological Research in Asia*, 13, 74-7. https://doi.org/10.1016/j.ara.2017.05.002

Castillo, C.C. et al. (2016). "Archaeogenetic Study of Prehistoric Rice Remains from Thailand and India: Evidence of Early Japonica in South and Southeast Asia". *Archaeological and Anthropological Sciences*, 8(3), 523-43. https://doi.org/10.1007/s12520-015-0236-5

Castillo, C.C. et al. (2018a). "Social Responses to Climate Change in Iron Age North-east Thailand: New Archaeobotanical Evidence". *Antiquity*, 92(365), 1274-91. https://doi.org/10.15184/aqy.2018.198

Castillo, C.C.; et al. (2018b). "Hunter-Gatherer Specialization in the Late Neolithic of Southern Vietnam – The Case of Rach Nui". *Quaternary International*, 489, 63-79. https://doi.org/10.1016/j.quaint.2016.11.034

Castillo, C.C.; Fuller, D.Q. (2010). "Still too Fragmentary and Dependent upon Chance? Advances in the Study of Early Southeast Asian Archaeobotany". Bellina, B.; Bacus, E.A.; Pryce, T.O.; Wisseman Christie, J. (eds), *Fifty Years of Archaeology in Southeast Asia: Essays in Honour of Ian Glover*. Bangkok: River Books, 91-111.

Castillo, C.C.; Fuller, D.Q. (2016). s.v. "Bananas". *The Oxford Handbook of the Archaeology of Diet*, 518-38. https://doi.org/10.1093/oxfordhb/9780199694013.013.7

Castillo, C.C.; Bellina, B.; Fuller, D.Q. (2016). "Rice, Beans and Trade Crops on the Early Maritime Silk Route in Southeast Asia". *Antiquity,* 90(353), 1255-69. https://doi.org/10.15184/aqy.2016.175

Chanchala, S. (2005). "Palaeoethnobotany: Ancient Man, Plants and Environment in North and North Western India – Studies of Botanical Remains from Ancient Sites in UP". Mehrotra, N.C.; Rajanikanth, A. (eds), *Annual Report 2004-2005 Birbal Sahi Institute of Palaeobotany.* Lucknow: Birbal Sahni Institute of Paleobotany, 26-7.

Chang, K.-C. (1964). "Prehistoric and Early Historic Culture Horizons and Traditions in South China". *Current Anthropology*, 5(5), 359, 368-75. https://doi.org/10.1086/200525

Chang, K.-C. (1970). "The Beginnings of Agriculture in the Far East". *Antiquity*, 44, 175-85. https://doi.org/10.1017/s0003598x0004148x

Chang, K.-C. (1977a). "Chinese Archaeology since 1949". *The Journal of Asian Studies*, 36(4), 623-46. https://doi.org/10.2307/2054432

Chang, K.-C. (1977b*). Food in Chinese Culture: Anthropological and Historical Perspectives*. New Haven: Yale University Press.

Chang, K.-C. (1986). *The Archaeology of Ancient China*. New Haven: Yale University Press.

Chang Kwang-Chih 张光直 (1999). "Kaoguxue yu "Ruhe Jianshe Juyou Zhongguo Tese de Renleixue 考古学与《如何建设具有中国特色的人类学》(Archaeology and "how to build an Anthropology with Chinese characteristics")". Chang Kwang-Chih (ed.), *Zhongguo Kaoguxue Lunwenji* 中国考古学论文集 (Essays on Chinese Archaeology). Beijing: Sanlian Shudian, 1-9.

Chang, T.; Bunting, A. (1976). "The Rice Cultures (and Discussions)". *Philosophical Transaction of the Royal Society of London B: Biological Sciences*, 275(936), 143-57. https://doi.org/10.1098/rstb.1976.0077

Charles, M.; Bogaard, A. (2010). "Charred Plants Macro-Remains from Jeitun: implications for Early Cultivation and Herding Practices in Western Central Asia". Harris, D.R. (ed.), *Origins of Agriculture in Western Central Asia: An Environmental-Archaeological Study.* Philadelphia: University of Pennsylvania Museum of Archaeology and Anthropology, 150-66.

Chatteerjee, D. (1951). "Note on the Origin and Distribuition of Wild and Cultivated Rice". *Indian Journal of Genetic Plant Breed*, 11, 18-22.

Chauhan, R.S. et al. (2010). "Genetic and Genome Resources in Buckwheat – Present Status and Future Prospects". *The European Journal of Plant Science and Biotechnology*, 4, 33-44.

Chen, F.H. et al. (2014). "Holocene Vegetation History, Precipitation Changes and Indian Summer Monsoon Evolution Documented from Sediments of Xingyun Lake, South-West China". *Journal of Quaternary Science*, 29(7), 661-74. https://doi.org/10.1002/jqs.2735

Chen, F.H. et al. (2015). "Agriculture Facilitated Permanent Human Occupation of the Tibetan Plateau After 3600 B.P". *Science*, 347(6219), 248-50. https://doi.org/10.1126/science.1259172

Chen, G.H. (2020). "Kushan Period Rice in the Amu Darya Basin: Evidence for Prehistoric Exchange along the Southern Himalaya". *China Earth Sciences,* 63, 841-51. https://doi.org/10.1007/s11430-019-9585-2

Chen Jun 陈君; Chen Quanjia 陈全家; Zhu Zhonghua 朱忠华 (2019). "Yunnan Zongzan Yizhi Dongwu Gugu Yicun Yanjiu 云南宗咱遗址出土动物骨骼遗存研究 (Research on the animal bone remains from the site of Zongzan, Yunnan)". *Bianjiang Kaogu Yanjiu*, 2, 247-63.

Chen, S.; Phillips, S. (2006). "*Echinochloa*". Wu, Z.; Raven, P. (eds), *Flora of China*, vol. 22. Beijing: Science Press, 515-18.

Chen, S.; Yu, P.-L. (2017a). "Early 'Neolithics' of China: Variation and Evolutionary Implications". *Journal of Anthropological Research*, 73(2), 149-80. https://doi.org/10.1086/692104

Chen, S.; Yu, P.-L. (2017b). "Intensified Foraging and the Roots of Farming in China". *Journal of Anthropological Research*, 73(3), 381-412. https://doi.org/10.1086/692660

Chen Tingting 陈亭亭 et al. (2019). "Gansu Diqu Qijia Wenhua Shiqi Nongye Jiegou de Shikong Bianhua ji qi Yingxiang Yinsu Fexi 甘青地区齐家文化时期农业结构的时空变化及其影响因素分析 (Analysis of spatiotemporal changes in agricultural structure and its influencing factors during the Qijia Culture period in Gansu and Qinghai regions)". *Quaternary Sciences*, 39(1), 132-43.

Chen Wei 陈苇 et al. (2021). "Sichuan Jinchuanxian Liujiazhai Yizhi 2011 Nian Fajue Jianbao 四川金川县刘家寨遗址2011年发掘简报 (Sichuan Jinchuan County Liujiazhai Site Excavation Report in 2011)". *Kaogu*, 3, 2-17, 126.

Chen Wei et al. (2022). "Sichuan Jinchuanxian Liujiazhai Yizhi 2012 Nian Fajue Jianbao 四川金川县刘家寨遗址2012年发掘简报 (Sichuan Jinchuan County Liujiazhai Site Excavation Report in 2012)". *Kaogu*, 4, 2-5, 21-2.

Chen Weiwei; Zhang Juzhong 张居中; Cang Quanfa 蔡全法(2012). *Henan Xinmi Gucheng Yizhi Chutu Zhiwu Yicun Fenxi* 河南新密古城寨遗址出土植物遗存分析 (Analysis of Plant Remains from Guchengzhai City Site in Xinmi, Henan). *Huaxia Kaogu*, 1, 54-62.

Chen Wenhua 陈文华 (1989). "Zhongguo Daozuo Qiyuan de Jige Wenti – "Zhongguo de Daozuo Qiyuan" Xuyan 中国稻作起源的几个问题 –《中国的稻作起源》序言 (Preface to "The Origin of Rice in China" – Some issues on the origin of rice in China)". *Nongye Kaogu*, 2, 83-99.

Chen Xuexiang 陈雪香 (2007). "Shandong Rizhao Laingchu Xinshiqi Shidai Yizhi Fuxuan Tuyang Jieguo Fenxi 山东日照两处新石器时代遗址浮选土样结果分析 (Results on the fotation carried out at two sites in the Rizhao area of Shandong). *Nanfang Wenwu*, 1, 92-4.

Chen, X.M. et al. (2014). "Vegetation History, Climatic Changes and Indian Summer Monsoon Evolution during the Last Glaciation (36,400-13,400calyr BP) Documented by Sediments from Xingyun Lake, Yunnan, China". *Palaeogeography, Palaeoclimatology, Palaeoecology*, 410, 179-89. https://doi.org/10.1016/j.palaeo.2014.05.027

Chen, X.M. et al. (2022). "Late Holocene Land Use Evolution and Vegetation Response to Climate Change in the Watershed of Xingyun Lake, SW China". *Catena*, 211, 105973. https://doi.org/10.1016/j.catena.2021.105973

Chen Xuexiang 陈雪香; Fang Hui 方辉 (2008). "Cong Jinan Daxingzhuang Shandai Yizhi Fuxuan Jieguo Kann Shangdai Nongye Jingji 从济南大辛庄商代遗址浮选结果看商代农业经济 (A case study of agriculture in the Shang Dynasty: Macro plant remains from the Daxinzhuang site, Jinan, China)". Shandong Daxue Dongfang Kaogu Yanjiu Zhongxin 山东大学. 东方考古研究中心(ed.), *Dongfang Kaogu (disiji)* 东方考古 (第四集) (East Asian Archaeology vol. 4). Jinan: Science Press, 47-68.

Chen, Xuexiang; Wang Langzhi 王良智; Wang Qin 王青 (2010). "Henan Bo'ai Xian Xijincheng Yizhi 2006-2007 Nian Fuxuan Jieguo Fenxi 河南博爱县西金城遗址 2006-2007 年浮选结果分析 (Analysis of flotation samples from Xijincheng Site, Boaixian, Henan 2006-2007)". *Huaxia Kaogu*, 3, 67-76.

Chen Xuexiang et al. (2009). "Ludongnan Jichu XIanqin Yizhi Diaocha Caiyang Fuxuan Jieguo Fenxi 鲁东南几处先秦遗址调查采样浮选结果分析 (Carbonized seeds from the field survey in Southeastern Shandong)". 山东大学东方考古研究中心 Shandong Daxue Dongfang Kaogu Yanjiu Zhongxin (ed.), *Dongfang Kaogu (diliuji)* 东方考古 (第六辑) (East Asian Archaeology vol. 6). Jinan: Science Press, 354-7.

Chen Xuexiang (2016). "Zhongguo Qingtong Shidai Xiaomai Zhongzhi Guomo de Kaoguxue Guangcha 中国青铜时代小麦种植规模的考古学观察 (An Archaeological Perspective on Scale of Wheat Cultivation during the Chinese Early Bronze Age. *Zhongguo Nongshi*, 35(3), 3-9.

Chen Songtao 陈松涛 et al. (2019). "Shandong Wutai Yizhi Longshan Wenhua Juluo Shengji de Zhiwu Dayicun Zhengju 山东午台遗址龙山文化聚落生计的植物大遗存证据 (The archeobotanical record of Longshan period site at Wutai site, Shandong province)". *Jianghan Kaogu*, 1, 105-13.

Chen, T. et al. (2020). "Human Responses to Climate Change in the Late Prehistoric Western Loess Plateau, Northwest China". *Radiocarbon*, 62(5), 1193-207. https://doi.org/10.1017/RDC.2020.32

Cheng, T-K. (1965). "Archaeology in Communist China". *The China Quarterly*, 23, 67-77. https://doi.org/10.1017/s0305741000009917

Cheng Zhijie 程至杰 (2016). *Huaihe Shang, Zhongyou Diqu Xinshiqi Shidai Zhiwuxing Shiwu Ziyuan Liyong Yanjiu* 淮河上、中游地区新石器时代植物性食物资源利用研究 (Study on plant food utilization in the Neolithic upper and middle Huai River) [PhD dissertation]. Hefei: University of Sciences and Technology of China.

Cheng Zhijie et al. (2016a). "Anhui Suzhou Yangou Yizhi Tanhua Zhiwu Yicun Yanjiu 安徽宿州杨堡遗址炭化植物遗存研究 (A Study on Charred Plant Remains in Yangpu Site of Suzhou, Anhui)". *Jianghan Kaogu*, 1, 95-103.

Cheng Zhijie et al. (2016b). "Anhui Huainan Xiaosungang Yizhi Tanhua Zhiwu Yicun Yanjiu 安徽淮南小孙岗遗址炭化植物遗存研究 (Research on charred plant remains from the Xiaosungang site in Huainan city, Anhui Province)". *Quaternary Sciences*, 2, 302-11.

Cheng, Z. et al. (2022). "Ethnobotanical Study on Wild Edible Plants Used by Dulong People in Northwestern Yunnan, China". *Journal of Ethnobiology and Ethnomedicine*, 18(1). https://doi.org/10.1186/s13002-022-00501-3

Cheng, Zhijie et al. (2022). "Henan Xiangcheng Jiazhuang he Hougao Laojia Yizhi Tanhua Zhiwu Yicun Jieshi de Yangshao Shiqi de Yuanshi Nongye 河南项城贾庄和后高老家遗址炭化植物遗存揭示的仰韶时期的原始农业 (Primitive agriculture in the Yangshao period revealed by charred plant remains from the Jiazhuang and Hougaolaojia sites in Xiangcheng, Henan Province)". *Acta Anthropologica Sinica*, 41(1), 85-95.

Chengdu Sheng Wenwu Kaogu Yanjiusuo 成都省文物考古研究所 (2010). "Chengdu Zhonghai Guoji Shequ 2 Hao Didian Shangzhou Yizhi Fajue Baogao 成都中海国际社区2号地点商周遗址发掘报告 (Excavation Report of Shang and Zhou Sites at Site 2, Zhonghai International Community, Chengdu)". *Chengdu Kaogu Faxian* 成都考古发现 (Archaeological Discoveries in Chengdu). Chengdu: Science Press, 171-254.

Chengdu Shi Kaogu Yanjiusuo; Xinduqu Wenwu Guanlisuo (2010). "Chengdu Shi Xinduqu Zhujiacun Yizhi Fajue Baogao 成都市新都区褚家村遗址发掘报告 (A Report on the Zhujiacun site in Xindu District, Chengdu)". *Chengdu Kaogu Faxian* 成都考古发现 *(Archaeological Discoveries in Chengdu)*. Chengdu: Science Press, 32-74.

Ch'ien, S.; Nienhauser, W. (eds) (1994-2019). *The Grand Scribe's Records*. Vols. 1-11. Bloomington (IN): Indiana University Press.

Childe, V.G. (1962). *The Prehistory of European Society.* London: Cassell.

Chiou-Peng, TH. (2018). "Early Copper-Base Metallurgy at Settlement Sites in Western Yunnan". Linduff, K.M.; Rubinson, K.S. (eds), *How Objects Tell Stories. Essays in Honor of Emma C. Bunker*. Turnhout: Brepols Publishers, 153-72.

Choi, J.Y. et al. (2017). “The Rice Paradox: Multiple Origins but Single Domestication in Asian Rice”. *Molecular Biology and Evolution*, 34(4), 969-79. https://doi.org/10.1093/molbev/msx049

Chomicki, G.; Schaefer, H.; Renner, S.S. (2019). “Origin and Domestication of Cucurbitaceae Crops: Insights from Phylogenies, Genomics and Archaeology”. *New Phytologist*, 226(5), 1240-55. https://doi.org/10.1111/nph.16015

Ciarla, R. (2007). “Rethinking Yuanlongpo: The Case for Technological Links between the Lingnan (PRC) and Central Thailand in the Bronze Age”. *East and West,* 57, 305-32.

Ciarla, R. (2013). *Interazioni culturali e tecnologiche tra Cina meridionale e Sudest asiatico continentale tra la fine del 2. millennio aC e l’inizio del 1. millennio aC: la dispersione meridionale della tecnologia del rame/bronzo* [PhD dissertation]. Venice: Ca’ Foscari University of Venice.

Cohen, D.J. (1998). “The Origins of Domesticated Cereals and the Pleistocene-Holocene Transition in East Asia”. *The Review of Archaeology*, 19(2), 22-9.

Cohen, D.J. (2011). “The Beginnings of Agriculture in China. A Multiregional View.”. *Current Anthropology*, 52(S4), 273-93. https://doi.org/10.1086/659965

Cooke, M.; Fuller, D.Q. (2015). “Agricultural Continuity and Change during the Megalithic and Early Historic Periods in South India”. Basa, K.K.; Mohanty, R.K.; Ota, S.B. (eds), *Megalithic Traditions in India. Archaeology and Ethnography*, vol. 2. Delhi: Aryan Books International, 445-76.

Cooke, M.; Fuller, D.Q.; Rajan, K. (2005). “Early Historic Agriculture in Southern Tamil Nadu: Archaeobotanical Research at Mangudi Kodumanal and Perur”. Franke-Vogt, U.; Weisshaar, J. (eds), *South Asian Archaeology 2003 = Proceedings of the European Association for South Asian Archaeology Conference*. (Bonn, Germany, 7-11 July 2003). Aachen: Linden Soft, 341-50.

Costantini, L. (1979). “Plant Remains at Pirak”. Jarrige, J.-F.; Santoni, M. (eds), *Fouilles de Pirak.* Paris: Diffusion de Boccard, 326-33.

Costantini, L. (1983). “The Beginning of Agriculture in the Kachi Plain: The Evidence of Mehrgarh”. Allchin, B. (ed.), *South Asian Archaeology 1981*. Cambridge: Cambridge University Press, 29-33.

Costantini, L. (1987). “Appendix B. Vegetal Remains”. Stacul, G. (ed.), *Prehistoric and Protohistoric Swat, Pakistan.* Rome: Instituto Italiano per il Medio ed Estremo Orientale, 155-65.

Costantini, L. (1990). “Harappan Agriculture in Pakistan: The Evidence of Nausharo”. *South Asian Archaeology 1987*, 321-32.

Costantini, L.; Biasini, L.C. (1985). “Agriculture in Baluchistan between the 7th and 3rd Millenium BC”. *Newsletter of Baluchistan Studies*, 2, 16-37.

Crawford, G.W. (1983). *Paleoethnobotany of the Kameda Peninsula Jomon*. Ann Arbor: Museum of Anthropology; University of Michigan. Anthropological Papers 73. https://doi.org/10.3998/mpub.11396334

Crawford, G.W. (2006). “East Asian Plant Domestication”. Stark, M.T. (ed.), *Archaeology of Asia*. Malden: Blackwell Publishing, 77-95.

Crawford, G.W. (2011a). “Early Rice Exploitation in the Lower Yangzi Valley: What Are We Missing?” *The Holocene*, 22(6), 613-21. https://doi.org/10.1177/0959683611424177

Crawford, G.W. (2011b). “Advances in Understanding Early Agriculture in Japan”. *Current Anthropology*, 52(4), 331-45. https://doi.org/10.1086/658369

Crawford, G.W. et al. (2005). “Late Neolithic Plant Remains from Northern China: Preliminary Results from Liangchengzhen, Shandong”. *Current Anthropology*, 46(2), 309-17. https://doi.org/10.1086/428788

Crawford, G.W. et al. (2013). “Shandong Jinan Changqing Yuezhuang Yizhi Zhiwu Yicun De Chubu Fenxi 山东济南长清月庄遗址植物遗存的初步分析 (Preliminary analysis on the plant remains from Yuezhuang, in Chanqing, Jinan, Shandong)”. *Jianghan Kaogu*, 2, 107-16.

Crawford, G.W. et al. (2016). “People and Plant Interaction at the Houli Culture Yuezhuang Site in Shandong Province, China”. *The Holocene*, 26(10), 1594-604. https://doi.org/10.1177/0959683616650269

Crawford, G.W.; Chen Xuexiang 陈雪香; Wang Jianhua 王建华 (2006). “Shandong Jinan Changqingqu Yuezhuang Yizhi Fajue Houli Wenhua Shiqi de Tanhuadao 山东济南长清区月庄遗址发现后李文化时期的碳化稻 (Carbonized rice from the Houli site of Yuezhuang, Jinan, Changqing, Shandong)”. Shandong Daxue Dongfangkaogu Yanjiu Zhongxin

山东大学东方考古研究中心 (ed.), *Dongfang Kaogu (disanji)* 东方 考古(第三辑) (East Asian Archaeology vol. 3). Beijing: Science Press, 247-51.

Crawford, G.W.; Hurley, W.; Yoshizaki, M. (1976). "Implications of Plant Remains from the Early Jomon Hamanasuno Site, Hokkaido". *Asian Perspectives*, 19(1), 145-55. https://doi.org/10.1353/asi.2006.0010

Crawford, G.W.; Leng. J.; Lee, G.-A. (2001). *Palaeoethnobotany in Northern China and Southern Korea during the Neolithic/Bronze Periods*. New Orleans: Society for American Archaeology (unpublished).

Cui Shaolin 崔晓林; Li Xiuqing 李秀清 (1990). "Tanshisi Niandai Ceding Baogao (Liu)碳十四年代测定报告(六) (Radiocarbon dates in Chinese archaeology (sixth))". *Wenwu*, 7, 80-5.

Curnoe, D. et al. (2015). "A Hominin Femur with Archaic Affinities from the Late Pleistocene of Southwest China". *PLoS ONE,* 10(12), e0143332. https://doi.org/10.1371/journal.pone.0143332

d'Alpoim Guedes, J.A. (2011). "Millets, Rice, Social Complexity, and the Spread of Agriculture to the Chengdu Plain and Southwest China". *Rice*, 4(3-4), 104-13. https://doi.org/10.1007/s12284-011-9071-1

d'Alpoim Guedes, J.A. (2013). *Adaptation and Invention During the Spread of Agriculture to Southwest China* [PhD dissertation]. Cambridge (MA): Harvard University.

d'Alpoim Guedes, J.A. (2018). "Did Foragers Adopt Farming? A Perspective from the Margins of the Tibetan Plateau". *Quaternary International*, 489, 91-100. https://doi.org/10.1016/j.quaint.2016.12.010

d'Alpoim Guedes, J.A. et al. (2013a). "Moving Agriculture onto the Tibetan Plateau: The Archaeobotanical Evidence". *Archaeological and Anthropological Sciences*, 6(3), 255-69. https://doi.org/10.1007/s12520-013-0153-4

d'Alpoim Guedes, J.A. et al. (2013b). "Site of Baodun Yields the Earliest Evidence for the Spread of Rice and Foxtail Millet Agriculture to Southwest China". *Antiquity*, 87, 758-71. https://doi.org/10.1017/s0003598x00049449

d'Alpoim Guedes, J.A. et al. (2015). "Early Evidence for the Use of Wheat and Barley as Staple Crops on the Margins of the Tibetan Plateau". *Proceedings of the National Academy of Sciences (PNAS)*, 112(18), 5625-30. https://doi.org/10.1073/pnas.1423708112

d'Alpoim Guedes, J.A. et al. (2019). "The Wet and the Dry, the Wild and the Cultivated: Subsistence and Risk Management in Ancient Central Thailand". *Archaeological and Anthropological Sciences*, 11, 6473-84. https://doi.org/10.1007/s12520-019-00794-8

d'Alpoim Guedes, J.A. et al. (2020). "Three Thousand Years of Farming Strategies in Central Thailand". *Antiquity*, 94(376), 966-82. https://doi.org/10.15184/aqy.2020.8

d'Alpoim Guedes, J.A.; Butler, E.E. (2014). "Modeling Constraints on the Spread of Agriculture to Southwest China with Thermal Niche Models". *Quaternary International*, 349, 29-41. https://doi.org/10.1016/j.quaint.2014.08.003

d'Alpoim Guedes, J.A.; Jin, G.; Bocinsky, K.R. (2015). "The Impact of Climate on the Spread of Rice to North-Eastern China: A New Look at the Data from Shandong Province". *PLoS ONE* 10(6), e0130430. https://doi.org/10.1371/journal.pone.0130430

d'Alpoim Guedes, J.A.; Manning, S.W.; Bocinsky, R.K. (2016). "A 5500-year Model of Changing Crop Niches on the Tibetan Plateau". *Current Anthropology*, 57, 517-22. https://doi.org/10.1086/687255

d'Alpoim Guedes, J.A.; Hein, A. (2018). "Landscapes of Prehistoric Northwestern Sichuan: From Early Agriculture to Pastoralist Lifestyles". *Journal of Field Archaeology*, 43(2), 121-35. https://doi.org/10.1080/00934690.2018.1423830

Dai, F. et al. (2012). "Tibet is One of the Centers of Domestication of Cultivated Barley". *Proceedings of the National Academy of Sciences (PNAS),* 109(42), 16969-73. https://doi.org/10.1073/pnas.1215265109

Dai, F. et al. (2014). "Transcriptome Profiling Reveals Mosaic Genomic Origins of Modern Cultivated Barley". *Proceedings of the National Academy of Sciences (PNAS)*, 111(37), 13403-8. https://doi.org/10.1073/pnas.1414335111

Dai, J.; et al. (2021). "Earliest Arrival of Millet in the South China Coast Dating Back to 5,500 Years Ago". *Journal of Archaeological Science*, 129, 105356. https://doi.org/10.1016/j.jas.2021.105356

Dai Zongpin 戴宗品 (2021). *Yunnan Kaogu Jianshi* 云南考古简史 (Short History of Archaeological Research in Yunnan).

Dal Martello, R. (2022). "The Origins of Multi-Cropping Agriculture in Southwestern China: Archaeobotanical Insights from Third to First Millennium B.C. Yunnan". *Asian Archaeology*, 6(1), 65-85. https://doi.org/10.1007/s41826-022-00052-2

Dal Martello, R. et al. (2018). "Early Agriculture at the Crossroads of China and Southeast Asia: Archaeobotanical Evidence and Radiocarbon Dates from Baiyangcun, Yunnan". *Journal of Archaeological Science: Reports*, 20, 711-21. https://doi.org/10.1016/j.jasrep.2018.06.005

Dal Martello, R. et al. (2023a). "The Domestication and Dispersal of Large-Fruiting *Prunus* spp.: A Metadata Analysis of Archaeobotanical Material". *Agronomy*, 13(4), 1027. https://doi.org/10.3390/agronomy13041027

Dal Martello, R. et al. (2023b). "Morphometric approaches to Cannabis Evolution and Differentiation from Archaeological Sites: Interpreting the Archaeobotanical Evidence from Bronze Age Haimenkou, Yunnan". *Vegetation History and Archaeobotany*, 33(4), 503-18. https://doi.org/10.1007/s00334-023-00966-6

Dal Martello, R. et al. (forthcoming). s.v. "The History and Practice of Archaeobotany in China". Hein, A.; Lovell, J. (eds), *Oxford Handbook on the History and Practice of Chinese Archaeology*. Oxford: Oxford University Press.

Dal Martello, R.; Li, X.; Fuller, D.Q. (2021). "Two-Season Agriculture and Irrigated Rice during the Dian: Radiocarbon Dates and Archaeobotanical Remains from Dayingzhuang, Yunnan, Southwest China". *Archaeological and Anthropological Sciences*, 13, 62. https://doi.org/10.1007/s12520-020-01268-y

Daniels, J.; Daniels, C. (1993/4). "Sugarcane in Prehistory". *Archaeology in Oceania*, 28(1), 1-7. https://doi.org/10.1002/j.1834-4453.1993.tb00309.x

De Bruijn, J. (1992). "*Clausena lansium* (Lour.) Skeels". Verheij, E.W.M; Coronel, R.E. (eds), *Plant Resources of South-East Asia*. Vol. 2, *Edible Fruits and Nuts.* Prosea; Pudoc, Wageningen, 141-3.

de Candolle, A. (1885). *The Origin of Cultivated Plants.* The International Scientific Series, vol. 48. New York: D. Appleton and Company.

de Klerk, P.; Couwenberg, J.; Joosten, H. (2015). "Pollen and Macrofossils Attributable to *Fagopyrum* in western Eurasia prior to the Late Medieval: An Intercontinental Mystery". *Palaeogeography, Palaeoclimatology, Palaeoecology*, 440, 1-21. https://doi.org/10.1016/j.palaeo.2015.08.024

de Wet, J.M.J. (2000). s.v. "Millets". Kiple, K.; Ornelas, K. (eds), *The Cambridge World History of Food*. Cambridge: Cambridge University Press, 112-21.

de Wet, J.M.J. et al. (1983). "Domestication of Mawa Millet (*Echinochloa colona*)". *Economic Botany*, 37, 283-91. https://doi.org/10.1007/BF02858883

Dearing, J.A. et al. (2008). "Using Multiple Archives to Understand Past and Present Climate–Human–Environment Interactions: the lake Erhai Catchment, Yunnan Province, China". *Journal of Paleolimnology*, 40(1), 3-31. https://doi.org/10.1007/s10933-007-9182-2

Debaine-Francfort, C. (1988). "Archéologie du Xinjiang des origines aux Han. Premiere partie". *Paleorient,* 14(1), 5-29.

Debaine-Francfort, C. (1989). "Archéologie du Xinjiang des origines aux Han. IIème partie". *Paleorient*, 15(1), 183-213.

Decroocq, S. et al. (2016). "New insights into the history of domesticated and wild apricots and its contribution to Plum pox virus resistance". *Molecular Ecology*, 25, 4712-29. https://onlinelibrary.wiley.com/doi/10.1111/mec.13772

Deng Zhenhua 邓振华 (2015). *Hanshui zhongxiayou Shiqian Nongye Yanjiu* 汉水中下游史前农业研究 (Research on prehistoric agriculture in the lower reaches of the Han River) [PhD dissertation]. Beijing: Peking University.

Deng Zhenhua (2023). "Jinsha Jiangliuyu Nongye de Xingcheng yu Zaoqi Fazhan 金沙江流域农业的形成与早期发展 (Formation and early development of agriculture in the Jinsha River Basin)". *Chinese Cultural Forum*, 1, 142-53.

Deng Zhenhua et al. (2013). "Hubei Tianmen Shi Shijiahe Gucheng Sanfangwan he Tanjialing Yizhi Chutu Zhiwu Yicun Fenxi 湖北天门市石家河古城三房湾和谭家岭遗址出土植物遗存分析 (Analysis of plant remains unearthed from Sanfangwan and Tanjialing sites in Shijiahe Ancient City, Tianmen City, Hubei Province)". *Kaogu*, 1, 91-9, 2.

Deng, Z.H. et al. (2015). "From Early Domesticated Rice of the Middle Yangtze Basin to Millet, Rice and Wheat Agriculture: Archaeobotanical Macro-Remains from Baligang,

Nanyang Basin, Central China (6700-500 BC)". *PLoS One*, 10(10), e0139885. https://doi.org/10.1371/journal.pone.0139885
Deng, Z.H. et al. (2018). "The Ancient Dispersal of Millets in Southern China: New Archaeological Evidence". *The Holocene*, 28(1), 34-43. https://doi.org/10.1177/0959683617714603
Deng, Z.H. et al. (2019). "Food and Ritual Resources in Hunter-Gatherer Societies: Canarium Nuts in Southern China and Beyond". *Antiquity*, 93(372), 1460-78. https://doi.org/10.15184/aqy.2019.173
Deng, Z.H. et al. (2020). "Assessing the Occurrence and Status of Wheat in Late Neolithic Central China: the Importance of Direct AMS Radiocarbon Dates from Xiazhai". *Vegetation History and Archaeobotany*, 29(1), 61-73. https://doi.org/10.1007/s00334-019-00732-7
Deng, Z.H. et al. (2021). "A Preliminary Study of Early Agriculture Practices at the Haojiatai Site in Luohe City, Henan Province". *Science China Earth Sciences*, 64, 307-17. https://doi.org/10.1007/s11430-020-9694-3
Deng, Z.H. et al. (2022a). "First Farmers in the South China Coast: New Evidence From the Gancaoling Site of Guangdong Province". *Frontiers in Earth Science*, 10. https://doi.org/10.3389/feart.2022.858492
Deng, Z. et al. (2022b). "Early Austronesians Cultivated Rice and Millet Together: Tracing Taiwan's First Neolithic Crops". *Frontiers in Plant Science*, 13. https://www.frontiersin.org/articles/10.3389/fpls.2022.962073
Deng Zhenhua 邓振华; Qin Ling 秦岭 (2017). "Zhongyuan Longshan Shiqi Nongye Jiegou de Bijiao Yanjiu 中原龙山时代农业结构的比较研究 (A comparative study on the agriculture structure of the central plains in the Longshan period)". *Huaxia Archaeology*, 3, 98-108.
Deng, Z.H.; Yan, Z.; Yu, Z. (2020). "Bridging the Gap on the Southward Dispersal Route of Agriculture in China: New Evidences from the Guodishan Site, Jiangxi Province". *Archaeological and Anthropological Sciences*, 12, 151. https://doi.org/10.1007/s12520-020-01117-y
Denham, T. (2011). "Early Agriculture and Plant Domestication in New Guinea and Island Southeast Asia". *Current Anthropology*, 52(4), 379-95. https://doi.org/10.1086/658682
Denham, T. (2014). "New Guinea during the Holocene". Renfrew, C.; Bahn, P.G. (eds), *The Cambridge World Prehistory*. Vol. 1, *Africa, South and Southeast Asia and the Pacific*. New York: Cambridge University Press, 578-97.
Denham, T.; Zhang, Y.K.; Barron, A. (2018). "Is There a Centre of Early Agriculture and Plant Domestication in Southern China?". *Antiquity*, 92(365), 1165-79. https://doi.org/10.15184/aqy.2018.156
Desse, J. et al. (2008). "Faune et Flore des Niveaux Profonds de Shahi-Tump (Balochistan, Pakistan). Premiers Résultats". *Paléorient*, 34(1), 159-71. https://doi.org/10.3406/paleo.2008.5237
Diamond, J.; Bellwood, P. (2003). "Farmers and Their Languages: The First Expansions". *Science,* 300(5619), 597-603. https://doi.org/10.1126/science.1078208
Diffloth, G. (1994). "The Lexical Evidence for Austric, So Far". *Oceanic Linguistics*, 33(2), 309-22. https://doi.org/10.2307/3623131
Diffloth, G. (2005). "The Contribution of Linguistic Paleontology to the Homeland of Austro-asiatic". Sagart, L.; Blench, R.; Sanchez-Mazas, A. (eds), *The Peopling of East Asia: Putting Together Archaeology, Linguistics and Genetics*. London: Routledge, 79-82.
Ding, W.-N. et al. (2020). "Ancient Orogenic and Monsoon-Driven Assembly of the World's Richest Temperate alpine Flora". *Science*, 369(6503), 578-81. https://doi.org/10.1126/science.abb4484
Dodson, J.R. et al. (2013). "Origin and Spread of Wheat in China". *Quaternary Science Reviews*, 72, 108-11. https://doi.org/10.1016/j.quascirev.2013.04.021
Dodson, J.R.; Dong, G.H. (2016). "What Do We Know about Domestication in Eastern Asia?". *Quaternary International,* 426, 2-9. https://doi.org/10.1016/j.quaint.2016.04.005
Donegan, P.; Stampe, D. (2004). "Rhythm and the Synthetic Drift of Munda". *The Yearbook of South Asian Languages and Linguistics*, 3-36. https://doi.org/10.1515/9783110179897.3
Dong, G.H. et al. (2014). "A Comparative Study of 14C Dating on Charcoal and Charred Seeds from Late Neolithic and Bronze Age Sites in Gansu and Qinghai Provinces, NW China". *Radiocarbon*, 56, 157-63. https://doi.org/10.2458/56.16507.
Dong Guanghui 董广辉 et al. (2017). "*Nongzuowu Chuanbo Shijiao Xia De Ouya Dalu Shiqian Dongxifang Wenhua Jiaoliu* 农作物传播视角下的欧亚大陆史前东西方文化交流 (Prehistoric

cultural exchanges between East and West in Eurasia from the perspective of crop spread)". *Chinese Science: Earth Sciences*, 47(5), 530-43.

Dong, Y. et al. (2023). "Dual Domestications and Origin of Traits in Grapevine Evolution". *Science*,379, 892-901. https://www.science.org/doi/abs/10.1126/science.add8655

Dong, Y.S. et al. (2001). "The Genetic Diversity of Annual Wild Soybeans Grown in China". *Theoretical and Applied Genetics,* 103(1), 98-103. https://doi.org/10.1007/s001220000522

Dubu Zhongshi 渡部忠世; Jun Shaoting 尹绍亭 (transl.) (1982). *Daomi zhi Lu* 稻米之路 (The Rice Road). Kunming: Yunnan People Publishing House.

Dvorak, J. et al. (2012). "The Origin of Spelt and Free-Threshing Hexaploid Wheat". *Journal of Heredity*, 103(3), 426-41. https://doi.org/10.1093/jhered/esr152

Dykoski, C. et al. (2005). "A High-Resolution, Absolute-Dated Holocene and Deglacial Asian Monsoon Record from Dongge Cave, China". *Earth and Planetary Science Letters*, 233(1-2), 71-86. https://doi.org/10.1016/j.epsl.2005.01.036

Eda, M. et al. (2013). "Geographical Variation of Foxtail Millet, *Setaria italica* (L.) P. Beauv. based on rDNA PCR–RFLP". *Genetic Resources and Crop Evolution,* 60(1), 265-74. https://doi.org/10.1007/s10722-012-9832-8

Enfield, N.J. (2021). "Language Histories and Classifications". *The Languages of Mainland Southeast Asia*. *Cambridge Language Surveys*. Cambridge: Cambridge University Press, 38-117.

Fairservis, W. (1982). "Allahdino: A Small Site of The Harappan Civilization". Possehl, G.L (ed.), *Harappan Civilization*. New Delhi: Oxford IBH Publishers, 107-12.

Falkenhausen, L. von. (1993). "On the Historiographical Orientation of Chinese Archaeology". *Antiquity,* 67, 839-49. https://doi.org/10.1017/s0003598x00063821

Falkenhausen, L. von. (1995). "The Regionalist Paradigm in Chinese Archaeology". Kohl, P.L.; Fawcett, C. (eds), *Nationalism, Politics, and the Practice Of Archaeology*. Cambridge: Cambridge University Press, 198-217.

Fang, J. (1991). "Lake Evolution during the past 30,000 Years in China, and its Implications for Environmental Change". *Quaternary Research*, 36(1), 37-60. https://doi.org/10.1016/0033-5894(91)90016-x

FAO (Food and Agriculture Organisation) (2024). *Crop Information: Wheat*. Rome: FAO.

FAOSTAT (Food and Agriculture Organisation Statistics) (2024). *Food and Agriculture Organisation, Statistics*. https://www.fao.org/faostat/en/#data/QCL/visualize

Faust, M.; Timon, B. (1995). "Origin and Dissemination of Peach". *Horticultural Reviews*, 331-79. https://doi.org/10.1002/9780470650585.ch10

Fawcett, J.A. et al. (2023). "Genome Sequencing Reveals the Genetic Architecture of Heterostyly and Domestication History of Common Buckwheat". *Nature Plants*, 9(8), 1236-51. https://doi.org/10.1038/s41477-023-01474-1

Feldman, M.; Kislev, M.E. (2007). "Domestication of Emmer Wheat and Evolution of Free-Threshing Tetraploid Wheat". *Israel Journal of Plant Sciences*, 55(3), 207-21. https://doi.org/10.1560/ijps.55.3-4.207

Feng, Z.-D.; An, C.B.; Wang, H.B. (2006). "Holocene Climatic and Environmental Changes in the Arid and Semi-Arid Areas of China: a Review". *The Holocene,* 16(1), 119-30. https://doi.org/10.1191/0959683606hl912xx

Fernandes, R.; Jaouen, K. (2017). "Isotopes in Archaeology". *Archaeological and Anthropological Sciences*, 9, 1305-6. https://doi.org/10.1007/s12520-017-0507-4

Fick, S.E.; Hijmans, R.J. (2017). "WorldClim 2: New 1km Spatial Resolution Climate Surfaces for Global Land Areas". *International Journal of Climatology,* 37(12), 4302-15. https://doi.org/10.1002/joc.5086

Filipović, D. et al. (2020). "New AMS 14C Dates Track the Arrival and Spread of Broomcorn Millet Cultivation and Agricultural Change in Prehistoric Europe". *Scientific Reports,* 10(1), 13698. https://doi.org/10.1038/s41598-020-70495-z

Fiorentino, G. et al. (2015). "Stable Isotopes in Archaeobotanical Research". *Vegetation History and Archaeobotany*, 24, 215-27. https://doi.org/10.1007/s00334-014-0492-9

Fischer, C.E.C. (1934). "Gramineae". Gamble, J.S. (ed.), *Flora of the Presidency of Madras*, 10, 1690-864.

Flad, R. (2011). *Salt Production and Social Hierarchy in Ancient China: An Archaeological Investigation of Specialization in China's Three Gorges*. Cambridge: Cambridge University Press.

Flad, R. et al. (2010). "Early Wheat in China: Results from New Studies at Donghuishan in the Hexi Corridor". *The Holocene*, 20(6), 955-65. https://doi.org/10.1177/0959683609358914

Flad, R.; Chen Pochan 陳伯楨 (2006). "Sichuan Pendi jiqi Linjin Diqu de Xinshiqi Shidai Kaogu 四川盆地及其邻近地区的新石器时代考古 (The archaeology of the Sichuan Basin and surrounding areas during the Neolithic period)". Li Shuicheng 李水城; Falkenhausen, L. von (eds), *Zhongguo Yanye Kaogu* 中国盐业考古 (Salt archaeology in China), vol. 1. Beijing: Science Press, 183-259.

Flad, R.; Chen, P. (2013). *Ancient Central China: Centers and Peripheries along the Yangzi River.* Cambridge: Cambridge University Press.

Fogg, W. (1983). "Swidden Cultivation of Foxtail Millet by Taiwan Aborigines: A Cultural Analogue of the Domestication of *Setaria italica* in China". Keightley, D. (ed.), *The Origins of Chinese Civilization.* Berkeley: University of California Press, 95-115.

Frachetti, M. (2013). "Bronze Age Pastoralism and Differentiated Landscapes along the Inner Asian Mountain Corridor". Abraham, S.A. et al. (eds), *Connections and Complexity: New Approaches to the Archaeology of South Asia*. London; New York: Routledge, 279-98.

Frachetti, M.D. et al. (2010). "Earliest Evidence of Broomcorn Millet and Wheat in the Central Eurasian Steppe Region". *Antiquity,* 84(326), 993-1010. https://doi.org/10.1017/s0003598x0006703x

Freeman, D. (1970). *Report on the Iban*. London: Athlone.

French, D. (1971). "An Experiment in Water-Sieving". *Anatolian Studies,* 21, 59-64. https://doi.org/10.2307/3642629

Fu Daxiong 傅大雄 (2001). "Xizang Changguogou Yizhi Xinshiqi Shidai Nongzuowu Yicun de Faxian, Jianding yu Yanjiu 西藏昌果沟遗址新石器时代农作物遗存的发现、定与研究 (Identification and research on the Neolithic crop remains at Changguogou site, Tibet)". *Kaogu*, 3, 66-74.

Fuller, D.Q. (2003). *Indus and Non-Indus Agricultural Traditions: Local Developments and Crop Adoptions on the Indian Peninsula*. Maryland: Lexington Books.

Fuller, D.Q. (2007). "Contrasting Patterns in Crop Domestication and Domestication Rates: Recent Archaeobotanical Insights from the Old World". *Annals of Botany*, 100(5), 903-24. https://doi.org/10.1093/aob/mcm048

Fuller, D.Q. (2008). "The Spread of Textile Production and Textile Crops in India Beyond the Harappan Zone: an Aspect of the Emergence of Craft Specialization and Systematic Trade". *Linguistics, Archaeology and the Human Past. Indus Project.* Kyoto: Research Institute for Humanity and Nature, 1-26.

Fuller, D.Q. (2011a). "Pathways to Asian Civilizations: Tracing the Origins and Spread of Rice and Rice Cultures". *Rice,* 4(3), 78-92. https://doi.org/10.1007/s12284-011-9078-7

Fuller, D.Q. (2011b). "Finding Plant Domestication in the Indian Subcontinent". *Current Anthropology,* S2, S347-62. https://doi.org/10.1086/658900

Fuller, D.Q. (2014). s.v. "Millets: Origins and Development". *Encyclopedia of Global Archaeology*. Cham: Springer, 4945-8. https://doi.org/10.1007/978-1-4419-0465-2_2181

Fuller, D.Q. (2017). "Long and Attenuated: Comparative Trends in the Domestication of Tree Fruits". *Vegetation History and Archaeobotany*, 27(1), 165-76. https://doi.org/10.1007/s00334-017-0659-2

Fuller, D.Q. (2020). "Transitions in Productivity: Rice Intensification from Domestication to Urbanisation". *Archaeology International,* 23(1), 88-103. https://doi.org/10.14324/111.444.ai.2020.08

Fuller, D.Q. et al. (2009). "The Domestication Process and Domestication Rate in Rice: Spikelet Bases from the Lower Yangtze". *Science,* 323(5921), 1607-10. https://doi.org/10.1126/science.1166605

Fuller, D.Q. et al. (2010). "Consilience of Genetics and Archaeobotany in the Entangled History of rice". *Archaeological and Anthropological Sciences,* 2(2), 115-31. https://doi.org/10.1007/s12520-010-0035-y

Fuller, D.Q. et al. (2014). "Convergent Evolution and Parallelism in Plant Domestication Revealed by an Expanding Archaeological Record". *Proceedings of the National Academy of Sciences (PNAS),* 111(17), 6147-52. https://doi.org/10.1073/pnas.1308937110

Fuller, D.Q. et al. (2016). “Entanglements and Entrapment on the Pathway toward Domestication”. Der, L.; Fernandini, F. (eds), *Archaeology of entanglement*. Walnut Creek (CA): Left Coast Press, 151-72. https://doi.org/10.4324/9781315433936-15
Fuller, D.Q. et al. (2017). “Charred Pomelo Peel, Historical Linguistics and Other Tree Crops: Approaches to Framing the Historical Context of Early Citrus Cultivation in East, South and Southeast Asia”. Zech-Matterne, V.; Fiorentino, G. (eds), *AGRUMED: Archaeology and History of Citrus Fruit in the Mediterranean. Acclimatization, Diversifications, Uses*. Naples: Publications du Centre Jean Bérard, 31-50.
Fuller, D.Q.; Allaby, R. (2009). “Seed Dispersal and Crop Domestication: Shattering, Germination and Seasonality in Evolution under Cultivation”. Stergaard, L. (ed.), *Fruit Development and Seed Dispersal.* Oxford: Wiley-Blackwell, 238-95.
Fuller, D.Q.; Asouti, E.; Purugganan, M.D. (2011). “Cultivation as Slow Evolutionary Entanglement: Comparative Data on Rate and Sequence of Somestication”. *Vegetation History and Archaeobotany*, 21(2), 131-45. https://doi.org/10.1007/s00334-011-0329-8
Fuller, D.Q.; Castillo, C.C. (2016). “Diversification and Cultural Construction of a Crop: The Case of Glutinous Rice and Waxy Cereals in the Food Cultures of Eastern Asia”. Lee-Thorp, J.; Katzenberg, M. (eds), *The Oxford Handbook of the Archaeology of Diet*. Oxford: Oxford University Press, 323-43.
Fuller, D.Q.; Castillo, C.C. (2021). “The Origins and Spread of Cereal Agriculture in Mainland Southeast Asia”. Sidwell, P.; Jenny, M. (eds), *The Languages and Linguistics of Mainland Southeast Asia*. Berlin: De Gruyter Mounton, 45-60.
Fuller, D.Q.; Denham, T. (2022). “Coevolution in the Arable Battlefield: Pathways to Crop Domestication, Cultural Practices, and Parasitic Domesticoids”. Schultz, Td. R.; Gawne, R.; Peregrine, P.N. (eds), *The Convergent Evolution of Agriculture in Humans and Insects*, 177-208. https://doi.org/10.7551/mitpress/13600.003.0017
Fuller, D.Q.; Denham, T.; Allaby, R. (2023). “Plant Domestication and Agricultural Ecologies”. *Current Biology*, 33(11), R636-49. https://doi.org/10.1016/j.cub.2023.04.038
Fuller, D.Q.; Harvey, E.; Qin, L. (2006). “A Critical Assessment of Early Agriculture in East Asia, with emphasis on Lower Yangtze Rice Domestication”. *International Seminar on the ‘First Farmers in Global Perspective’* (Lucknow, India, 18-20 January 2006).
Fuller, D.Q.; Harvey, E.; Qin, L. (2007). “Presumed Domestication? Evidence for Wild Rice Cultivation and Domestication in the Fifth Millennium BC of the Lower Yangtze Region”. *Antiquity,* 81(312), 316-31. https://doi.org/10.1017/s0003598x0009520x
Fuller, D.Q.; Lucas, L. (2014). s.v. “Archaeobotany”. *Encyclopedia of Global Archaeology.* New York: Springer. https://doi.org/10.1007/978-1-4419-0465-2_2273
Fuller, D.Q.; Lucas, L. (2017). “Adapting Crops, Landscapes, and Food Choices: Patterns in the Dispersal of Domesticated Plants Across Eurasia”. *Human Dispersal and Species Movement*, 304-31. https://doi.org/10.1017/9781316686942.013
Fuller, D.Q.; Qin, L. (2009). “Water Management and Labour in the Origins and Dispersal of Asian Rice”. *World Archaeology*, 41, 88-111. http://dx.doi.org/10.1080/00438240802668321
Fuller, D.Q.; Qin, L. (2010). “Declining Oaks, Increasing Artistry, and Cultivating Rice: the Environmental and Social Context of the Emergence of Farming in the Lower Yangtze Region”. *Environmental Archaeology,* 15(2), 139-59. https://doi.org/10.1179/14614 1010x12640787648531
Fuller, D.Q.; Qin, L. (unpublished). *Botanical Work on Material From the Site of Huitupo.*
Fuller, D.Q.; Stevens, C.J. (2019). “Between Domestication and Civilization: The Role of Agriculture and Arboriculture in the Emergence of the First Urban Societies”. *Vegetation History and Archaeobotany*, 28(3), 263-82. https://doi.org/10.1007/s00334-019-00727-4
Fuller, D.Q.; Weisskopf, A. (2011). “The Early Rice Project: from Domestication to Global Warming”. *Archaeology International,* 13-14, 44-51. https://doi.org/10.5334/ai.1314
Fuller, D.Q.; Weisskopf, A. (2020). s.v. “Barley: Origins and Development”. *Encyclopedia of Global Archaeology*. Cham: Springer International Publishing, 1302-6.
Fuller, D.Q.; Willcox, G.; Allaby, R.G. (2011a). “Early Agricultural Pathways: Moving Outside the ‘Core Area’ Hypothesis in Southwest Asia”. *Journal of Experimental Botany*, 63(2), 617-33. https://doi.org/10.1093/jxb/err307
Fuller, D.Q.; Willcox, G.; Allaby, R.G. (2011b). “Cultivation and Domestication had Multiple Origins: Arguments against the Core Area Hypothesis for the Origins of Agriculture in the

Near East". *World Archaeology*, 43(4), 628-52. https://doi.org/10.1080/00438243.2011.624747

Fuller, D.Q.; Zhang Hai 张海 (2007). "Yinghe Zhongshangyou Gudi Zhiwu Kaogu Diaocha de Chubu Baogao 颍河中上游谷地植物考古调查的初步报告 (A preliminary report of the survey archaeobotany of the upper Ying valley (Henan province)". Beijing Daxue Kaogu Wenbo Cueyuan 北京大学考古文博学院; Henan Sheng Wenwu Kaogu Yanjiusuo 河南省文物考古研究所. *Dengfeng Wangchenggang Kaogu Faxian yu Yanjiu (2002-2005)* 登封王城岗考古发现与研究 (2002-2005) (Archaeological Discovery and Research at the Wangchenggang Site in Dengfeng (2002-2005)). Zhengzhou: Great Elephant Publisher, 916-58.

Furbank, R.T.; Taylor, W.C. (1995). "Regulation of Photosynthesis in C3 and C4 Plants: A Molecular Approach". *The Plant Cell*, 797-807. https://doi.org/10.1105/tpc.7.7.797

Gadyuchenko, L.L. (2002). "Organic Remains from Fortified Settlements and Necropoli of the 'Country of Towns'". Jones-Bley, K.; Zdanovich, D.G. (eds), *Regional Specifics in Light of Global Models BC Complex Societies of central Eurasia from the 3rd to the 1st Millennium.* Vol. 2, *The Iron Age; Archaeoecology, Geoarchaeology, and Palaeogeography; Beyond Central Eurasia.* Washington, D.C.: Institute of Man, 400-18.

Gai Yuyi 盖钧镒 et al. (2000). "Zhongguo Zaipei Dadou he Yesheng Dadou butong Shengtai Leixing Qunti jian Yichuan Yanhua Guanxi de Yanjiu 中国栽培大豆和野生大豆不同生态类型群体间遗传演化关系的研究 (Studies on the Evolutionary Relationship among ecotypes of *G. max* and *G. soja* in China)". *Acta Agronomica Sinica*, 5, 513-20.

Gao Feng 高 峰 et al. (2023). "Yunnan Gengma Fodongdi Yizhi Fajue Jianbao 云南省耿马佛洞地遗址发掘简报 (A preliminary report on the excavation of Fodongdi site in Gengma, Yunnan Province)". *Acta Anthropologica Sinica*, 42(1), 122-8.

Gao Feng (2004). "Yilang Jiuxiang Zhangkoudong Gurenlei Yizhi 宜良九乡张口洞古人类遗址 (Ancient Homo site of Zhangkoudong in Jiuxiang, Yilang". Che Zhimin 车志敏; Li Canguang 李灿光; Pu Yonghong 普永宏 (eds), *Yunnan Nianjian* 云南年鉴 (Yunnan Yearbook). Kunming: Yunnan Nianjian Zazhishi, 292.

Gao, W. et al. (2022). "The Spatiotemporal Patterns of Human Settlement during the Longshan and Erlitou Periods in Relation to Extreme Floods and Subsistence Strategy in the Upper and Middle Qin River Reaches, Central China". *Land*, 11(7), 7. https://doi.org/10.3390/land11071088

Gao, Y. (2021). "Research on Chenopodium in Ancient Southwest China". *IOP Conference Series: Earth and Environmental Science*, 621(1), 012124. https://doi.org/10.1088/1755-1315/621/1/012124

Gao, Y.; Kingwell-Banham, E.; Stevens, C.J. [unpublished]. *Botanical Work on Material from the Site of Maoshan.*

Gao, Y. et al. (2020a). "A Review on the Spread of Prehistoric Agriculture from Southern China to Mainland Southeast Asia". *Science China Earth Sciences*, 63(5), 615-25. https://doi.org/10.1007/s11430-019-9552-5

Gao, Y. et al. (2020b). "New Evidence from the Qugong Site in the central Tibetan Plateau for the Prehistoric Highland Silk Road". *The Holocene*, 31(2), 230-9. https://doi.org/10.1177/0959683620941144

Ge Jifang 葛季芳 (1978). "Yunnan Faxian De You Duanshi (Shiben) 云南发现的有段石(石奔) (The 'shiben' discovered in Yunnan)". *Kaogu*, 1, 68-9.

Ge, Q. et al. (2007). "Temperature and Precipitation Changes in China During the Holocene". *Advances in Atmospheric Sciences*, 24(6), 1024-36. https://doi.org/10.1007/s00376-007-1024-7

Geng Deming 耿德铭; Li Jicai 李技彩; Zhang Shaoquan 张绍全 (1990). "Changning Chutian Xinshiqi Shidai Fangwu he Daomi Yicun 昌宁出土新石器时代房屋和稻米遗存 (Neolithic rice and house unearthed in Changning)". *Zhongguo Wenwu Bao*.

Godfrey, J. (2017). *A Brief History of the British Plant Hunters.* https://rhododendron.com.au/wp-content/uploads/2017/05/A-Brief-History-of-the-British-Plant-Hunters-v2-sml.pdf

Gong Wei 宫玮 (2016). *Jinan Daxinzhuang, Liujiazhuang Shangdai Xianmin Shiwu Jieguo Yanjiu* 济南大辛庄、刘家庄商代先民食物结构研究 (Research of Human diet in Shang period of the Daxinzhuang site and Liujiazhuang site – Results from the plant remanis and the stable isotope of Carbon and Nitrogen) [Master's thesis]. Jinan: Shandong University.

Gorman, C. (1971). "The Hoabinhian and After: Subsistence Patterns in Southeast Asia during the Late Pleistocene and Early Recent Periods". *World Archaeology*, 2(3), 300-20. https://doi.org/10.1080/00438243.1971.9979482
Gremillion, K.J. (2014). "Goosefoot (*Chenopodium*)". Minnis, P.E. (ed.), *New Lives for Ancient and Extinct Crops*. Tucson: University of Arizona Press, 44-64.
Grivet, L. et al. (2004). "A Review of Recent Molecular Genetics Evidence for Sugarcane Evolution and Domestication". *Ethnobotany Research and Applications*, 2, 9-17. https://doi.org/10.17348/era.2.0.9-17
Groppi, A.; et al. (2021). "Population Genomics of Apricots Unravels Domestication History and Adaptive Events". *Nature Communications*, 12(1), 3956. https://doi.org/10.1038/s41467-021-24283-6
Gros, S. (2014). "The Bittersweet Taste of Rice. Sloping Land Conversion and the Shifting Livelihoods of the Drung in Northwest Yunnan (China)". *Himalaya, the Journal of the Association for Nepal and Himalayan Studies,* 34(2), 11. http://digitalcommons.macalester.edu/himalaya/vol34/iss2/11
Gross, B.L.; Olsen, K.M. (2010). "Genetic Perspectives on Crop Domestication". *Trends in Plant Science*, 15(9), 529-37. https://doi.org/10.1016/j.tplants.2010.05.008
Gross, B.; Zhao, Z. (2014). "Archaeological and Genetic Insight into the Origins of Domesticated Rice". *Proceedings of the National Academy of Sciences (PNAS),* 111(7), 6190-7. https://doi.org/10.1073/pnas.1308942110
Gu Haibing 顾海滨 (1994). "Liyang Pingyuan sige Xinshiqi Yizhi Shuidao Guisuanti de Chubu Yanjiu 澧阳平原四个新石器遗址水稻硅酸体的初步研究 (Preliminary research on the phytoliths from four Neolithic sites in Caoyang Pingyuan)". *Hunan Kaogu Jikan,* 125-35.
Guangxi Zhuangzu Zizhiqu Wenwu Gongzuodui Napo Xian Bowuguan 广西壮族自治区文物工作队那坡县博物馆 (2003). "Guangxi Napo Xian Gantuoyan Yizhi Fajue Jianbao 广西那坡县感驮岩遗址发掘简报 (Brief Report on the Excavation of Gantuoyan Site in Napo County, Guangxi) ". *Kaogu*, 10, 899-920, 964-6, 2.
Guizhou Sheng Wenwu Kaogu Yanjiusuo 贵州省文物考古研究所 (2006). "Guizhou Weiningxian Wujiadaping Shangzhou Yizhi 贵州威宁县吴家大坪商周遗址 (Shang-Zhou Site at Wujiadaping in Weining County,Guizhou)". *Kaogu*, 8, 28-40.
Gunn, B.F.; Baudouin, L.; Olsen, K.M. (2011). "Independent Origins of Cultivated Coconut (*Cocos nucifera* L.) in the Old World Tropics". *PLoS ONE*, 6(6), e21143. https://doi.org/10.1371/journal.pone.0021143
Guo, H.J. et al. (2002). "Economic Development, Land Use and Biodiversity Change in the Tropical Mountains of Xishuangbanna, Yunnan, Southwest China". *Environmental Science Policy*, 5(6), 471-9. https://doi.org/10.1186/s13002-023-00609-0
Guo Hunjun 郭辉军; Long Chunlin 龙春林 (eds) (1998). *Yunnan de shengwu duoyangxing* 云南的生物多样性 (Biodiversity of Yunnan, Southwest China). Kunming: Yunnan Science and Technology Press.
Guo, J. et al. (2010). "A Single Origin and Moderate Bottleneck during Domestication of Soybean (*Glycine max*): Implications from Microsatellites and Nucleotide Sequences". *Annals of Botany,* 106(3), 505-14. https://doi.org/10.1093/aob/mcq125
Gou Rongzhen 郭荣臻; Jin Guiyun 靳桂云 (2019). "Xian Qin Shiqi Haidai Diqu de Daizuoye 先秦时期海岱地区的麦作农业 (Wheat agriculture in Haidai area during the pre-Qin period)". *Quaternary Research*, 39(1), 144-60.
Guo Rongzhen et al. (2019). "Shandong Heze Shilipu Bei Yizhi Xian Qin Shiqi Shengye Jinji de Tanhua Zhiwu Yicun Zhengju 山东菏泽十里铺北遗址先秦时期生业经济的炭化植物遗存证据 (The carbonized plant remains of pre-Qin period from Shilipubei site, Heze city, Shandong Province)". *Zhongguo Nongshi*, 5, 15-26.
Guo, Y. et al. (2011). "Stable Carbon and Nitrogen Isotope Evidence of Human and Pig Diets at the Qinglongquan Site, China". *Science China, Earth Sciences*, 54(4), 519-27.
Guojia Wenwuju 国家文物局 (ed.) (2001). *Zhongguo Wenwu Dituji: Yunnan Fence* 中国文物地图集: 云南分册 (Atlas of Chinese Cultural Relics: Yunnan Volume). Kunming: Yunnan Science and Technology Press.
Guojia Wenwuju 国家文物局 (2009). *Tianye Kaogu Gongzuo Guicheng* 田野考古工作规程 (Field Archaeology Work Protocol). Beijing: Cultural Relics Press.
Han, X. (2004). "Who Invented the Bronze Drum? Nationalism, Politics, and a Sino-Vietnamese Archaeological Debate of the 1970s and 1980s". *Asian Perspectives*, 43(1), 7-33. https://doi.org/10.1353/asi.2004.0004

Handan Shi Wenwu Baoguansuo 邯郸市文物保管所; Handan Diqu Cishan Kaogudui Duanxunban 邯郸地区磁山考古队短训班 (1977). “Hebei Cishan Xinshiqi Yizhi Shijue 河北磁山新石器遗址试掘 (Test excavations at the Cishan site, Hebei)”. *Kaogu*, 6, 361-72.

Hao Shougang 郝守刚; Xue Jinzhuang 薛进庄; Cui Haiting 崔海亭 (2008). “Donghulin sihao Renmuzang de Guoke 东湖林四号人墓葬中的果核 (Celtis seeds from burial no. 4 at the Donghulin site)”. *Acta Anthropologica Sinica*, 3, 249-55.

Hao, X. et al. (2022). “The Neolithic Occupants in the Yanyuan Basin: Excavation of the Burials at the Guijiabao Site, Sichuan Province, Southwest China”. *Archaeological Research in Asia*, 29, 100341. https://doi.org/10.1016/j.ara.2021.100341

He, K. et al. (2017). “Prehistoric evolution of the dualistic structure mixed rice and millet farming in China”. *Holocene*, 27, 1885-98. https://doi.org/10.1177/0959683617708455

Harlan, J. (1975). *Crops and Ancient Man.* 2nd ed. Madison: American Society for Agronomy. https://doi.org/10.2135/1992.cropsandman

Harlan, J.R.; Zohary, D. (1966). “Distribution of Wild Wheats and Barley”. *Science*, 153(3740), 1074-80. https://doi.org/10.1126/science.153.3740.1074

Harris, D. (1989). “An Evolutionary Continuum of People-Plant Interaction”. Harris, D.; Hillman, G. (eds), *Foraging and Farming: the Evolution of Plant Exploitation*. London: Unwin Hyman, 11-26.

Harrison, B.A. (transl.) (1941-55). *“Columella”. De Rerum Rustica (On Agriculture)*. Vols 1-3. Cambridge (MA): Harvard University Press.

Harvey, E.L. (2007). *Early Agricultural Communities in Northern and Eastern India: an Archaeobotanical Investigation* [PhD dissertation]. London: Institute of Archaeology, University College London.

Harvey, E.L.; Fuller, D.Q. (2005). “Investigating Crop Processing Using Phytolith Analysis: the Example of Rice and Millets”. *Journal of Archaeological Science*, 32, 739-52. https://doi.org/10.1016/j.jas.2004.12.010

Harvey, E.L. et al. (2005). “Early Agriculture of Neolithic Vindyhas (North-Central India)”. Franke-Vogt, U.; Weisshaar, J. (eds), *South Asian Archaeology 2003 = Proceedings of the European Association for South Asian Archaeology Conference* (Bonn, Germany, 7-11 July 2003). Aachen: Linden Soft, 329-34.

Hastorf, C.A. (2016). *The Social Archaeology of Food: Thinking about Eating from Prehistory to the Presen*t. Cambridge: Cambridge University Press.

He Jiejun 何介钧 (1999). “Lixian Chengtoushan Guchengzhi 1997-1998 Niandu Fajue Jianbao 澧县城头山古城址 1997-1998 年度发掘简报 (Report on the 1997-1998 excavation of the ancient city of Chengtoushan in Lixian)”. *Wenwu*, 6, 4-17, 1-2.

He Jinlong 何金龙 (1990). “Tonghai Haidongcun Beiqiu Yizhi 通海海东村贝丘遗址 (The shell-midden site of Haidong in Tonghai) “. *Zhongguo Kaoguxue Nanjian* 中国考古学年鉴 (Chinese Archaeology Yearbook). Beijing: Cultural Relics Press, 304-5.

He, K. et al. (2020). “Role of Dynamic Environmental Change in Sustaining the Protracted Process of Rice Domestication in the Lower Yangtze River”. *Quaternary Science Reviews,* 242, 106456. https://doi.org/10.1016/j.quascirev.2020.106456

He, K. et al. (2022a). “Holocene Spatiotemporal Millet Agricultural Patterns in Northern China: a Dataset of Archaeobotanical Macroremains”. *Earth System Science Data*, 14(10), 4777-91. https://doi.org/10.5194/essd-14-4777-2022

He, K. et al. (2022b). “Antipodal Pattern of Millet and Rice Demography in response to 4.2 ka Climate Event in China”. *Quaternary Science Reviews*, 295, 107786. https://doi.org/10.1016/j.quascirev.2022.107786

He, K. et al. (2022c). “Coupled and Decoupled Legumes and Cereals in Prehistoric Northern and Southern China”. *Frontiers in Plant Science*, 13. https://doi.org/10.3389/fpls.2022.1013480

He Kunyu 何锟宇 (2015). “Maerkang Haxiu Yizhi Shiqian Wenhua yu Shengye-Jianlun Minjiang Shangyou Majiayao Leixing de Shengye Fangshi 马尔康哈休遗址史前文化与生业 – 兼论岷江上游地区马家窑类型的生业方式 (The Prehistoric Culture and Subsistence of the Haxiu Site in Barkam County – Also on the Subsistence Patterns of the Majiayao Type Culture in the Upper Reach of the Min River)”. *Kaogu*, 5, 72-82, 2.

He, N. (2013). “The Longshan Period Site of Taosi in Southern Shanxi Province”. Underhill, A.P. (ed.), *A Companion to Chinese Archaeology*. Oxford: Blackwell, 255-77.

He, Q. et al. (2023). "A Graph-Based Genome and Pan-Genome Variation of the Model Plant *Setaria*". *Nature Genetics*, 55(7), 1232-42. https://doi.org/10.1038/s41588-023-01423-w

He, Y. et al. (2024). "Genomic Insight into the Origin, Domestication, Dispersal, Diversification and Human Selection of Tartary buckwheat". *Genome Biology,* 25, 61. https://doi.org/10.1186/s13059-024-03203-z

Hebei Sheng Wenwu Guanlichu 河北省文物管理处; Handanshi Wenwu Baoguansuo 邯郸市文物保管所 (1981). "Hebei Wu'an Ci Han Yizhi 河北武安磁山遗址 (The Cishan Site at Wu'an, Hebei)". *Acta Archaeologica Sinica*, 3, 303-38.

Hein, A. (2014). Diffusionism, Migration, and the Archaeology of the Chinese Border Region. Hein, A. (ed.), *The 'Crescent-Shaped Cultural-Communication Belt': Tong Enzheng's Model in Retrospect: An Examination of Methodological, Theoretical and Material Concerns of Long-Distance Interactions in East Asia*. BAR International Series. Oxford: BAR publishing, 1-17.

Heine-Geldern, R. von. (1917). "Kopfjagd und Menschenopfer in Assam und Birma und ihre Ausstrahlungen nach Vorderindien". *Mitteilungen der Anthropologischen Gesellschaft in Wien,* 37, 1-65.

Helbæk, H. (1954). "Prehistoric Food Plants and Weeds in Denmark". *Danmarks Geologiske*, 2, *Række*, 80, 250-61.

Helbæk, H. (1958). "Grauballemandens sidste Måltid (The last meal of Grauballe Man. An analysis of the food remains in the stomach)". *Kuml*, 8(8), 83-116. https://doi.org/10.7146/kuml.v8i8.102770

Helbæk, H. (1959). "How Farming Began in the Old World". *Archaeology*, 12(3), 183-9. http://www.jstor.org/stable/41663682

Helbæk, H. (1960). "Comment on *Chenopodium album* as a Food Plant in Prehistory". *Veröffentlichungen des Geobotanische Institutes der ETH, Rübel, Zürich*, 31, 16-19.

Helbaek, H. (1960). *The Paleoethnobotany of the Near East and Europe*. Chicago: Chicago University Press.

Helbaek, H. (1961). "Studying the Diet of Ancient Man". *Archaeology*, 14(2), 95-101. https://www.jstor.org/stable/41663867

Helbaek, H. (1969). "Plant Collecting, Dry-Farming, and Irrigation Agriculture in Prehistoric Deh Luran". Hole, F.; Flannery, K.; Neely, J. (eds), *Prehistory and human ecology of the Deh Luran Plain*. Ann Arbor: University of Michigan, 383-426. Memoirs of the Museum of Anthropology 1.

Hemudu Kaogudui 河姆渡考古队 (1980). "Zhejiang Hemudu Yizhi Dierqi Fajue de Zhuyao Shouhuo 浙江河姆渡遗址第二期发掘的主要收获 (Main Results of the Second Excavation at the Hemudu Site)". *Wenwu,* 5, 1-15.

Henan Sheng Wenwu Kaogu Yanjiusuo 河南省文物考古研究所 (1999). *Wuyang Jiahu* 舞阳贾湖 (Jiahu in Wuyang). 2 vols. Beijing: Science Press.

Henan Sheng Wenwu Kaogu Yanjiusuo 河南省文物考古研究所 et al. (1999). *Zhechuan Xiawanggang* 浙川下王岗 (The site of Xiawanggang in Zhechuan). Beijing: Cultural Relics Press.

Henry, A.G. (ed.) (2020). *Handbook for the Analysis of Micro-Particles in Archaeological Samples*. *Interdisciplinary Contributions to Archaeology.* Springer International Publishing. https://doi.org/10.1007/978-3-030-42622-4

Higgs, E.S. (ed.) (1972*) Papers in Economic Prehistory*. London: Cambridge University Press.

Higham, C.F.W. (1996a). "Archaeology and Linguistics in Southeast Asia: Implications of the Austric Hypothesis". *Bulletin of the Indo-Pacific Prehistory Association*, 14, 110-18.

Higham, C.F.W. (1996b). *The Bronze Age of Southeast Asia*. Cambridge: Cambridge University Press.

Higham, C.F.W. (2002). *Early Cultures of Mainland Southeast Asia*. Bangkok: River Books Co. Ltd.

Higham, C.F.W. (2004). *Encyclopedia of Ancient Asian Civilizations*. New York: Facts of File.

Higham, C.F.W. (2013). "Hunter-Gatherers in Southeast Asia: From Prehistory to the Present". *Human Biology*, 85(1-3), 21. https://doi.org/10.13110/humanbiology.85.1-3.0021

Higham, C.F.W. (2014). *Early Mainland Southeast Asia: from First Humans to Angkor*. Bangkok: River Books.

Higham, C.F.W. (2021). "The Later Prehistory of Southeast Asia and Southern China: the Impact of Exchange, Farming and Metallurgy". *Asian Archaeology*, 4(2), 63-93. https://doi.org/10.1007/s41826-021-00040-y

Higham, C.F.W. (2024). "The Settlement of Mainland Southeast Asia by Anatomically Modern Humans". Ueki, T.: Summerhayes, G.; Hiscock, P. (eds), *In the Footsteps of Our Ancestors*. London: Routledge, 38-68.

Higham, C.F.W.; Douka, K.; Higham, T.F.G. (2015). "A New Chronology for the Bronze Age of Northeastern Thailand and Its Implications for Southeast Asian Prehistory". *PLoS ONE*, 10(9), e0137542. https://doi.org/10.1371/journal.pone.0137542

Higham, C.F.W.; Higham, T. (2009). "A New Chronological Framework for Prehistoric Southeast Asia, based on a Bayesian Model from Ban Non Wat". *Antiquity*, 83(319), 125-44. https://doi.org/10.1017/s0003598x00098136

Higham, C.F.W.; Lu, T.L.-D. (1998). "The Origins and Dispersal of Rice Cultivation". *Antiquity*, 72(278), 867-77. https://doi.org/10.1017/s0003598x00087500

Higham, C.F.W.; Thosarat, R. (2004). *The Origins of the Civilization of Angkor*. Vol. 1, *The Excavation of Ban Lum Khao.* Bangkok: Fine Arts Department of Thailand.

Hillman, A.L. et al. (2017). "An 8,600 Year Lacustrine Record of Summer Monsoon Variability from Yunnan, China". *Quaternary Science Reviews*, 174, 120-32. https://doi.org/10.1016/j.quascirev.2017.09.005

Hillman, A.L. et al. (2021). "A 17,000-Year Multi-Proxy Study of the Indian Summer Monsoon from Lake Dian, Yunnan, China". *Palaeogeography, Palaeoclimatology, Palaeoecology*, 567, 110292. https://doi.org/10.1016/j.palaeo.2021.110292

Ho, P.T. (1969). "The Loess and the Origin of Chinese Agriculture". *The American Historical Review*, 75(1), 1-36. https://doi.org/10.1086/ahr/75.1.1

Ho, P.-T. (1975). *The Cradle of the East: An inquiry into the Indigenous Origins of Techniques and Ideas of Neolithic and Early Historic China, 5000-1000 B.C.* Hong Kong: Chinese University of Hong Kong.

Ho, P.-T. (1977). "The Indigenous Origins of Chinese Agriculture". Reed, C. (ed.), *Origins of Agriculture*. The Hague: Mouton. https://doi.org/10.1515/9783110813487.413

Hodell, D.A. et al. (1999). "Paleoclimate of Southwestern China for the Past 50,000 yr Inferred from Lake Sediment Records". *Quaternary Research*, 52(3), 369-80. https://doi.org/10.1006/qres.1999.2072

Hole, F.; Flannery, K.; Neely, J. (eds) (1969). *Prehistory and Human Ecology of the Deh Luran Plain*. Ann Arbor: University of Michigan. Memoirs of the Museum of Anthropology 1.

Hosner, D. et al. (2016). "Spatiotemporal Distribution Patterns of Archaeological Sites in China during the Neolithic and Bronze Age: An Overview". *The Holocene*, 26(10), 1576-93. https://doi.org/10.1177/0959683616641743

Hoste, I.; Verloove, F. (2022). "Taxonomy of the Weed Species of the Genus *Echinochloa* (Poaceae, Paniceae) in Southwestern Europe: Exploring the Confused Current State of Affairs". *PhytoKeys*, 197, 1-31. https://doi.org/10.3897/phytokeys.197.79499

Hu, H.Y. et al. (2022). "Agricultural Economic Foundation of Early Social Complexity in the Eastpart of Henan: New Evidence from the Pingliangtai site of Huaiyang City". *Quaternary Sciences*, 42(6), 1697-708. http://www.dsjyj.com.cn/en/article/doi/10.11928/j.issn.1001-7410.2022.06.18

Hu Shaojin 胡绍锦 (1995). "Yiliang Jiuxiang Zhangkoudong Faxian de Jiushiqi 宜良九乡张口洞发现的旧石器 (Paleoliths excavated in Zhangkou Cave, Jiuxang, Yiliang County)". *Acta Anthropologica Sinica*, 1, 21-31.

Hu Shaojin (1977). "Yunnan Sheng Chenggong Xian Faxian Jiushiqi 云南省呈贡县发现旧石器 (Paleoliths discovered in Chenggong County, Yunnan Province)". *Vertrebata PalAsiatica*, 15, 225-8.

Hu, Y. et al. (2008). "Stable Isotope Analysis of Humans from Xiaojingshan Site: Implications for Understanding the Origin of Millet Agriculture in China". *Journal of Archaeological Science,* 35(11), 2960-5. https://doi.org/10.1016/j.jas.2008.06.002

Huan, X. et al. (2015). "Bulliform Phytolith Research in Wild and Domesticated Rice Paddy Soil in South China". *PLoS ONE,* 10(10), e0141255. https://doi.org/10.1371/journal.pone.0141255

Huan, F.X. et al. (2024). "Technological Diversity in the Tropical-Subtropical Zone of Southwest China during the Terminal Pleistocene: Excavations at Fodongdi Cave". *Archaeological and Anthropological Sciences,* 16, 25. https://doi.org/10.1007/s12520-023-01928-9

Huan, X. et al. (2022a). "Intensification of Rice Farming and its Environmental Consequences Recorded in a Liangzhu Reservoir, China". *Quaternary International,* 619, 39-45. https://doi.org/10.1016/j.quaint.2022.01.012

Huan, X. et al. (2022b). “New Evidence Supports the Continuous Development of Rice Cultivation and Early Formation of Mixed Farming in the Middle Han River Valley, China”. *The Holocene,* 32(9), 924-34. https://doi.org/10.1177/09596836221101253
Huan, X. et al. (2022c). “The Emergence of Rice and Millet Farming in the Zang-Yi Corridor of Southwest China Dates Back to 5000 Years Ago”. *Frontiers in Earth Science*, 10. https://doi.org/10.3389/feart.2022.874649
Huang Derong 黄德荣 (1990). “Dongchuan Shi Yingpancun Gudai Tanhua Daogu 东川市营盘村古代炭化稻谷 (Ancient charred rice discovered at Yingpancun, Dongchuan city, Yunnan)”. *Zhongguo Kaoguxue Nanjian* 中国考古学年鉴. Beijing: Cultural Relics Press, 305.
Huang Haode 黄昊德; Zhao Binfu 赵宾福 (2004). “Baodun Wenhua de Faxian jiqi Laiyuan Kaocha 宝墩文化的发现及其来源考察 (On the discovery and origin of the Baodun culture)”. *Zhonghua Wenhua Luntan*, 2, 15-19.
Huang, P. et al. (2014). “Population Genetics of *Setaria viridis*, A New Model System”. *Molecular Ecology,* 23(20), 4912-25. https://doi.org/10.1111/mec.12907
Huang Qixu 黄其煦 (1982). “Huixiangfa zai Kaoguxue zhong de Yingyong 灰像法”在考古学中的应用 (The application of the dust separation method in Archaeology)”. *Kaogu,* 4, 418-20, 460.
Huang Qixu (1986). “Kaogu Fajue Gongzuo zhong Huishou Zhiwu Yicun de Fangfa zhiyi – Paomo Fuxuanfa 考古发掘工作中回收植物遗存的方法之 – 泡沫浮选法 (Flotation: a method for the recovery of plant remains in archaeological excavations)”. *Nongye Kaogu,* 2, 95-9.
Huang Zhanyue 黃展嶽; Zhao Xueqian 趙學謙 (1959). “Yunnan Dianchi Dong’an Xinshiqi Shidai Yizhi Diaocha Ji 雲南滇池東岸新石器時代遺址調查記 (Report on the archaeological survey of the eastern shore of Dian Lake, Yunnan)”. *Kaogu*, 4, 173-5, 184.
Hubei Provincial Cultural Relics Management Committee 湖北省文物管理委员会; Wang, Shencai 王善才 (1964). “Hubei Jingshan Zhujiaju Xinshiqi Yizhi Diyici Fajue 湖北京山朱家咀新石器遗址第 – 次发掘 (First excavation of the Neolithic site of Zhujiaju in Jingshan county, Hebei)”. *Kaogu*, 5, 215-19.
Hudson, B.; Lwin.; N. (2012). “Earthenware from a Firing Site in Myanmar (Burma) Dates to more than 4,500 Years Ago”. *Bulletin of the Indo-Pacific Prehistory Association*, 32, 19-22. https://doi.org/10.7152/bippa.v32i0.12988
Hung, H.-C. (2014). s.v. “Rice in China”. *Encyclopedia of the History of Science, Technology, and Medicine in Non-Western Cultures.* Dordrecht: Springer. https://doi.org/10.1007/978-94-007-3934-5_10026-1
Hung, L. (2021). *Painted Pottery Production and Social Complexity in Neolithic Northwest China*. Edited by A. Womack, A. Hein. Oxford: BAR publishing. BAR International Series, Archaeology of East Asia 5.
Hunt, H.V. et al. (2008). “Millets across Eurasia: Chronology and Context of Early Records of the Genera *Panicum* and *Setaria* from Archaeological Sites in the Old World”. *Vegetation History and Archaeobotany,* 17, 5-18. https://doi.org/10.1007/s00334-008-0187-1
Hunt, H.V. et al. (2011). “Genetic Diversity and Phylogeography of Broomcorn Millet (*Panicum miliaceum* L.) Across Eurasia”. *Molecular Ecology,* 20(22), 4756-71. https://doi.org/10.1111/j.1365-294x.2011.05318.x
Hunt, H.V. et al. (2014). “Reticulate Evolution in *Panicum* (Poaceae): the Origin of Tetraploid Broomcorn Millet, *P. miliaceum*”. *Journal of Experimental Botany,* 65(12), 3165-75. https://doi.org/10.1093/jxb/eru161
Hunt, H.V. et al. (2018). “The Geography of Crop Origins and Domestication: Changing Paradigms from Evolutionary Genetics”. Lightfoot, E.; Liu, X.Y.; Fuller, D.Q. (eds), *Far from the Hearth: Essays in Honour of Martin K. Jones.* Cambridge: McDonald Institute of Archaeological Research, 177-88. https://doi.org/10.17863/CAM.38308
Hunt, H.V.; Shang, X.; Jones, M.K. (2017). “Buckwheat: A Crop from Outside the Major Chinese Domestication Centres? A Review of the Archaeobotanical, Palynological and Genetic Evidence”. *Vegetation History and Archaeobotany,* 27, 493-506. https://doi.org/10.1007/s00334-017-0649-4
Huo,W. (2019). “The Highland Silk Road during the Prehistoric Times in Tibet”. *China’s Tibet*, 30(2), 64-6.
Hymowitz, T. (1970). “On the Domestication of the Soybean”. *Economic Botany,* 24(4), 408-21. https://doi.org/10.1007/bf02860745
Hyslop, G.; d’Alpoim-Guedes, J. (2020). “Linguistic Evidence Supports a Long Antiquity of Cultivation of Barley and Buckwheat over that of Millet and Rice in Eastern Bhutan”.

Vegetation History and Archaeobotany, 30(4), 571-9. https://doi.org/10.1007/s00334-020-00809-8

Ishii, T. et al. (2013). “OsLG1 Regulates a Closed Panicle Trait in Domesticated Rice”. *Nature genetics,* 45(4), 462-5. https://doi.org/10.1038/ng.2567

Ishikawa, R.; Castillo, C.C.; Fuller, D.Q. (2020). “Genetic Evaluation of Domestication-Related Traits in Rice: Implications for the Archaeobotany of Rice Origins”. *Archaeological and Anthropological Sciences,* 12(8), 197. https://doi.org/10.1007/s12520-020-01112-3

Jacques, G.; Stevens, C.J. (2024). “Linguistic, Archaeological and Genetic Evidence Suggests Multiple Agriculture-Driven Migrations of Sino-Tibetan Speakers from Northern China to the Indian subcontinent”. *Quaternary International*, 711, 1-20. https://doi.org/10.1016/j.quaint.2024.09.001

Jamieson, R.; Beck, M. (2010). “Barley and Identity in the Spanish Colonial Audiencia of Quito: Archaeobotany of the 18th Century San Blas Neighborhood in Riobamba”. *Journal of Anthropological Archaeolology*, 29, 208-18. https://doi.org/10.1016/j.jaa.2010.02.003.

Janick, J. (2005). “The Origins of Fruits, Fruit Growing, and Fruit Breeding”. *Plant Breeding Reviews*, vol. 25. Oxford: Wiley & Sons Oxford, 255-321. https://doi.org/10.1002/9780470650301.ch8

Janik, L. (2002). “Wandering Weed: The Journey of Buckwheat (*Fagopyrum* sp.) as an Indicator of Human Movement in Eurasia”. Boyle, K.; Renfrew, C.; Levine, M. (eds), *Ancient Interactions: East and West in Eurasia*. Cambridge: McDonald Institute of Archeology, 299-308.

Jaquot, M.; Courtois, B. (1987). *Upland Rice*. Paris: The Tropical Agriculturalist, CTA.

Jarman, H.N.; Legge, A.J.; Charles, J.A. (1972). “Retrievals of Plant Remains from Archaeological Sites”. Higgs, E.S. (ed.), *Problems in Economic Prehistory*. Cambridge: Cambridge University Press, 39-48.

Jeong, S.-C. et al. (2018). “Genetic Diversity Patterns and Domestication Origin of Soybean”. *Theoretical and Applied Genetics,* 132(4), 1179-93. https://doi.org/10.1007/s00122-018-3271-7

Ji Duxue 吉笃学 (2009). “Zhongguo Xibei Diqu Caiji Jingji xiang Nongye Jingji Guodu de Keneng Dongyin 中国西北地区采集经济向农业经济过度的可能动因 (The reasons of the transition from a foraging to an agricultural economy in Northwest China)”. *Kaogu yu Wenwu*, 4, 36-47.

Ji, X.P. et al. (2016a). “The Oldest Hoabinhian Technocomplex in Asia (43.5 ka) at Xiaodong Rockshelter, Yunnan Province, Southwest China”. *Quaternary International*, 400, 166-74. https://doi.org/10.1016/j.quaint.2015.09.080

Ji, X.P. et al. (2016b). “Cave Use and Palaeoecology at Maludong (Red Deer Cave), Yunnan, China”. *Journal of Archaeological Science: Reports*, 8, 277-83. https://doi.org/10.1016/j.jasrep.2016.06.025

Ji Xueping 吉学平; Ma Juan 马娟 (2005). “Yunnan Lincang Xiaodong Faxian Jiushiqi Shidai Zaoqi Yizhi 云南临沧硝洞发现旧石器时代早期遗址 (Early Palaeolithic sites discovered in Xiaodong, Lincang, Yunnan)”. *Zhongguo Wenwu Bao*. http://www.zhongguowenwubao.com/

Jia, G. et al. (2013). “Molecular Diversity and Population Structure of Chinese Green Foxtail [*Setaria viridis* (L.) Beauv.] Revealed by Microsatellite Analysis”. *Journal of Experimental Botany*, 64(12), 3645-56. https://doi.org/10.1093/jxb/ert198

Jia Shijie 贾世杰 (2011). “Zhengzhou Shangcheng Tanhua Zhiwu Yicun YAnjiu 郑州商城炭化植物遗存研究(Research on carbonized plant remains in Zhengzhou Shangcheng)” [Master’s thesis]. Hefei: University of Science and Technology of China.

Jia Xin 贾鑫 (2012). *Qinghai Sheng Dongbu Diqu Xinshiqi – Qintongqi Shidai Wenhua Bianhua Guocheng yu Zhiwu Yicun Yanjiu* 青海省东北部地区新石器-青铜时代文化演化过程与植物遗存研究 (Study of the Cultural Evolution and Plant Remains of Neolithic-Bronze Age in Northeast Qinghai Province) [PhD dissertation]. Lanzhou: Lanzhou University.

Jia, X. et al. (2013). “The Development of Agriculture and its Impact on Cultural Expansion During the late Neolithic in the Western Loess Plateau, China”. *The Holocene*, 23, 83-90. https://doi.org/10.1177/0959683612450203

Jiang, H.-E. et al. (2009). “Evidence for Early Viticulture in China: Proof of a Grapevine (Vitis vinifera L.; Vitaceae) in the Yanghai Tombs, Xinjiang”. *Journal of Archaeological Science*, 36(7), 1458-65. https://doi.org/10.1016/j.jas.2009.02.010

Jiang Leping 蒋乐平 (2013a). "Qiantang Jiangliuyu de Zaoqi Xinshiqi Shidai Ji Wenhua Puxi 钱塘江流域的早期新石器时代及文化谱系研究 (The early Neolithic age of the Qiantangjiang Basin and its cultural lineage)". *Dongnan Wenhua*, 6, 44-53, 127-8.

Jiang, L. (2013b). "The Kuahuqiao Site and Culture". Underhill, A. (ed.), *A Companion to Chinese Archaeology*. Oxford: Wiley-Blackwell, 535-54. https://doi.org/10.1002/9781118325698.ch26

Jiang Ming 姜铭 et al. (2013). "Shuangliu Xian Sangongtang Yizhi 2009-2010 Niandu Zhiwu Dayicun Fuxuan Jieguo ji qi Chubu Yanjiu 双流县三官堂遗址 2009-2010 年度植物大遗存浮选结果及其初步研究 (Plant remains from the Sanguantang Site, Shuangliu County: Flotation results and preliminary research)". *Chengdu Kaogu Faxian* 成都考古发现 (Archaeological Discoveries in Chengdu). Chengdu: Cultural Relics Press, 319-37, 655-7.

Jiang Ming et al. (2016). "Xichang Shi Henglan Shan Yizhi 2014 Nian Fuxuan Jieguo ji Chubu Yanjiu 西昌市横栏山遗址2014年浮选结果及初步研究 (Flotation Results on Henglanshan Site in Xichang City in 2014)". *Chengdu Kaogu Faxian* 成都考古发现 (Archaeological Discoveries in Chengdu). Chengdu: Cultural Relics Press, 115-34, 520-2.

Jiang Qinhua 姜钦华 (1994a). "Kaoguxue yu Dizhixue de Jiehe ji Fazhan Qianjing 考古学与地质学的结合及发展前景 (The background development of the union between Geology and Archaeology)". *Zhongyuan Wenwu,* 3, 104-6.

Jiang Qinhua (1994b). "Huafen Fenxi yu Zhiguishi Fenxi de Jiehe zai Kaoguxue zhong de 花粉分析与植硅石分析的结合在考古学中的应用 (The application of combined pollen and phytoliths studies in Archaeology)". *Kaogu*, 319(4), 372-5.

Jiang Qinhua (1994c). "Yingyong Zhiguishi Fenxi Jianding Woguo Shiqian de Daozuo Nongye 应用植硅石分析鉴定我国史前的稻作农业 (Using phytoliths to individuate rice agriculture in prehistoric China)". *Nongye kaogu* 农业考古*,* 1, 85-8.

Jiang Qinhua, Wang Xianceng 王宪曾 (1994). "Kaoguxue de Yimen Xinjishu: Zhiwu Guishi Fenxi 考古学的－门新技术：植物硅石分析 (A new technique in Archaeology: phytoliths analysis)". *Kaogu yu Wenwu,* 4, 94-8.

Jiang Yuchao 蒋宇超 (2011). *Hutuohe shangyou kagou diaocha chutu zhiwu yicun chubu yanjiu* 滹沱河上游考古调查出土植物遗存初步研究 (Preliminary Analysis of plant remains from archaeological regional survey in the upper Hutou river valley) [BA thesis]. Beijing: Peking University.

Jiang Yuchao et al. (2019). "Dazhiwu Yicun Fanyin de Longshan Shidai Xigaoyuan de Nongye Huodong yu Quyu Chayi 大植物遗存反映的龙山时代山西高原的农业活动与区域差异 Plant macro-remains reveals the agricultural pattern and regional variation of Shanxi plateau during Longshan Period)". *Quaternary Sciences*, 39(1), 123-31. http://www.dsjyj.com.cn/article/doi/10.11928/j.issn.1001–7410.2019.01.12

Jiang Zhanghua 江章华 (2004). "Minjiang Shangyou Xinshiqi Shidai Yicun Xinfaxian de Jidian Sikao 岷江上游新石器时代遗存新发现的几点思考 (Some considerations on the newly discovered Neolithic site in the Minjiang Upper Basin)". *Sichuan Wenwu*, 3, 10-14.

Jiang Zhanghua; Wang Yi 王毅; Zhang Qi 张擎 (2001). "Chengdu Pingyuan Zaoqi ji qi Kaoguxue Wenhua Chulun 成都平原早期城址及其考古学文化初论 (A preliminary discussion on the cultures of the early walled cities of the Chengdu Plain). Su Bai 宿白 (ed.), *Su Bingqi yu Dangdai Zhongguo Kaoguxue* 苏秉琦与当代中国考古学 (Su Bingqi and Chinese Archaeology)". Beijing: Science Press, 699-721.

Jiang Zhilong 蒋志龙 et al. (2011). "Yunnan Chengjiang Jinlianshan Mudi 2008~2009 Nian Faxue Jianbao 云南澄江县金莲山墓地 2008-2009 年发掘简报 (Preliminary report on the 2008-2009 excavation of the Jinlianshan cemetery in Chengjiang, Yunnan)". *Kaogu*, 1, 17-30, 99-103, 109.

Jiang Zhilong et al. (2023). "Yunnan Kunming Shi Hebosuo Qingtong Shidai Yizhi 云南昆明市河泊所青铜时代遗址 (The Bronze Age site of Hebosuo in Kunming city, Yunnan)". *Kaogu*, 7, 60-78, 2.

Jiang Zhilong; Zhu Zhonghua 朱忠华 (2014). "Yunnan Dongchuan Yubeidi Yizhi Kaogu Fajue de Zhongyao Shouhou 云南东川玉碑地遗址考古发掘的重要收获 (Important finds from the excavation of Yubeidi in Dongchuan, Yunnan)". *Zhongguo Wenwubao*, 8.

Jin, G.Y. (unpublished). *Compilation of Archaebotanical Material from Sites in China.* Jinan: Shandong.

Jin Guiyun 靳桂云 (1999). "Turang Weixingtai Fenxi ji qi zai Kaoguxue zhong de Yingyong 土壤微形态分析及其在考古学中的应用 (The application of soil micromorphology analyses in Archaeology)". *Diqiu Kexue Jinzhan,* 2, 96-9.

Jin Guiyun (2006). "Shandong Diqu Xian Qin Kaogu Yizhi Zhiguiti Fenxi ji qi Xianguang Wenti 山东地区先秦考古遗址植硅体分析及其相关问题 (Phytolith analysis and related issues from Pre-Qin archaeological Sites in the Shandong Region)". Shandong Daxue Dongfang Kaogu Yanjiu Zhongxin 山东大学东方考古研究中心 (ed.), *Dongfang Kaogu (disanji)* 东方考古 (第三辑) (East Asian Archaeology, Vol. 3). Beijing: Science Press, 259-79.

Jin Guiyun (2007). "Haidai Diqu Xinshiqi Shidai Renlei Shengye yu Huanjing Guanxi Yanjiu 海岱地区新石器时代人类生业与环境关系研究 (Study of the Relationship Between Human Subsistence and Environment in the Neolithic Haidai Region)". *Huanjing Kaogu Yanjiu*, 4, 117-29.

Jin, G.Y. et al. (2007). "Neolithic Rice Paddy from the Zhaojiazhuang Site, Shandong, China". *Chinese Science Bulletin* 52(24), 3376-84. https://doi.org/10.1007/s11434-007-0449-9

Jin Guiyun 靳桂云 et al. (2009a). "Shandong Diqu Kaogu Yizhi Chutu Mutan Zhongshu Yanjiu 山东地区考古遗址出土木炭种属研究 (Research on charred macro fossils unearthed from archaeological sites in Shandong)". Shandong Daxue Dongfang Kaogu Yanjiu Zhongxin 山东大学东方考古研究中心 (ed.), *Dongfang Kaogu (diliuji)* 东方考古 (第六集) (East Asian Archaeology, vol. 6). Beijing: Science Press, 289-305.

Jin Guiyun et al. (2009b). "Shandong Chiping Longshan Wenhua Yizhi Zhiwu Kaogu Diaocha 山东茌平龙山文化遗址植物考古调查 (A report on the Archaeobotanical Survey on the Chiping area Longshan Sites)". Shandong Daxue Dongfang Kaogu Yanjiu Zhongxin (ed.), 山东大学东方考古研究中心编, *Dongfang Kaogu (diliuji)* 东方考古 (第六集) (East Asian Archaeology. Vol. 6). Beijing: Science Press, 317-20.

Jin Guiyun et al. (2009c). "Shandong Yingxian, Jiaozhou Zhiwu Kaogu Diaocha 山东莒县、胶州植物考古调查 (Report on the archaeobotanical survey of Yingxian and Jiaozhou Shandong)". Shandong Daxue Dongfang Kaogu Yanjiu Zhongxin (ed.), 山东大学东方考古研究中心编, *Dongfang Kaogu (diliuji)* 东方考古 (第六集) (East Asian Archaeology, Vol. 6). Beijing: Science Press, 344-9.

Jin Guiyun et al. (2009d). "Shandong Yantai Zhaogezhuang Yueshi Wenhua Yizhi Tanhua Zhiwu Yicun Yanjiu 山东烟台照格庄岳石文化遗址炭化植物遗存研究 (Report on the carbonised plant remains from Zhaogezhuang, Yantai, Shandong)". Shandong Daxue Dongfang Kaogu Yanjiu Zhongxin (ed.), 山东大学东方考古研究中心编, *Dongfang Kaogu (diliuji)* 东方考古 (第六集) (East Asian Archaeology, Vol. 6). Beijing: Science Press, 331-43.

Jin Guiyun et al. (2011a). "Zhaojiazhuang Yizhi Tanhua Zhiwu Yicun 赵家庄遗址炭化植物遗存 (Analysis on carbonized plant remains from Zhaojiazhuang site, Shandong province)". Zhongguo Shehui Kexue Yuan Kaogu Yanjiusuo Kejigu Zhongxin 中国社会科学院考古研究所科技古中心 (ed.), *Keji Kaogu (disanji*) 科技考古(第三辑) (Archaeological Science, vol. 3). Beijing: Science Press, 36-53.

Jin Guiyun et al. (2011b). "Zibo Shi Fangjia Longshan Wenhua Yizhi Zhiwu Kaogu Baogao 淄博市房家龙山文化遗址植物考古报告 (Report on the archaeobotanical remains from the Longshan Period site of Fangjia in Zibo City)". Shandong Sheng Wenwu Kaogu Yanjiusuo 山东省文物考古研究所 (ed.), *Haidai Kaogu (disiji*) 海袋考古 (第四集) (Haidai Archaeology, vol. 4). Beijing: Science Press, 67-72.

Jin Guiyun et al. (2013). "Shandong Jimo Beiqian Yizhi 2007 Tanhua Zhongzi Guoshi Yicun Yanjiu 山东即墨北阡遗址 (2007) 炭化种子果实遗存研究 (Report on the archaeobotanical remains from the site of Beiqian in Jimo, Shandong)". Shandong Daxue Dongfang Kaogu Yanjiu Zhongxin 山东大学东方考古研究中心 (ed.), *Dongfang Kaogu (dishiji)* 东方考古 (第十辑) (East Asian Archaeology, Vol. 10). Beijing: Science Press, 255-79.

Jin, G. et al. (2014). "8000-Year Old Rice Remains from the North Edge of the Shandong Highlands, East China". *Journal of Archaeological Science*, 51, 34-42. https://doi.org/10.1016/j.jas.2013.01.007

Jin, G.Y. et al. (2016). "Archaeobotanical Records of Middle and Late Neolithic Agriculture from Shandong Province, East China, and a Major Change in Regional Subsistence During the Dawenkou Culture". *The Holocene*, 26(10), 1605-15. https://doi.org/10.1177/0959683616641746

Jin, G. et al. (2020). "The Beixin Culture: Archaeobotanical Evidence for a Population Dispersal of Neolithic Hunter-Gatherer-Cultivators in Northern China". *Antiquity*, 94, 1426-43. https://doi.org/10.15184/aqy.2020.63

Jin Guiyun; Lu Houyuan 吕厚远; Wei Chengmei 魏成敏 (1999). "Shandong Linzitianwang Longshan Wenhua Yizhi Zhiwu Guisuanti Yanjiu 山东临淄田旺龙山文化遗址植物硅酸

体研究 (Research on the phytoliths from the Longshan Culture site of Linzitianwang in Shandong)". *Kaogu,* 377(2), 82-7, 104.

Jin Guiyun; Wang Chunyan 王春燕 (2006). "Shandong Diqu Zhiwu Kaogu de Xinfaxian he Xinjinzhan 山东地区植物考古的新发现和新进展 (New discoveries and recent research in the archaeobotany from the Shandong region)". *Shandong Daxue Xuebao (Zhexue Shehui Kexueban)*, 5, 55-61.

Jin Guiyun; Wang Chuanming 王传明; Lan Yufu 兰玉富 (2009). "Xu Cheng Xuejiazhuang Yizhi Tanhua Zhiwu Yicun Fenxi Jieguo 诸城薛家庄遗址炭化植物遗存分析结果 (Results on the analysis of charred plant remains of the Xuejiazhuang site)". Shandong Daxue Dongfang Kaogu Yanjiu Zhongxin 山东大学东方考古研究中心 (ed.), *Dongfang Kaogu (diliuji)* 东方考古 (第6集) (East Asian Archaeology, Vol. 6). Beijing: Science Press, 350-3.

Jin Hetian 金河天(2013). *Haimenkou Yizhi Zhiwu Yicun Zonghe Yanjiu* 海门口遗址植物遗存综合研究 (Comprehensive study on the archaeobotanical remains from Haimenkou) [PhD dissertation]. Beijing: Peking University.

Jin, H.T. et al. (2014a). "Early Subsistence Practices at Prehistoric Dadunzi in Yuanmou, Yunnan: New Evidence for the Origins of Early Agriculture in Southwest China". Hein, A. (ed.), *The 'Crescent-Shaped Cultural-Communication Belt': Tong Enzheng's Model in Retrospect. An Examination of Methodological, Theoretical and Material Concerns of Long-Distance Interactions in East Asia.* Oxford: BAR publishing, 133-40. BAR International Series 2679.

Jin Hetian et al. (2014b). "Yunnan Yuanmou Dadunzi Yizhi Fuxuan Jieguo ji Fenxi 云南元谋大墩子遗址浮选结果及分析 (Study on the flotation results from Dadunzi, Yuanmoum, Yunnan)". *Jianghan Kaogu*, 3, 109-14.

Jin, J.J.H. (2010). *Zooarchaeological and Taphonomic Analysis of the Faunal Assemblage from Tangzigou, Southwestern China* [PhD dissertation]. Philadelphia: The Pennsylvania State University.

Jin, J.J.H. et al. (2012). "Micromammals from an Early Holocene Archaeological Site in Southwest China: Paleoenvironmental and Taphonomic Perspectives". *Quaternary International*, 281, 58-65. https://doi.org/10.1016/j.quaint.2012.04.012

Jones, M.K. (2004). "Between Fertile Crescents: Minor Grain Crops and Agricultural Origins". Jones, M.K. (ed.), *Traces of ancestry: studies in honour of Colin Renfrew*. Oxford: Oxbow Books, 127-35. https://doi.org/10.3828/bfarm.2004.3.6

Jones, M.K. et al. (2011). "Food Globalization in Prehistory". *World Archaeology*, 43(4), 665-75. https://doi.org/10.1080/00438243.2011.624764

Jones, R.T. et al. (2012). "Holocene Environmental Change at Lake Shudu, Yunnan Province, Southwestern China". *Hydrobiologia*, 693(1), 223-35. https://doi.org/10.1007/s10750-012-1124-y

Joshi, B.D. (1991). "Genetic Resources of Leaf and Grain Amaranthus and Chenopod". *Biodiversity*. Madras: Macmillan India Ltd, 121-34.

Kaifeng Diqu Wenguanhui Xinzhengxian Wenguanhui 开封地区文管会新郑县文管会 (1978). "Henan Xinzheng Peiligang Xinshiqi Shidai Yizhi 河南新郑裴李岗新石器时代遗址 (The Neolithic site of Xinzheng, in Henan)". *Kaogu*, 2, 73-9, 145-6.

Kaifeng Diqu Wenwu Guanli Anwuhui Xinzheng Xian Wenwu Guanli Anwuhui Zhengzhou Daxue Lishixi Kaogu Zhuanye 开封地区文物管理委员会新郑县文物管理委员会郑州大学历史系考古专业 (1979). "Peiligang Yizhi Yijiuqiba Nian Fajue Jianbao 裴李岗遗址 – 九七八年发掘简报 (Preliminary report on the 1978 excavation of Peiligang)". *Kaogu*, 3, 197-205.

Kajale, M.D. (1991). "Current Status of Indian Palaeoethnobotany: Introduced and Indigenous Food Plants with a Discussion of the Historical and Evolutionary Development of Indian Agriculture and Agricultural Systems in General". Renfrew, J.M. (ed.), *New Light on Early Farming - Recent Developments in Palaeoethnobotany*. Edinburgh: Edinburgh University Press, 155-89.

Kajale, M.D. (1996). "Palaeobotanical Investigations at Balathal: Preliminary Results". *Man and Environment*, 21(1), 98-102.

Kajale, M.D.; Deotare, B.C. (1997). "Late Quaternary Environmental Studies on Salt Lakes in Western Rajasthan, India: a Summarised View". *Journal of Quaternary Science*, 12(5), 405-12. https://doi.org/10.1002/(sici)1099-1417(199709/10)12:5<405::aid-jqs323>3.0.co;2-n

Kalinová, J.; Moudrý, J. (2003). "Evaluation of Frost Resistance in Varieties of Common Buckwheat (*Fagopyrum esculentum* Moench)". *Plant, Soil and Environment*, 49(9), 410-13. https://doi.org/10.17221/4145-pse

Källén, A. (2004). *And Through Flows The River: Archaeology and the Pasts of Lao Pako* [PhD dissertation]. Uppsala: Uppsala University.

Kamkar, B. et al. (2006). "Cardinal Temperatures for Germination in Three Millet Specieses (*Panicum miliaceum*, *Pennisetum glaucum* and *Setaria italica*)". *Asian Journal of Plant Sciences,* 5(2), 316-19. https://doi.org/10.3923/ajps.2006.316.319

Kan Yong 阚勇 (1977). "Yuanmou Dadunzi Xinshiqi Shidai Yizhi 元谋大墩子新石器时代遗址 (The Neolithic site of Dadunzi in Yuanmou)". *Acta Archaeologica Sinica*, 1, 43-72, 169-78.

Kan Yong (1978). "Yuanmou Dadunzi Xinshiqi Shidai Yizhi de Shehui Xingzhi 元谋大墩子新石器时代遗址的社会性质 (The nature of society at the Neolithic site of Dadunzi, in Yuanmou)". *Wenwu*, 10, 19-25.

Kan Yong (1983). "Yunnan Gengma Shifodong Yizhi Chutu Tanhua Gudao 云南耿马石佛洞遗址出土炭化古稻 (Charred rice discovered in Shifodong site in Yunnan province)". *Nongye Kaogu*, 2, 80-3.

Kang, J. et al. (2016). "Wild Food Plants and Fungi Used in the Mycophilous Tibetan Community of Zhagana (Tewo County, Gansu, China)". *Journal of Ethnobiology and Ethnomedicine*, 12(1). https://doi.org/10.1186/s13002-016-0094-y

Kang Lihong 康利宏 (2013). "Yunnan Yuanmou Mopanshan Xinshiqi Shidai Yizhi 云南元谋磨盘山新石器时代遗址 (The Neolithic site of Mopanshan in Yuanmou, Yunnan)". Guojia Wenwuju 国家文物局 (ed.), *Zhongguo Zhongyao Kaogu Faxian* 中国重要考古发现 (Important archaeological discoveries in China). Beijing: Cultural Relics Press, 30-3.

Kang, Y.X. et al. (2013). "Wild Food Plants and Wild Edible Fungi in Two Valleys of the Qinling Mountains (Shaanxi, central China)". *Journal of Ethnobiology and Ethnomedicine*, 9(1), 26. https://doi.org/10.1186/1746-4269-9-26

Kang, Y.X. et al. (2014). "Wild Food Plants Used by the Tibetans of Gongba Valley (Zhouqu county, Gansu, China)". *Journal of Ethnobiology and Ethnomedicine,* 10(1), 20. https://doi.org/10.1186/1746-4269-10-20

Karlgren, B. (transl.) (1950). *The Book of Odes*. *Bulletin of the Museum of Far Eastern Antiquities*, 16-17. Göteborg: Elanders Boktryckeri Aktiebolag.

Kashyap, A.; Weber, S. (2013). "Starch Grain Analysis and Experiments Provide Insights into Harappan Cooking Practices". Abraham, A.S. et al. (eds), Connection*s and Complexity. New Approaches to the Archaeology of South Asia.* New York: Routledge, 177-94.

Katzenberg, M.A.; Waters-Rist, A.L. (2019). "Stable Isotope Analysis. A Tool for Studying Past Diet, Demography, and Life History". Katzenberg, M.A.; Grauer, A.L. (eds), *Biological Anthropology of the Human Skeleton*. Hoboken (NJ): John Wiley & Sons, Inc., 467-504. https://doi.org/10.1002/9781119151647.ch14

Kealhofer, L.; Piperno, D.R. (1994). "Early Agriculture in Southeast Asia: Phytolith Evidence from the Bang Pakong Valley, Thailand". *Antiquity*, 68(260), 564-72. https://doi.org/10.1017/s0003598x00047050

Keng, H. (1973). "Economic Plants of Ancient North China as Mentioned in Shih Ching (Book of Poetry)". *Economic Botany*, 28(4), 391-410. https://doi.org/10.1007/bf02862856

Khan, F.; Knox, J.; Thomas, K. (1990). "The Bannu Archaeological Project: investigations at Sheri Khan Tarakai 1987-9". *South Asian Studies,* 6(1), 241-7. https://doi.org/10.1080/02666030.1990.9628415

Kim, M.Y. et al. (2010). "Whole-Genome Sequencing and Intensive Analysis of the Undomesticated Soybean (*Glycine soja* Sieb. and Zucc.) Genome". *Proceedings of the National Academy of Sciences (PNAS),* 107, 22032-7. https://doi.org/10.1073/pnas.1009526107

Kim, M.Y. et al. (2012). "Tracing Soybean Domestication History: From Nucleotide to Genome". *Breeding Science,* 61(5), 445-52. https://doi.org/10.1270/jsbbs.61.445

King, C.L. et al. (2014). "Economic Change after the Agricultural Revolution in Southeast Asia?" *Antiquity*, 88(339), 112-25. https://doi.org/10.1017/s0003598x00050250

Kingwell-Banham, E. (2019). "Dry, Rainfed or Irrigated? Reevaluating the Role and Development of Rice Agriculture in Iron Age-Early Historic South India Using Archaeobotanical Approaches". *Archaeological and Anthropological Sciences*, 11(12), 6485-500.

Kircho, L.B. (2020). "The Rise of the Early Urban Civilization in Southwestern Central Asia: From the Middle Chalcolithic to the Middle Bronze Age in Southern Turkmenistan". Lyonnet, B.; Dubova, N. (eds), *The World of the Oxus Civilization*. London: Routledge, 110-42.

Klepper, B. et al. (1998). "The Physiological Life Cycle of Wheat: Its Use in Breeding and Crop Management". *Euphytica*, 100(1-3), 341-7. https://doi.org/10.1023/a:1018313920124

Knörzer, K.-H. (2000). "3000 Years of Agriculture in a Valley of the High Himalayas". *Vegetation History and Archaeobotany,* 9(4), 219-12. https://doi.org/10.1007/bf01294636

Komatsuda, T. et al. (2007). "Six-Rowed Barley Originated from a Mutation in a Homeodomain-Leucine Zipper I-Class Homeobox Gene". *Proceedings of the National Academy of Sciences*, 104(4), 1424-9. https://doi.org/10.1073/pnas.0608580104

Kong Zhaochen 孔昭宸; Liu Changjiang 刘长江; Zhang Juzhong 张居中 (1999). "Mianchi Bancun Xinshiqi Yizhi Zhiwu Yicun ji qi zai Renlei Huanjingxue shang de Yiyi 渑池班村新石器遗址植物遗存及其在人类环境学上的意义(Discovery of plant remains in the Neolithic site at the Bancun site, Mianchi county, Henan province and their significance in human environment)". *Acta Anthropologica Sinica*, 4, 291-5.

Konishi, T.; Ohnishi, O. (2007). "Close Genetic Relationship Between Cultivated and Natural Populations of Common Buckwheat in the Sanjiang area is not Due to Recent Gene Flow Between Them-An Analysis Using Microsatellite Markers". *Genes & Genetic Systems*, 82(1), 53-64. https://doi.org/10.1266/ggs.82.53

Konishi, T.; Yasui, Y.; Ohnishi, O. (2005). "Original Birthplace of Cultivated Common Buckwheat Inferred from Genetic Relationships Among Cultivated Populations and Natural Populations of Wild Common Buckwheat Revealed by AFLP Analysis". *Genes & Genetic Systems*, 80(2), 113-19. https://doi.org/10.1266/ggs.80.113

Körber-Grohne, U. (1996). *Pflaumen, Kirschpflaumen, Schlehen. Heutige Pflanzen und Ihre Geschichte Seit der Frühzeit.* Stuttgart: Theiss.

Kottek, M. et al. (2006). "World Map of the Köppen-Geiger Climate Classification Updated". *Meteorologische Zeitschrift*, 15(3), 259-63. https://doi.org/10.1127/0941-2948/2006/0130

Kozlowski, S.; Aurenche, O. (2005). *Territories, Boundaries and Cultures in the Neolithic Near East*. Oxford: BAR Publishing. Archaeopress-Maison de l'Orient et de la Méditennanée. BAR International series 1362.

Krzyzanska, M. et al. (2021). "Modelling the Potential Ecological Niche of Domesticated Buckwheat in China: Archaeological Evidence, Environmental Constraints and Climate Change". *Vegetation History and Archaeobotany,* 31(4), 331-45. https://doi.org/10.1007/s00334-021-00856-9

Kuzmina, E.E. (2008). *The Prehistory of the Silk Road*. Philadelphia: University of Pennsylvania Press.

Larson, G.; et al. (2014). "Current Perspectives and the Future of Domestication Studies". *Proceedings of the National Academy of Sciences (PNAS)*, 111(17), 6139-46. https://doi.org/10.1073/pnas.1323964111

Larson, G.; Fuller, D.Q. (2014). "The Evolution of Animal Domestication". *Annual Review of Ecology, Evolution, and Systematics*, 45(1), 115-36. https://doi.org/10.1146/annurev-ecolsys-110512-135813

Le Thierry d'Ennequin, M. et al. (2000). "Assessment of Genetic Relationships Between *Setaria italica* and its Wild Relative *S. viridis* using AFLP Markers". *Theoretical and Applied Genetics,* 100(7), 1061-6. https://doi.org/10.1007/s001220051387

Lee, C.Y. et al. (2019). "Reconstructing Subsistence at the Yingpanshan and Gaoshan sites in Sichuan Province, China: Insights from Isotope Analysis on Bone Samples and Charred Crop Remains". *Archaeometry*, 62(1), 172-86. https://doi.org/10.1111/arcm.12509

Lee, C.Y. et al. (2020). "Dietary History of Two Human Individuals at the Yingpanshan Site, Sichuan Province, Revealed by Carbon and Nitrogen Isotope Analysis of Serial Samples of Dentinal Collagen". *International Journal of Osteoarchaeology*, 30(4), 565-74. https://doi.org/10.1002/oa.2871

Lee, G.-A.; Bestel, S. (2007). "Contextual Analysis of Plant Remains at the Erlitou-Period Huizui site, Henan, China". *Indo-Pacific Prehistory Association Bulletin*, 27, 49-60. https://doi.org/10.7152/bippa.v27i0.11976

Lee, G.-A. et al. (2007). "Plants and People from The Early Neolithic to Shang Periods in North China". *Proceedings of the National Academy of Sciences (PNAS)*, 104, 1087-92. https://doi.org/10.1073/pnas.0609763104

Lee, G.-A. et al. (2011). "Archaeological Soybean (*Glycine max*) in East Asia: Does Size Matter?" *PLoS ONE,* 6(11), e26720. https://doi.org/10.1371/journal.pone.0026720

Legge, J. (1861-72). *The Chinese Classics: with a Translation, Critical and Exegetical Notes, Prolegomena, and Copious Indexes.* 5 vols. 2nd ed. Oxford: Claredon Press. https://babel.hathitrust.org/cgi/pt?id=hvd.hw1vni&seq=7

Legge, J [1885] (2010). *The Li Chi (Book of Rites).* 2 vols. Whitefish (MT): Kessinger Publishing.

Lev-Yadun, S.; Gopher, A.; Abbo, S. (2000). "The Cradle of Agriculture". *Science*, 288(5471), 1602-3. https://doi.org/10.1126/science.288.5471.1602

Li, C.X. et al. (2021). "Genetic Divergence and Population Structure in Weedy and Cultivated Broomcorn Millets (*Panicum miliaceum* L.) Revealed by Specific-Locus Amplified Fragment Sequencing (SLAF-Seq)". *Frontiers in Plant Science,* 12. https://doi.org/10.3389/fpls.2021.688444

Li Fan 李璠 (1994). "Ruzhou Lilou Yizhi Chutu de Tanhua Liangli de Jianding 汝州李楼遗址出土的碳化粮粒的鉴定 (On the identification of charred grains unearthed from the Lilou site, in Ruzhou)". *Acta Archaeologica Sinica*, 1, 96-7.

Li, H.-L. (1970). "The Origin of Cultivated Plants in Southeast Asia". *Economic Botany*, 24(1), 3-19. https://doi.org/10.1007/bf02860628

Li, H.-L. (1979). *A Fourth Century Flora of Southeast Asia*. Hong Kong: The Chinese University Press.

Li, H. et al. (2015). "Population History and its Relationship with Climate Change on the Chinese Loess Plateau during the Past 10,000 Years". *The Holocene*, 25(7), 1144-52. https://doi.org/10.1177/0959683615580200

Li, H.M. et al. (2016). "Prehistoric Agriculture Development in the Yunnan-Guizhou Plateau, Southwest China: Archaeobotanical Evidence". *Science China Earth Sciences*, 59(8), 1562-73. https://doi.org/10.1007/s11430-016-5292-x

Li, J. et al. (2022). "Chilling Tolerance in Rice: Past and Present". *Journal of Plant Physiology*, 268, 153576. https://doi.org/10.1016/j.jplph.2021.153576

Li, K.; Min, R. (2014). "The Site of Haimenkou: New Research on the Chronology of the Early Bronze Age In Yunnan". Hein, A. (ed.), *The 'Crescent- Shaped Cultural-Communication Belt': Tong Enzheng's Model in Retrospect. An Examination of Methodological, Theoretical and Material Concerns of Long-Distance Interactions in East Asia*. Oxford: BAR Publishing, 123-32. BAR International Series 2679.

Li Kunsheng 李昆声 (1981). "Yunnan Yazhou Zaipeidao Qibo Yanjiu zhong de Diwei 云南亚洲栽培稻起薄研究中的地位 (The role of Yunnan in the origin of rice agriculture in Asia)". *Yunnan Shehui Kexue,* 1, 69-73.

Li Kunsheng (1984). "Yunnan Daozuo Wenhua de Qiyuan 亚洲稻作文化的起源 (The origin of rice culture in Asia)". *Shehui Kexue Zhanxian*, 4, 122-30.

Li Kunsheng; Li Baolun 李保伦 (1983). "Yunnan Qujing Faxian Tanhua Gudao 云南曲靖发现炭化古稻 (Ancient charred rice discovered at Qujing, Yunnan)". *Nongye Kaogu*, 2, 78-9, 72.

Li, X. et al. (2007). "The Earliest Archaeobiological Evidence of the Broadening Agriculture in China Recorded at Xishanping Site in Gansu Province". *Science in China Series D: Earth Sciences*, 50, 1707-14. https://doi.org/10.1007/s11430-007-0066-0

Li, Xiaorui 李小瑞 (2016). "Min yi Shi wie Tian - Yunnan Gudai de Zhuyao Nongye Zuowu 民以食为天 – 云南古代的主要农作物 (Food comes first: Staple crops in ancient Yunnan)". https://mp.weixin.qq.com/s/DmWuz1-rsmAum7h5W44MRw

Li Xiaorui 李小瑞; Liu Xu 刘旭 (2016). "Yunnan Jiangchuan Guangfentou Yizhi Zhiwu Yicun Fuxuan Jieguo ji Fenxi 云南江川光坟头遗址植物遗存浮选结果及分析 (An analysis on the carbonized seeds and fruits from Guangfentou site in Jiangchuan, Yunnan)". *Nongye Kaogu*, 3, 20-7.

Li, Y. et al. (2008). "Genetic Structure and Diversity of Cultivated Soybean (*Glycine max* (L.) Merr.) Landraces in China". *Theoretical and Applied Genetics,* 117(6), 857-71. https://doi.org/10.1007/s00122-008-0825-0

Li, Y. et al. (2010). "Genetic Diversity in Domesticated Soybean (*Glycine max*) and its Wild Progenitor (*Glycine soja*) for Simple Sequence Repeat and Single-Nucleotide Polymorphism Loci". *New Phytologist*, 188(1), 242-53. https://doi.org/10.1111/j.1469-8137.2010.03344.x

Li, Y. et al. (2012). "Analysis of Average Standardized SSR Allele Size Supports Domestication of Soybean along the Yellow River". *Genetic Resources and Crop Evolution,* 60(2), 763-76. https://doi.org/10.1007/s10722-012-9873-z

Li, Y. et al. (2014). "De Novo Assembly of Soybean Wild Relatives for Pan-Genome Analysis of Diversity and Agronomic Traits". *Nature Biotechnology*, 32, 1045-52. https://doi.org/10.1038/nbt.2979

Li, Y. et al. (2021). "Agriculture, the Environment, and Social Complexity From the Early to Late Yangshao Periods (5000-3000 BC): Insights From Macro-Botanical Remains in

North-Central China". *Frontiers in Earth Science*, 9. https://www.frontiersin.org/articles/10.3389/feart.2021.662391

Li, Y. et al. (2023). "New Discoveries at the Sanxingdui Bronze Age site in South-west China". *Antiquity*, 97(391), e4. https://doi.org/10.15184/aqy.2022.150

Li, Y.H. et al. (2020). "A New Technological Analysis of Hoabinhian Stone Artifacts from Vietnam and its Implications for Cultural Homogeneity and Variability between Mainland Southeast Asia and South China". *Asian Perspectives*, 60(1), 71-96. https://doi.org/10.1353/asi.2020.0037

Li Yongqiang 李永强 et al. (2020). "Henan Xinzheng Peiligang Yizhi 2018-2019 Nian Fajue 河南新郑裴李岗遗址2018-2019年发掘 (The excavation of the Peiligang site of Xinzheng city, Henan, 2018-2019)". *Acta Archaeologica Sinica*, 4, 521-45.

Li Zheng 李政 (2015). "Yunnan Jiangchuan Gantangqing Jiushiqi Yizhi Faxian Muzhipin Xiguo nei Shouci Faxian 云南江川甘棠箐旧石器遗址发现木制品 系国内首次发现 (Wooden tools discovered at the Palaeolithic site of Gantangqing in the Sanjiang region, Yunnan. First time discovered in China)". *Zhongguo Wenwu Bao*.

Lian, H. (2015). *Rice Harvesting, Processing, Storage and Charring at Mojiaoshan site, Liangzhu Culture* [Master thesis]. London: University College London.

Lightfoot, E.; Liu, X.Y.; Jones, P.J. (2018). "A World of C4 Pathways: On the Use of $\delta^{13}C$ Values to Identify the Consumption of C_4 Plants in the Archaeological Record". Lightfoot, E.; Liu, X.Y.; Fuller, D.Q. (eds), *Far from the Hearth. Essays in Honours of Martin K. Jones*. Cambridge: University of Cambridge Press, 165-76.

Limp. F.W. (1974). "Water Separation and Flotation Processes". *Journal of Field Archaeology,* 1(3-4), 337-42.

Lin, S.M.; Qiao, Y.L.; Walker, D. (1986). "Late Pleistocene and Holocene Vegetation History at Xi Hu, Er Yuan, Yunnan Province, Southwest China". *Journal of Biogeography*, 13(5), 419. https://doi.org/10.2307/2844966

Lister, D.L. et al. (2018). "Barley Heads East: Genetic Analyses Reveal Routes of Spread through Diverse Eurasian Landscapes". *PLoS ONE,* 13(7), e0196652. https://doi.org/10.1371/journal.pone.0196652

Liu Chang 刘昶; Fang Yanming 方燕明 (2010). "Henan Yuzhou Wadian Yizhi Chutu Zhiwu Yicun Fenxi 河南 禹州 瓦 店 遗址 出土 植物 遗存 分析 (Analysis of archaeobotanical samples from the Wadian Site, Yuzhou, Hennan)". *Nanfang Wenwu*, 4, 55-64.

Liu Changjiang 刘长江; Jin Guiyun; Kong Zhaochen 孔昭宸 (2008). *Zhiwu Kaoguxue-Zhongzi Guoshi Yanjiu* 植物考古学-种子果实研究 (Archaeobotany: Research on seeds and fruits). Beijing: Science Press.

Liu Changjiang; Kong Zhaochen; Lang Shude 朗树德 (2004). "Dadiwan Yizhi Nongye Zhiwu Yicun yu Renlei Shengcun de Huanjing Taolun 大地湾遗址农业植物遗存与人类生存的环境探讨 (Plant remains at the Dadiwan site and a discussion of human adaptation to the environment)". *Zhongyuan Wenwu*, 4, 26-30.

Liu Chao 刘昶; Zhao Zhijun 赵志军; Fang Yanming 方燕明 (2018). "Henan Yuzhou Wadian Yizhi 2007, 2009 Niandu Zhiwu Yicun Fuxuan Jieguo Fenxi 河南禹州瓦店遗址2007-2009年度植物遗存浮选结果分析 (Analysis of the flotation results of the plant remains from Wadian site (2007 and 2009) in Yuzhou, Henan Province)". *Huaxia Archaeology*, 1, 95-102.

Liu Huashi 刘化石 et al. (2023). "Xinshiqi Shidai Wanqi Jingshan Diqu Shusu Nongye Chutan – Laizi Hedongtian, Hetoudi Yizhi Xianmin Guji Shengwu Linhuishi de Wending Tongweisu Zhengju 新石器时代晚期凉山地区粟黍农业初探 - 来自河东田、河头地遗址先民骨骼生物磷灰石的稳定同位素证据 (A preliminary study on millet and millet agriculture in the Liangshan area during the late Neolithic Age – Stable isotope evidence of bioapatite from ancestor bones at the Hedongtian and Hetoudi sites). *Quaternary Research*, 43(5), 1404-16.

Liu Hong 刘弘; Wang Hao 王昊 (2007). "Henglanshan Yizhi yu Lizhou Yizhi Jingji Xingtai zhi Bijiao 横栏山遗址和礼州遗址经济形态之比较 (Comparison of economic subsistence modes between the sites of Henglanshan and Lizhou)". *Sichuan Wenwu*, 5, 43-9.

Liu Huan 刘焕 et al. (2013). "Shaanxi Liangzhu Yangshao Shiqi Yizhi Fuxuan Jieguo Fenxi ji qi Duibi 陕西两处仰韶时期遗址浮选结果分析及其对比 (Analysis and comparison of flotation results of two Yangshao period sites in Shaanxi)". *Kaogu yu Wenwu*, 4, 106-12.

Liu Jianfeng 刘建峰 et al. (2011). "Shaanxi Huayang Xinglefang Yizhi Fajue Jianbao 陕西华阴兴乐坊遗址发掘简报 (Report on Excavations of Xinglefang Site, Huayin, Shanxi)". *Kaogu yu Wenwu*, 6, 33-47.

Liu, L. (2004). *The Chinese Neolithic: Trajectories to Early States*. Cambridge: Cambridge University Press.

Liu Li 刘莉 (2008). "Zhongguo Shiqian de Nianmo Shiqi, Jianguo Caiji, Dingju ji Nongye Qiyuan 中国史前的碾磨石器、坚果采集、定居及农业起源 (Grinding stones, nut collection, and origins of sedentism and agriculture in prehistoric China)". Editorial Board (ed.), *Qingzhu he Bingdi Xiansheng Jiushi Huadan Lunwenji* 庆祝何炳棣先生九十华诞论文集 (Essays for the celebration of Ping-ti Ho's 90th birthday). Xi'an: Sanqin Press, 105-32.

Liu, L. et al. (2007). "Evidence for the Early Beginning (c. 9000 cal. BP) of Rice Domestication in China: A Response". *The Holocene*, 17(8), 1059-68. https://doi.org/10.1177/0959683607085121

Liu, L. et al. (2010). "What Did Grinding Stones Grind? New light on Early Neolithic Subsistence Economy in the Middle Yellow River Valley, China". *Antiquity*, 84(325), 816-33. https://doi.org/10.1017/s0003598x00100249

Liu, L. et al. (2013). "Paleolithic Human Exploitation of Plant Foods during the Last Glacial Maximum in North China". *Proceedings of the National Academy of Sciences (PNAS),* 110(14), 5380-5. https://doi.org/10.1073/pnas.1217864110

Liu, L.; Chen, X. (2012). *The Archaeology of China. From the Late Paleolithic to the Early Bronze Age.* Cambridge: Cambridge University Press. https://doi.org/10.1017/cbo9781139015301

Liu, R. et al. (2021a). "Synthesis of Stable Isotopic Data for Human Bone Collagen: A Study of the Broad Dietary Patterns across Ancient China". *The Holocene*, 31(2), 302-12. https://doi.org/10.1177/0959683620941168

Liu, R. et al. (2021b). "Two Sides of the Same Coin: a Combination of Archaeometallurgy and Environmental Archaeology to Re-Examine the Hypothesis of Yunnan as the Source of Highly Radiogenic Lead in Early Dynastic China". *Frontier in Earth Science,* 9. https://doi.org/10.3389/feart.2021.662172

Liu, X. et al. (2020). "Geographic Differentiation and Phylogeographic Relationships Among World Soybean Populations". *The Crop Journal,* 8(2), 260-72. https://doi.org/10.1016/j.cj.2019.09.010

Liu Xiaoyuan 刘晓媛 (2014). *Anban Yizhi 2012 Nian Zhiwu Yicun Yanjiu* 案板遗址2012年发掘植物遗存研究 (Research on Plant Remains Excavated at the Anban Site in 2012) [Masters Thesis]. Xi'an: Northwest University.

Liu, X.Y. (2009). *Food Webs, Subsistence and Changing Culture: The Development of Early Farming Communities in the Chifeng Region, North China* [PhD dissertation]. Cambridge: Cambridge University.

Liu, X.Y. et al. (2016). "The virtues of small grain size: Potential pathways to a distinguishing feature of Asian wheats". *Quaternary International*, 426, 107-19. https://doi.org/10.1016/j.quaint.2016.02.059

Liu, X.Y. et al. (2017). "Journey to the East: Diverse Routes and Variable Flowering Times for Wheat and Barley En Route to Prehistoric China". *PLoS ONE*, 12(11), e0187405. https://doi.org/10.1371/journal.pone.0187405

Liu, X.Y. et al. (2019). "From Ecological Opportunism to Multi-Cropping: Mapping Food Globalisation in Prehistory". *Quaternary Science Reviews,* 206, 21-8. https://doi.org/10.1016/j.quascirev.2018.12.017

Liu, X.Y.; Fuller, D.Q.; Jones, M.K. (2015). "Early Agriculture in China". Barker, G.; Goucher, C. (ed.), *The Cambridge World History*. Cambridge: Cambridge University Press, 310-34. https://doi.org/10.1017/cbo9780511978807.013

Liu, X.Y.; Hunt, H.V.; Jones, M.K. (2009). "River Valleys and Foothills: Changing Archaeological Perceptions of North China's Earliest Farms". *Antiquity*, 83(319), 82-95. https://doi.org/10.1017/s0003598x00098100

Liu, X.Y.; Reid, R.E.B. (2020). "The Prehistoric Roots of Chinese Cuisines: Mapping Staple Food Systems of China, 6000 BC-220 AD". *PLoS ONE*, 15(11), e0240930. https://doi.org/10.1371/journal.pone.0240930

Liu Xu 刘旭; Sun Hua 孙华 (2009). "Yeshishan Yicun de Chubu Fenxi 野石山遗存的初步分析 (Preliminary analysis on the remains from Yeshishan)". *Kaogu,* 8, 67-8, 97.

Liu Xu; Dai Zongpin 戴宗品 (2008). "3000 Nianqian de Xueju Shenghuo: Gengma Shifodong Yizhi 3000 年前的穴居生活: 耿马石佛洞 遗址 (Cave Life from 3000 years ago: The site of Shifodong, Gengma) ". *Zhongguo Wenhua Yichan*, 6, 84-7.

Liu Yan 刘妍 et al. (2022). "Cong Zhiwu Yicun Kan Gudai Xinjian Dama de Renshi he Liyong 从植物遗存看古代新疆大麻的认识和利用 (Understanding and utilization of cannabis in ancient Xinjiang from plant remains)". *Zhongguo kexueyuan daxue Xuebao*, 39(4), 567-76.

Liu Ziming 柳子明 (1975). "Zhongguo Zaipeidao de Qixiang ji qi Fazhan 中国栽培稻的起想及其发展 (The origin and development of cultivated rice in China)". *Yichuan Xuebao*, 1, 23-30.

Lone, F.A.; Khan, M.; Buth, G.M. (1993). *Palaeoethnobotany Plants and Ancient Man in Kashmir*. Rotterdam: AA Balkema.

Long Ruihua 龙瑞华 et al. (1991). "Yunnan Zhongbu Jiluhu Diqu Wangengxinshi – Quanxinshi Zhibei Yanjiu 云南中部杞麓湖地区晚更新世 – 全新世植被研究 (A study of late Pleistocene to Holocene vegetation in the Jilu lake area of central Yunnan)". *Yunnan Dizhixue*, 1, 105-18.

Long, T. et al. (2016). "Cannabis in Eurasia: Origin of Human Use and Bronze Age Trans-Continental Connections". *Vegetation History and Archaeobotany*, 26(2), 245-58. https://doi.org/10.1007/s00334-016-0579-6

Long, T. et al. (2018). "The Early History of Wheat in China from 14C Dating and Bayesian Chronological Modelling". *Nature Plants*, 4(5), 272-9. https://doi.org/10.1038/s41477-018-0141-x

López-Pujol, J.; Zhang, F.-M.; Ge, S. (2006). "Plant Biodiversity in China: Richly Varied, Endangered, and in Need of Conservation". *Biodiversity and Conservation*, 15(12), 3983-4026. https://doi.org/10.1007/s10531-005-3015-2

Lu Hongliang 吕红亮 (2007). "Xizang Ali Diqu Dingdong Juzhu Yizhi Fajue Jianbao 西藏阿里地区丁东居住遗址发掘简报 (Excavations at the occupation site of Dingdong in Ngari, Tibet)". *Kaogu*, 11, 36-46, 102-3, 2.

Lu, H.Y. (2016). "Colonization of the Tibetan Plateau, Permanent Settlement, and the Spread of Agriculture: Reflection on Current Debates on the Prehistoric Archeology of the Tibetan Plateau". *Archaeological Research in Asia*, 5, 12-15. https://doi.org/10.1016/j.ara.2016.02.010

Lu, H.Y. (2023). "Local Millet Farming and Permanent Occupation on the Tibetan Plateau". *Science China Earth Sciences*, 66, 430-4. https://doi.org/10.1007/s11430-022-1018-7

Lu, H.Y. et al. (2002). "Rice Domestication and Climatic Change: Phytolith Evidence from East China". *Boreas,* 31(4), 378-85. https://doi.org/10.1080/030094802320942581

Lu, H.Y. et al. (2009a). "Earliest Domestication of Common Millet (*Panicum miliaceum*) in East Asia Extended to 10,000 Years Ago". *Proceedings of the National Academy of Sciences (PNAS)*, 106, 7367-72. https://doi.org/10.1073/pnas.0900158106

Lu, H.Y. et al. (2009b). "Phytoliths Analysis for the Discrimination of Foxtail millet (*Setaria italica*) and Common millet (*Panicum miliaceum*)". *PLoS ONE*, 4, e4448. https://doi.org/10.1371/journal.pone.0004448

Lu, H.Y. et al. (2016). "Earliest Tea as Evidence for One Branch of the Silk Road across the Tibetan Plateau". *Scientific Reports*, 6(1). https://doi.org/10.1038/srep18955

Lu Houyuan 吕厚远; Wang Yongji 王永吉 (1989). "Zhiwu Guisuanti de Yanjiu ji zai Qingdao Sanqian Duo Nian lai Guhuanjing Jieshi zhong de Yingyong 植物硅酸体的研究及在青岛三千多年来古环境解释中的应用 (The application of phytoliths studies to reconstruct the over 3000 years ancient environment of Qingdao)". *Kexue Tongbao*, 19, 1485-8.

Lu, L.; Bartholomew, B. (2003). "*Amygdalus* Linnaeus, Sp. Pl. 1: 472. 1753". *Flora of China,* 9, 391-5. http://flora.huh.harvard.edu/china/pdf/pdf09/Amygdalus.PDF

Lu, M.X. et al. (2021). "Environmental Influences on Human Subsistence Strategies in Southwest China During the Bronze Age: A Case Study at the Jiangxifen Site in Yunnan". *Frontiers in Earth Science*, 9. https://doi.org/10.3389/feart.2021.662053

Lu, M.X. et al. (2023). "Diverse Subsistence Strategies Related to the Spatial Heterogeneity of Local Environments in the Hengduan Mountain Region during the Bronze Age". *Frontiers in Earth Science*, 11. https://doi.org/10.3389/feart.2023.1144805

Lu, T.L.-D. (1999). *The Transition from Foraging to Farming and the Origin of Agriculture in China*. Oxford: John and Erica Hedges.

Lu, T.L.-D. (2002). "The Transformation of Academic Culture in Mainland Chinese Archaeology". *Asian Anthropology*, 1(1), 117-52. https://doi.org/10.1080/1683478x.2002.10552523

Lu, T.L.-D. (2009). "Archaeology in Africa and Asia: Prehistoric Coexistence: The Expansion of Farming Society from the Yangzi River Valley to Western South China". *Senri Ethnological Studies*, 73, 47.

Lu, T.L.-D. (2010). "Early Pottery in South China". *Asian Perspectives*, 49(1), 1-42. https://doi.org/10.1353/asi.2010.0003

Lu, T.L.-D. (2012). "Periphery or Land of Cultural Dynamics: Rethinking Prehistoric South China". *Documenta Praehistorica*, 39, 111-36. https://doi.org/10.4312/dp.39.9

Luan Fengshi 栾丰实 (1997). *Dong Yi Kaogu* 东夷考古 (Archaeology of the Eastern Yi). Beijing: Shandong University Press.

Luan Fengshi et al. (2007). "Shandong Qixia Xian Yangjiaquan Yizhi Zuowu Yicun de Diaocha he Chubu Yanjiu 山东栖霞县杨家圈遗址稻作遗存的调查和初步研究(Survey and preliminary study of rice farming remains on the Yangjiaquan site in Qixia County, Shandong)". *Kaogu*,12, 78-84.

Lubbocks, J. (1865). *Pre-Historic Times, as Illustrated by Ancient Remains, and the Manners and Customs of Modern Savages.* London: Williams and Norgate.

Luitel, D.R. et al. (2017). "An Overview: Distribution, Production, and Diversity of Local Landraces of Buckwheat in Nepal". *Advances in Agriculture*, 2017, 1-6. https://doi.org/10.1155/2017/2738045

Luo Erhu 罗二虎 (2004). "Zhongguo Gudai Xisheng Shidao Yanjiu 中国古代系绳石刀研究 (The cord-attached stone knives in Ancient China)". *Kaoguxue Jikan*, 1, 311-91.

Luo Erhu (2007). "Lun Zhongguo Gudai de Xisheng Taodao 论中国古代的系绳陶刀 (Discussions on the corded pottery knives)". *Kaogu* 考古, 12, 69-77.

Luo Erhu; Li Fei 李飞. (2013). "Lun Gudai Xisheng Shidao de Gongneng – Jian Tan Minzu Kaoguxue Fangfa 论古代系绳石刀的功能 – 兼谈民族考古学方法 (On the function of the ancient cord-attached stone knives, with a discussion on the methodology of ethnoarchaeology)". *Kaoguxue Yanjiu*, 27-35.

Luo Yunbing 罗运兵; Yao Luan 姚凌; Yuan Jing 袁靖 (2018). "Changjiang Shangyou Diqu Xianqin Shiqi de Shengye Jingji 长江上游地区先秦时期的生业经济 (Livelihood economy in the upper reaches of the Yangtze River during the pre-Qin period)". *Nanfang Wenwu*, 4, 96-110.

Ma Dequan 马得泉 et al. (1987). "Xizang Yesheng Damai de Fenlei he Fenbu 西藏野生大麦的分类和分布 (The classification and distribution of wild barley in the Tibet Autonomous Region)". *Scienta Agriculturae Sinica*, 2, 1-6.

Ma, M.M. et al. (2022a). "Asynchronous Transformation of Human Livelihoods in Key Regions of the Trans-Eurasia Exchange in China during 4000-2200 BP". *Quaternary Science Reviews*, 291, 107665. https://doi.org/10.1016/j.quascirev.2022.107665

Ma, M.M. et al. (2022b). "Understanding the Transport Networks Complex between South Asia, Southeast Asia and China during the Late Neolithic and Bronze Age". *The Holocene*, 33(2), 147-58. https://doi.org/10.1177/09596836221131698

Ma, M.M. et al. (2024). "Forager-Farmer Transition at the Crossroads of East and Southeast Asia 4900 Years Ago". *Science Bulletin*, 69(1), 103-13. https://doi.org/10.1016/j.scib.2023.10.015

Ma, X. (2005). *Emergent Social Complexity in the Yangshao Culture: Analyses of Settlement Patterns and Faunal Remains from Lingbao, Western Henan, China*. Oxford: British Archaeological Reports. BAR International Series 1453.

Ma Yongchao 马永超 et al. (2015). "Dalian Wangjiacun Yizhi Tanhua Zhiwu Yicun Yanjiu 大连王家村遗址炭化植物遗存研究 (Research on carbonized plant remains at the Wangjiacun site in Dalian)". *Beifang Wenwu*, 2, 39-43, 116.

Ma Yongchao 马永超; Jin Guiyun (2017). "Haidai Longshan Wenhua Zuowu Leixing ji Diyu Tezheng Fenxi 海岱龙山文化作物类型及地域特征分析 (Analysis of crop types and regional characteristics of Longshan cultural crops in Haidai)". Lai Fengshi 來丰实; Wang Fendong 王芬董 (eds), *Longshan Wenhua yu Zaoqi Wenhua – Di 22 Jie Guoji Lishi Kexue Dahui Zhangqiuweixing Huiyi Wenji* 龙山文化与早期文明 – 第22届国际历史科学大会章丘卫星会议文集 (Zhangqiu Weixing Collection of essays from the 22nd International Meeting on the History of Science). Shandong Daxue Wenhua Yichan Yanjiuyuan, Zhangqiu Shi Wenchang Xinju 山东大学文化遗产研究院, 章丘市文广新局. Beijing: Cultural Relics Press, 162-79.

Ma, Y. et al. (2015). "COLD1 Confers Chilling Tolerance in Rice". *Cell*, 162(1), 222. https://doi.org/10.1016/j.cell.2015.06.046

Ma, Y. et al. (2016). "Rice Bulliform Phytoliths Reveal the Process of Rice Domestication in the Neolithic Lower Yangtze River Region". *Quaternary International,* 426, 126-32. https://doi.org/10.1016/j.quaint.2016.02.030

Ma, Y. et al. (2018). "Multiple Indicators of Rice Remains and the Process of Rice Domestication: A Case Study in the Lower Yangtze River Region, China". *PLoS ONE,* 13(12), e0208104. https://doi.org/10.1371/journal.pone.0208104

Maclean, J.L. et al. (eds) (2002). *Rice Almanac: Source Book for the Most Important Economic Activity on Earth.* CABI Publishing Series. International Rice Research Institute. https://doi.org/10.1079/9780851996363.0000

Maeda, O. et al. (2016). "Narrowing the Harvest: Increasing Sickle Investment and the Rise of Domesticated Cereal Agriculture in the Fertile Crescent". *Quaternary Science Review*, 145, 226-37. https://doi.org/10.1016/j.quascirev.2016.05.032

Malaisse, F. et al. (2012). "Ethnomycology and Ethnobotany (South Central Tibet). Diversity, with Emphasis on Two Underrated Targets: Plants Used for Dyeing and Incense". *Geo-Eco-Trop*, 36, 185-99.

Marr, K.L.; Bhattarai, N.K.; Xia, Y.-M. (2005). "Allozymic, Morphological, and Phenological Diversity in Cultivated *Luffa acutangula* (Cucurbitaceae) from China, Laos, and Nepal, and Allozyme Divergence between *L. acutangula* and *L. aegyptiaca*". *Economic Botany*, 59(2), 154-65. https://doi.org/10.1663/0013-0001(2005)059[0154:amapdi]2.0.co;2

Marr, K.L.; Mei, X.Y.; Bhattarai, N.K. (2004). "Allozyme, Morphological And Nutritional Analysis Bearing On The Domestication of *Momordica Charantia* L. (Cucurbitaceae)". *Economic Botany*, 58(3), 435-55. https://doi.org/10.1663/0013-0001(2004)058[0435:amanab]2.0.co;2

Matsumura, H. et al. (2019). "Craniometrics Reveal 'Two Layers' of Prehistoric Human Dispersal in Eastern Eurasia". *Scientific Reports*, 9, 1451. https://doi.org/10.1038/s41598-018-35426-z

Matthews, P.J. (2003). "Identification of *Benincasa hispida* (wax gourd) from the Kana archaeological site, Western Highlands Province, Papua New Guinea". *Archaeology in Oceania*, 38(3), 186-91. https://doi.org/10.1002/j.1834-4453.2003.tb00544.x

Matthews, P.J. et al. (2015). "Taxonomy and Ethnobotany of *Colocasia esculenta* and *C. formasana* (Araceae): Implications for the Evolution, Natural Range, and Domestication of Taro". *Aroideana*, 38(1), 153-76.

Maun, M.A.; Barrett, S.C.H. (1986). The Biology of Canadian Weeds: 77. *Echinochloa crus-galli* (L.)" Beauv. *Canadian journal of plant science*, 66(3), 739-59. https://doi.org/10.4141/cjps86-093

McKean, M.B. (1983). *The Palynology of Balakot, a Pre-Harappan and Harappan Age Site in Las Bela, Pakistan* [PhD Dissertation]. Dallas; Ann Arbor: Southern Methodist University; University Microfilms.

Merwe, N.J. van der (1982). "Carbon Isotopes, Photosynthesis, and Archaeology: Different Pathways of Photosynthesis Cause Characteristic Changes in Carbon Isotope Ratios That Make Possible the Study of Prehistoric Human Diets". *American Scientist*, 70(6), 596-606. http://www.jstor.org/stable/27851731

Merwe, N.J. van der (1992). "Light Stable Isotopes and the Reconstruction of Prehistoric Diets". *Proceedings of the British Academy*, 77, 247-64.

Michael, P.W. (2001). "The Taxonomy and Distribution of Echinochloa Species (Barnyard Grasses) in the Asian-Pacific Region, with a review of Pertinent Biological Studies". Ni, H.; You, Z.G. (eds), *The Proceedings of the Eighteenth Asian-Pacific Weed Science Society Conferenc* (Beijing, 28 May-2 June 2001). Beijing: Standards Press of China, 57-66. http://apwss.org.in/documents/Conference_Proceedings/18_APWSS_I.pdf

Miller, K. (2014). *Archaeobotanical Remains from Ban Non Wat: Rice Agriculture in Prehistoric Thailand* [MSc thesis]. London: Institute of Archaeology, University College London.

Miller, N.F. (1993). "Preliminary Archaeobotanical Results from the 1989 Excavation at the Central Asian Site of Gonur Depe, Turkmenistan". *Information Bulletin 19.* Moscow: International Association for the Study of the Cultures of Central Asia, 149-63.

Miller, N.F. (1999). "Agricultural Development in Western Central Asia in the Chalcolithic and Bronze Ages". *Vegetation History and Archaeobotany*, 8(1), 13-19. https://doi.org/10.1007/bf02042837

Miller, N.F. (2011). "Preliminary Archaeobotanical Results". Pollock, S.; Bernbeck, R. (eds), *Excavations at Monjukli Depe, Meana-Caaca Region, Turkmenistan, 2010*. Archäologische Mitteilungen aus Iran und Turan 43, 213-21.

Min Rui 闵锐 (2009a). "Yunnan Jianchuan Xian Haimenkou Yizhi 云南剑川县海门口遗 (The site of Haimenkou in Jianchuan, Yunnan)". *Kaogu*, 7, 18-23, 2, 104.

Min Rui (2009b). "Yunnan Jianchuan Xian Haimenkou Yizhi Disanci fajue 云南剑川县海门口遗址第三次发掘 (Third excavation of Haimenkou, in Jianchuan county, Yunnan)". *Kaogu*, 8, 3-22, 97-102.

Min Rui et al. (2013). "Yunnan Xiangyun Xian Qinghuadong Yizhi 2010 Nian Shijue Baogao 云南祥云县清华洞遗址2010年试掘报告 (Archaeological Excavation of Qinghuadong Site, Xiangyun County, Yunnan, 2010)". *Nanfang Minzu Kaogy*, 263-94, 475-9.

Misra, V.D. et al. (2009). *Excavations at Jhusi (Pratishthanpur).* New Delhi: Indian Archaeological Society.

Miyamoto Kazuo (2009). *Noukounokigenwosagur*u (In search of the origin of agriculture). Tokyo: Yoshikawa kōbunkan.

Motuzaite-Matuzeviciute, G. et al. (2013). "The Early Chronology of Broomcorn Millet (*Panicum miliaceum*) in Europe". *Antiquity,* 87(338), 1073-85. https://doi.org/10.1017/s0003598x00049875

Mudar, K. (1995). "Evidence for Prehistoric Dryland Farming in Mainland Southeast Asia: Results of Regional Survey in Lopburi Province, Thailand". *Asian Perspectives*, 34(2), 157-94.

Muldoon, D.; Perason, C.; Wheeler, J. (1982). "The Effect of Temperature on Growth and Development of Echinochloa Millets". *Annals of Botany*, 50, 665-72. https://doi.org/10.1093/oxfordjournals.aob.a086408

Müller, J.; Rassmann, K.; Videiko, M. (2016). *Tripyllia Mega-Sites and European Prehistory 4100-3400 BCE*. London: Routledge. Themes in Contemporary Archaeology 2.

Murowchick, R.E.; Cohen, D.J. (2001). "Searching for Shang's Beginnings: Great City Shang, City Song, and Collaborative Archaeology in Shangqiu, Henan". *The Review of Archaeology,* 22(2), 47-60.

Murphy, C. et al. (2018). "Early Agriculture in Sri Lanka: New Archaeobotanical Analyses and Radiocarbon Dates from the Early Historic Sites of Kirinda and Kantharodai (Kandarodai)". *Archaeological Research in Asia*, 16, 88-102. https://doi.org/10.1016/j.ara.2018.06.001

Murphy, C. et al. (2019). "Looking Beyond the Surface: Use of High Resolution X-Ray Computed Tomography on Archaeobotanical Remains". *Interdisciplinaria Archaeologica - Natural Sciences in Archaeology,* X(1), 7-18. https://doi.org/10.24916/iansa.2019.1.1

Murphy, C.; Fuller, D.Q. (2016). "Food Production in India: South Asian Entanglements of Domestication". Shug, G.; Walimbe, S. (eds), *A Companion to South Asia in the Past.* Oxford: Wiley Blackwell, 344-57.

Murphy, C.; Fuller, D.Q. (2017). s.v. "The Agriculture of Early India". *Oxford Research Encyclopedia of Environmental Science*. https://doi.org/10.1093/acrefore/9780199389414.013.169

Murphy, C.; Fuller, D.Q. (2018). "Agricultural Origins and Frontiers in the Indian Subcontinent: a Current Synthesis". Korisettar, R. (ed.), *Beyond Stones and More Stones, Domestication of the Indian Subcontinent*. Bengaluru: The Mythic Society, 15-94.

Murphy, P.; Wiltshire, P.E.J. (1994). *A Guide to Sampling Archaeological Deposits for Environmental Analysis*. London: Museum of London Archaeological Service. Archaeological Site Manual.

Mutert, E.; Fairhurst, T.H. (2002). "Developments in Rice Production in Southeast Asia". *Better crops International*, 16, Special issue, 12-17. http://www.ipni.net/publication/bci.nsf/0/7C3A058883EE4FB185257BBA006531EB/$FILE/Better%20Crops%20International%202002-3%20p12.pdf

Myers, N. (1988). "Threatened Biotas: 'Hot Spots' in Tropical Forests". *Environmentalist,* 8(3), 187-208. https://doi.org/10.1007/bf02240252

Myers, N. et al. (2000). "Biodiversity Hotspots for Conservation Priorities". *Nature*, 403(6772), 853-8. https://doi.org/10.1038/35002501

Nanjing Bowuguan 南京博物院; Sihong Xian Bowuguan 泗洪县博物馆 (eds) (2016). "*Shunshaji: Sihong Xian Xinshiqi Shidai Yizhi Kaogu Fajue Baogao* 顺山集: 泗洪县新石器时代遗址考古发掘报告 (Shunshanji: A Report of the archaeological Excavation of the Neolithic site in Sihong county)". Beijing: China Science Publishing & Media Ltd.

Nasu, H. et al. (2007). "The Occurrence and Identification of Setaria italica (L.) P. Beauv. (Foxtail Millet) Grains from the Chengtoushan Site (ca. 5800 cal B.P.) in central China, with Reference to the Domestication Centre in Asia". *Vegetation History and Archaeobotany*, 16(6), 481-94. https://doi.org/10.1007/s00334-006-0068-4

Nasu, H. et al. (2012). "Land-Use Change for Rice and Foxtail Millet Cultivation in the Chengtoushan Site, Central China, Reconstructed from Weed Seed Assemblages". *Archaeological and Anthropological Sciences,* 4(1), 1-14. https://doi.org/10.1007/s12520-011-0077-9

NBS, National Bureau of Statistics (2021). *Communiqué of the Seventh National Population Census (No. 3) Population by Region.* https://www.stats.gov.cn/english/PressRelease/202105/t20210510_1817188.html

NBS, National Bureau of Statistics (2023). “25-18. Geographic Distribution and Population of Ethnic Minorities”. *China Statistical Yearbook 2023*. https://www.stats.gov.cn/sj/ndsj/2023/indexeh.htm

NBS, National Bureau of Statistics (2024). “Annual Data, Agriculture”. *National Data.* https://data.stats.gov.cn/english/easyquery.htm?cn=C01

Nesbitt, M. (2002). “When and Where Did Domesticated Cereals First Occur in southwest Asia”. Cappers, R.T.J.; Bottema, S. (eds), *The Dawn of Farming in the Near East. Studies in Early Near Eastern Production, Subsistence, and Environment 6*. Berlin: ex Oriente, 113-32.

Nesbitt, M. (2005). “The Migration of Plants. Grains”. Prance, G.; Nesbitt, M. (eds), *The Cultural History of Plants*. New York: Routledge, 45-60.

Nesbitt, M.; Caligari, P.D.S.; Brandham, P.E. (2001). *Wheat Evolution: Integrating Archaeological and Biological Evidence, Wheat Taxonomy: The Legacy of John Percival*. London: London Academic Press, 37-59.

Nguyen, T.M.H. (2002). “Plants at Dong Dau Archaeological Site Under Pollen and Spore Analysis”. *Archaeology*, 1, 60-7.

Nguyen, T.M.H. (2013). “Neolithic Vegetation in Northern Vietnam: An Indication Of Early Agricultural Activities”. *Journal of Austronesian Studies*, 4, 1.

Nguyen, T.M.H. (2017). “Burnt Rice from Four Archaeological Sites in Northern Vietnam”. *Vietnam Social Sciences,* 3(179), 64-77.

Nguyen, X.H. (1998). “Rice Remains from Various Archaeological Sites in North and South Vietnam”. Klokke, M.J.; Bruijn, T.D. (eds), *Southeast Asian Archaeology: Proceedings of the First Conference of the European Association of Southeast Asian Archaeologists*. Hull: Centre for South-East Asian Studies, 27-40.

Nong, K.Y. (2024). “Plant Use by Ancient Chinese Border Guards: an Archaeobotanical Investigation from the Keyakekuduke Beacon Tower Site (AD 618-907)”. *Environment, Land use and Urbanization in Central Asia Conference* (Jena, Germany, 22-26 January 2024).

Norman, J.; Mei, T.-L. (1976). “The Austroasiatics in Ancient South China: Some Lexical Evidence”. *Monumenta Serica*, 32(1), 274-301. https://doi.org/10.1080/02549948.1976.11731121

Obata Hiroki 小畑弘己 (2019). “遼東半島文家屯貝塚出土土器の圧痕分析成果（The result of pottery impression analysis in Wenjiadun Shell midden of Liaodong Peninsula)”. Miyamoto, K. (ed.), 東北アジア農耕伝播過程の植物考古学分析による実証的研究（A Scientific Research on the Process of Spread of Agriculture in North Eastern Asia by Botanic Archaeology). Fukuoka: Kyushu University, 38-60.

Ohnishi, O. (1991). “Discovery of the Wild Ancestor of Common Buckwheat”. *Fagopyrum*, 11(5), 5-10.

Ohnishi, O. (1998). “Search for the Wild Ancestor of Buckwheat III. The Wild Ancestor of Cultivated Common Buckwheat, and of Tartary Buckwheat”. *Economic Botany*, 52(2). https://doi.org/10.1007/bf02861199

Ohnishi, O. (2004). “On the Origin of Cultivated Buckwheat”. *Advances in Buckwheat Research. Proceedings of the 9th International Symposium on Buckwheat* (Prague, 18-22 August 2002), 16-21.

Ohnishi, O.; Konishi, T. (2001). “Cultivated and Wild Buckwheat Species in Eastern Tibet”. *Fagopyrum*, 18, 3-8.

Ohnishi, O.; Matsuoka, Y. (1996). “Search for the Wild Ancestor Of Buckwheat II. Taxonomy of Fagopyrum (Polygonaceae) Species Based on Morphology, Isozymes and cpDNA Variability”. *Genes & Genetic Systems*, 71(6), 383-90. https://doi.org/10.1266/ggs.71.383

Ohnishi, O.; Tomiyoshi, M. (2005). “Distribution of Cultivated and Wild Buckwheat in the Nu River Valley of Southwestern China”. *Fagopyrum*, 22, 1-5.

Ohnishi, O.; Yasui, Y. (1998). “Search for Wild Buckwheat Species in High Mountain Regions of Yunnan and Sichuan Provinces of China”. *Fagopyrum*, 15, 8-17.

Ohri, D. (2015). “The Taxonomic Riddle of *Chenopodium album* L. Complex (Amaranthaceae)”. *Nucleus*, 58, 131-4. https://doi.org/10.1007/s13237-015-0143-2

Olson, D.M. et al. (2001). "Terrestrial Ecoregions of the World: A New Map of Life on Earth". *BioScience*, 51(11), 933. https://doi.org/10.1641/0006-3568(2001)051[0933:teotwa]2.0.co;2

Oplinger, E. et al. (1989). "Buckwheat". University of Wisconsin Cooperative Extension Service, University of Minnesota Extension Service, Center for Alternative Plant and Animal Products (ed.), *Alternative Field Crops Manual*. Available at https://hort.purdue.edu/newcrop/afcm/buckwheat.html

Orton, C. (2000). *Sampling in Archaeology*. Cambridge: Cambridge University Press.

Osbaldestone, T.A.; Wood, R.P.A. (transl.) (2000). Dioscorides *De Materia Medica.* Johannesburg: IBIDIS Press.

Oxenham, M.F. et al. (2015). "Emergence and Diversification of the Neolithic in Southern Vietnam: Insights From Coastal Rach Nui". *The Journal of Island and Coastal Archaeology*, 10(3), 309-38. https://doi.org/10.1080/15564894.2014.980473

Padulosi, S. et al. (2009). "Food Security and Climate Change: Role of Plant Genetic Resources of Minor Millets". *Indian Journal of Plant Genetic Resources*, 22(1), 1-16.

Pan, Y. (2008). "Immature Wild Rice Harvesting at Kuahuqiao, China?" *Antiquity, Project Gallery,* 82(316). https://antiquity.ac.uk/projgall/pan316

Pan, Y.; Zheng, Y.; Chen, C. (2017). "Human Ecology of the Neolithic Kuahuqiao Culture in East China". Habu, J.; Olsen, J.; Lape, P. (eds), *Handbook of East and Southeast Asian Archaeology.* New York: Springer Science, Business Media, 347-77.

Panggabean, G. (1992). "*Syzygium aqueum* (Burm.f) Alston, *Syzygium malaccense* (L.) Merr. & Perry, *Syzygium samarangense* (Blume) Merr & Perry". Verheij, E.W.M;Coronel, R.E. (eds), *Plant Resources of Southaast Asia*. Vol. 2, *Edible Fruits and Nuts.* Prosea: Bogor.

Parkington, J.; Sealy, J.C.; Merwe, N.J. van der (1987). "On Stable Carbon Isotopes and Dietary Reconstruction". *Current Anthropology*, 28(1), 91-5. https://doi.org/10.1086/203495

Partap, T. (1999). "Sustainable Land Management in Marginal Mountain Areas of the Himalayan Region". *Mountain Research and Developments,* vol. 19(3). *Poverty, Rural Livelihoods, and Land Husbandry in Hillside Environments*, Part 1. Bern: International Mountain Society, 251-60.

Partap, T.; Joshi, B.D.; Galwey, N.W. (1998). "Chenopods: *Chenopodium* spp.". *Promoting the Conservation and Use of Underutilized and Neglected Crops*. Rome: Institute of Plant Genetics and Crop Plant Research, Gatersleben; International Plant Genetic Resources Institute.

Partap, T.; Kapoor, P. (1985a). "The Himalayan Grain Chenopods. I. Distribution and Ethnobotany". *Agriculture, Ecosystems & Environment*, 14(3-4), 185-99. https://doi.org/10.1016/0167-8809(85)90035-0

Partap, T.; Kapoor, P. (1985b). "The Himalayan Grain Chenopods. II. Comparative Morphology". *Agriculture, Ecosystems & Environment*, 14(3-4), 201-20. https://doi.org/10.1016/0167-8809(85)90036-2

Partap, T.; Kapoor, P. (1987). "The Himalayan Grain Chenopods. III. An Under-Exploited Food Plant with Promising Potential". *Agriculture, Ecosystems & Environment*, 19(1), 71-9. https://doi.org/10.1016/0167-8809(87)90052-1

Pautreau, J-P.; Coupey, A-S.; Kyaw, A.A. (eds) (2010). *Excavations in the Samon Valley: Iron Age burials in Myanmar.* Chiang Mai: Mission Archéologique Française au Myanmar.

Pearsall, D.M. (2015). *Paleoethnobotany: A Handbook of Procedures*. 3rd ed. New York: Routledge.

Pearson, R. (2005). "The Social Context of Early Pottery in the Lingnan Region of South China". *Antiquity*, 79(306), 819-28. https://doi.org/10.1017/s0003598x00114954

Pei, A. (1998). "Notes on New Advancements and Revelations in the Agricultural Archaeology of Early Rice Domestication in the Dongting Lake Region". *Antiquity*, 72, 878-85. https://doi.org/10.1017/s0003598x00087512

Peng Bangjiong 彭邦炯 (1989). "Jiaguwen Nongye Ziliao Zuanji Kaopan (San) 甲骨文农业资料选集考辨(三) (Compilation of Oracle Bone Inscriptions on Shang Dynasty agriculture (three)]". *Nongye Kaogu*, 2, 372-86.

Pennington, H.L.; Weber, S.A. (2004). "Paleoethnobotany: Modern Research Connecting Ancient Plants And Ancient Peoples". *Critical Reviews In Plant Sciences,* 23(1), 13-20. https://doi.org/10.1080/07352680490273220

Pereira da Cruz, R. et al. (2013). "Avoiding Damage and Achieving Cold Tolerance in Rice Plants". *Food and Energy Security*, 2(2), 96-119. https://doi.org/10.1002/fes3.25

Petrie, C.A.: Schaffer, J.G. (2019). "The Development of a 'Helmand Civilisation' South of the Hindu Kush". Ball, W.; Hammond, N.; Allchin, R. (eds), *The Archaeology of Afghanistan: From the Earliest Times to the Timurid Period*. 2nd ed. Edinburgh: Edinburgh University Press, 161-259.

Pigott, V.C. et al. (2006). "A Program of Analysis of Organic Remains from Prehistoric Copper-Producing Settlements in the Khao Wong Prachan Valley, Central Thailand: A Progress Report". Bacus, E.A.; Glover, I.C.; Pigott, V.C. (eds), Uncovering *Southeast Asia's Past: Selected Papers From the 10th International Conference of the European Association of Southeast Asian Archaeologists*. Singapore: National University of Singapore Press, 154-67.

Pigott, V.C.; Ciarla, R. (2007). "On the Origins of Metallurgy in Prehistoric Southeast Asia: The View from Thailand". La Niece, S.; Hook, D.; Craddock, P. (eds), *Metals and Mines: Studies in Archaeometallurgy*. London: Archetype; British Museum, 76-88.

Piperno, D.R. (2006). *Phytoliths: a Comprehensive Guide for Archaeologists and Paleoecologists*. Lanham: Altamira Press.

Pirzadah, T.B.; Rehman, R.U. (2021). "Reasons for Declining Buckwheat Production". Pirzadah, T.B.; Rehman, R.U. (eds), *Buckwheat: Forgotten Crop for the Future: Issues and Challenges*. Boca Raton: CRC Press.

PKU News (2009). *2008 China's Top 10 Discoveries in Archeology*. https://newsen.pku.edu.cn/news_events/news/focus/585.html

Pokharia, A.K. (2007). "Table 1. Plant Remains from Kanmer Excavation 05-06". Osada, T. (ed.), *Linguistics, Archaeology and the Human Past, Occasional Paper 2.* Kyoto: Research Institute for Humanity and Nature, Indus Project, 30-1.

Pokharia, A.K. (2008). "Palaeobotanical Record of Cultivated Crops and Associated Weeds and Wild Taxa from Neolithic Site, Tokwa, Uttar Pradesh, India". *Current Science,* 94, 2.

Pokharia, A.K.; Pal, J.N.; Srivastava, A. (2009). "Plant Macro-Remains from Neolithic Jhusi in Ganga Plain: Evidence for Grain-Based Agriculture". *Current Science*, 97(4), 564-72. https://doi.org/10.54991/jop.2011.169

Pokharia, A.K. et al. (2016). "Neolithi-Early Historic (2500-200 BC) Plant Use: The Archaeobotany of Ganga Plain, India". *Quaternary International*, 443, 223-37. https://doi.org/10.1016/j.quaint.2016.09.018

Pokharia, A.K. et al. (2017). "Early Neolithic Agriculture (2700-2000 BC) and Kushan Period Developments (AD 100-300): Macrobotanical Evidence from Kanispur in Kashmir, India". *Vegetation History and Archaeobotany*, 27, 477-91. https://doi.org/10.1007/s00334-017-0645-8

Pokharia, A.K.; Saraswat, K.S. (2004). "Plant Resources at Ojiyana, Rajasthan". *National Seminar on the Archaeology of the Ganges Plain, Joint Annual Conference of the Indian Archaeological Society, Indian Society of Prehistoric and Quaternary Studies, Indian History and Culture Society* (Lucknow, 28 December 2004).

Postgate, J. (1998). *Nitrogen Fixation*. Cambridge: Cambridge University Press.

Pryce, T.O. et al. (2018). "A First Absolute Chronology for Late Neolithic to Early Bronze Age Myanmar: New AMS14C Dates from Nyaung'gan and Oakaie". *Antiquity*, 92(363), 690-708. https://doi.org/10.15184/aqy.2018.66

Pryce, T.O. et al. (2021). "Copper-Base Metal Supply during the Northern Vietnamese Bronze and Iron Ages: Metallographic, Elemental, and Lead Isotope Data from Dai Trach, Thành Dên, Gò Mun, and Xuân Lâp". *Archaeological and Anthropological Sciences*, 14, 16. https://doi.org/10.1007/s12520-021-01489-9

Pryce, T.O. et al. (2022). "A Late 2nd/early 1st Millennium BC Interaction arc between Mainland Southeast Asia and Southwest China: Archaeometallurgical Data from Hebosuo and Shangxihe, Yunnan". *Journal of Archaeological Science*, 143, 105612. https://doi.org/10.1016/j.jas.2022.105612

Pryce, T.O. et al. (2023). "A Partial Prehistory of the Southwest Silk Road: Archaeometallurgical Networks Along the Sub-Himalayan Corridor". *Cambridge Archaeological Journal*, 34(2), 173-212. https://doi.org/10.1017/s0959774323000185

Pryce, T.O. et al. (2024). "Late Prehistoric and Early Historic Chronology of Myanmar: A Four-Millennia Sequence from Halin". *Antiquity*, 98(397), 30-47. https://doi.org/10.15184/aqy.2023.190

Purugganan, M.D. (2019). "Evolutionary Insights into the Nature of Plant Domestication". *Current Biology,* 29(14), R705-R714. https://doi.org/10.1016/j.cub.2019.05.053

Purugganan, M.D. (2022). "What is Domestication?" *Trends in Ecology & Evolution*, 37(8), 663-71. https://doi.org/10.1016/j.tree.2022.04.006

Purugganan, M.D.; Fuller, D.Q. (2009)."The Nature of Selection during Plant Domestication". *Nature*, 457, 843-8. https://doi.org/10.1038/nature07895

Purugganan, M.D.; Fuller, D.Q. (2011). "Archaeological Data Reveal Slow Rates of Evolution During Plant Domestication". *Evolution*, 65, 171-83. https://pubmed.ncbi.nlm.nih.gov/20666839/

Qi Bao 齐宝; Dong Wenliang 董文良 (2006). "Kaogu Faxian: Yunnan Lincang Faxian Jiushiqi Shidai Zaoqi Yizhi 考古发现：云南临沧发现旧石器时代早期遗址 (Archaeological discoveries: Early Palaeolithic sites discovered in Lincang, Yunnan)". Zhongguo Minzu Nianjian Bianjibu 中国民族年鉴编辑部(Editorial committee for the China's Etchinc Yearbook) (ed.), *Zhongguo Minzu Nianjian* 中国民族年鉴 (China's Ethnic Yearbook). Beijing: Central University for Ethnicities, 250.

Qi Wuyun 齐乌云 et al. (2017). "Shandong Shuhe Shangyou Shiqian Yizhi de Zhiwu Yicun Fuxuan Fenxi 山东沭河上游史前遗址的植物遗存浮选分析 (Flotation analysis of plant remains from prehistoric sites in the upper reaches of the Shuhe River in Shandong)". *Agricultural Archeology*, 1, 7-12.

Qin, L.; Fuller, D.Q. (2019). "Why Rice Farmers Don't Sail: Coastal Subsistence Traditions and Maritime Trends in Early China". Wu, C.; Rolett, B.V. (eds), *Prehistoric Maritime Culture and Seafaring of East Asia: A Multidisciplinary Recognition of the Origin of Maritime Silk Road.* Singapore: Springer.

Qin Ling 秦岭 (2012). "Zhongguo Nongye Qiyuan de Zhiwu Kaogu Yanjiu yu Zhanwang 中国农业起源的植物考古研究与展望 (Archaeobotanical research and prospects on the origins of agriculture in China)". School of Archaeology and Museology of Peking University (ed.) *Kaoguxue Yanjiu: Qingzhu Yan Wenming Xiansheng Bashi Shouchen Lunwen* Ji 考古学研究：庆祝严文明先生八十寿辰论文集 (Archaeological Research (Vol. 9): Celebrating 80th Anniversary of Yan Wenming). Beijing: Cultural Relics Press, 260-315.

Qin Ling; Fuller, D.Q. (2009). "Nanjiaokou Yizhi 2007 Nian Chutu Yangshao Wenhua, Zao, Zhongqi Zhiwu Yicun ji Xianguang Wenti Tantao 南交口遗址 2007 年出土仰韶文化早、中期植物遗存及相关问题探讨 (Discussion on plant remains of the early and middle Yangshao Period from Nanjiaokou Site, Henan Province and related topics)". *Henan sheng Wenwu Kaogu Yanjiusuo* 河南省文物考古研究所 (Henan Provincial Institute of Archaeology and Cultural Relics) (ed.), *Sanmenxia Nanjiaokou* 三门峡南郊口 (The site of Nanjiaokou in Sanmenxia). Beijing: Science Press, 427-35.

Qiu, Z. et al. (2014). "Paleo-Environment and Paleo-Diet Inferred from Early Bronze Age Cow Dung at Xiaohe Cemetery, Xinjiang, NW China". *Quaternary International*, 349, 167-77. https://doi.org/10.1016/j.quaint.2014.03.029

Qiu, Z. et al. (2019). "New Evidence for Rice Cultivation from the Early Neolithic Hehuashan site". *Archaeological and Anthropological Sciences,* 11, 1259-72. https://doi.org/10.1007/s12520-018-0602-1

Qiu, Z. et al. (2022). "Excavation at Hanjing Site Yields Evidence of Early Rice Cultivation in the Huai River more than 8000 years ago". *Science China Earth Sciences,* 65(5), 910-20. https://doi.org/10.1007/s11430-021-9885-x

Qiu Zhenwei 邱振威 et al. (2023). "Hebei Kangbao Xian Xinglong Yizhi 2018 ~ 2019 Nian Zhiwu Yicun Fuxuan Jieguo ji Fenxi 河北康保县兴隆遗址 2018-2019 年植物遗存浮选结果及分析 (Flotation results and analysis of plant remains excavated during the 2018-2019 in the Xinglong site, Kangbao County, Hebei Province)". *Kaogu*, 1, 106-20.

Qiu Zhonglang 邱中郎; Zhang Henyun 张银运; Hu Shaojuan 胡绍锦 (1985). "Kunming Chenggongxian Longtanshan Dier Didian de Renhuashi he Jiushiqi 昆明呈贡龙潭山第2地点的人化石和旧石 (Human tooth and paleoliths found at locality 2 of Longtanshan, Chenggong, Kunming)". *Acta Anthropologica Sinica*, 3, 233-41, 292.

Rackham, H. (transl.) (1938-63). *"Pliny the Elder". Naturalis Historia* (Natural History). Vols 1-10. Cambridge (MA): Harvard University Press.

Rahman, M. et al. (2020). "Agricultural Systems in Bangladesh: the First Archaeobotanical Results from Early Historic Wari-Bateshwar and Early Medieval Vikrampura". *Archaeological and Anthropological Sciences*, 12, 37. https://doi.org/10.1007/s12520-019-00991-5

Ramiah, K. (1937). *Rice in Madras*. Madras: Madras Government Press.

Reid, L.A. (1994). "Morphological Evidence for Austric". *Oceanic Linguistics*, 33(2), 323. https://doi.org/10.2307/3623132

Reid, L.A. (1996). "The Current State of Linguistic Research on the Relatedness of the Language Families of East and Southeast Asia". *Bulletin of the Indo-Pacific Prehistory Association*, 15-87. https://doi.org/10.7152/bippa.v15i0.11536
Reid, L.A. (1999). "New Linguistic Evidence for the Austric GHypothesis". Ross, M.D.; Zeitoun, E.; Li, P.J. (eds), *Selected Papers from the Eighth International Conference on Austronesian Linguistics*. Taipei: Academia Sinica.
Ren, L.L. et al. (2017). "Human Paleodiet and Animal Utilization Strategies During the Bronze Age in Northwest Yunnan Province, Southwest China". *PLoS ONE*, 12(5), e0177867. https://doi.org/10.1371/journal.pone.0177867
Ren, X. et al. (2013). "Tibet as a Potential Domestication Center of Cultivated Barley of China". *PLoS ONE*, 8(5), e62700. https://doi.org/10.1371/journal.pone.0062700
Renfrew, C. (1992). "Archaeology, Genetics and Linguistic Diversity". *Man*, 27(3), 445. https://doi.org/10.2307/2803924
Renfrew, C. (1996). "Language Families and the Spread of Farming". Harris, D. (ed.), *The Origins and Spread of Agriculture and Pastoralism in Eurasia*. London: University College Press, 70-92.
Renfrew, J. (1973). *Palaeoethnobotany. The Prehistoric Food Plants of the Near East and Europe.* London: Methuen & Co.
Rindos, D. (1980). "Symbiosis, Instability, and the Origins and Spread of Agriculture: A New Model". *Current Anthropology*, 21(6), 751-72. https://doi.org/10.1086/202569
Rindos, D. (1984). *The Origins of Agriculture: An Evolutionary Perspective*. New York: Academic Press.
Risi, J.C.; Galwey, N.W. (1984). "The *Chenopodium* Grains of the Andes: Inca Crops for Modern Agriculture". *Advances in Applied Biology*, 10, 145-95.
Rispoli, F. (2007). "The Incised and Impressed Pottery Style of Mainland Southeast Asia: Following the Paths of Neolithization". *East and West*, 57(1/4), 235-304. http://www.jstor.org/stable/29757730
Rispoli, F.; Ciarla, R.; Pigott, V.C. (2013). "Establishing the Prehistoric Cultural Sequence for the Lopburi Region, Central Thailand". *Journal of World Prehistory*, 26, 101-71. https://doi.org/10.1007/s10963-013-9064-7
Ritchey, M.M. et al. (2021). "The Wind that Shakes the Barley: The Role of East Asian Cuisines on Barley Grain Size". *World Archaeology*, 53(2), 287-304. https://doi.org/10.1080/00438243.2022.2030792
Robbeets, M. et al. (2021). "Triangulation Supports Agricultural Spread of the Transeurasian Languages". *Nature*, 599, 616-21. https://doi.org/10.4324/9781003243809-5
Rozheviz, R.J. (1931). "K poznaniyu risa: kritiko-botanicheskiy obzor vidov risa К познанию риса: критико-ботанический обзор видов риса (A contribution to the knowledge of rice: critical botanical review of rice species)". *Труды по прикладной ботанике, генетике и селекции* (Bulletin of Applied Botany, Genetics and Plant Breeding), 27(4), 11-33.
Rodden, J. (1981). "The Development of the Three Age System: Archaeology's First Paradigm". Glynn, D. (ed.), *Towards a History of Archaeology. Being the Papers Read at the First Conference on the History of Archaeology* (Aarhus, 20 August-2 September 1978). London: Thames & Hudson, 51-68.
Rojas-Sandoval, J.; Acevedo-Rodríguez, P. (2018). "*Echinochloa crus-galli* (Barnyard Grass)". *Invasive Species Compendium*. CABI. https://www.cabi.org/isc/datasheet/20367
Rosen, A.M. (1999). "Phytolith Analysis in Near Eastern Archaeology." Pike, S.; Gitin, S. (eds), *The Practical Impact of Science on Near Eastern and Aegean Archaeology. Wiener Laboratory Publication Number Three.* London: Archetype Publications, 9-15.
Rösch, M. (1998). "The History of Crops and Crop Weeds in South-Western Germany from the Neolithic Period to Modern Times, as Shown by Archaeobotanical Evidence". *Vegetation History and Archaeobotany*, 7(2), 109-25. https://doi.org/10.1007/bf01373928
Rouse, L.M.; Cerasetti, B. (2018). "Mixing Metaphors: Sedentary-Mobile Interactions and Local-Global Connections in Prehistoric Turkmenistan". *Antiquity,* 92(363), 674-89. https://doi.org/10.15184/aqy.2018.88
Rowlands, M.; Fuller, D.Q.; Benguigui, M. (transl.) (2009). "Moudre ou faire bouillir? Nourrir les Corps et les Esprits dans les Traditions Culinaires et Sacrificielles en Asie de l'Ouest, de l'Est et du Sud (To grind or to boil? Nourishing bodies and spirits in the divergent traditions of food and sacrifice in West, East, and South Asia)". *Techniques & Culture*, 52-3, 120-47. https://doi.org/10.4000/tc.4855

Ruan Qijuan 阮齐军 (2021). “Yunnan Lancang Jiang Xiayou Diqu Jiu-Xin Guodu Jieduan Shiqi Gongye Chubu Yanjiu 云南澜沧江下游地区旧 – 新过渡阶段石器工业初步研究 (Preliminary Study of the Lithic Industry during the Paleolithic-Neolithic Transitional Period in the Lower Valley of Lancang River, Yunnan Province)”. *Sichuan Wenwu*, 6, 34-42.

Sagart, L. (2008). “The Expansion of *Setaria* Farmers in East Asia: A Linguistic and Archaeological Model”. Sanchez-Mazas, A. et al. (eds), *Past Human Migrations in East Asia: Matching Archaeology, Linguistics and Genetics*. London and New York: Routledge, 133-57.

Sagart, L. (2011a). “How Many Independent Rice Vocabularies in Asia?”. *Rice*, 4(3-4), 121-33. https://doi.org/10.1007/s12284-011-9077-8

Sagart, L. (2011b). “The Austroasiatics: East to West or West to East?”. Enfield, N.J. (ed.), *Dynamics of Human Diversity in Mainland Southeast Asia.* Canberra: Pacific Linguistics, 345-60.

Sagart, L. (2022). “Language Families of Southeast Asia”. Higham, C.F.W.; Kim, N.C. (eds), *The Oxford Handbook of Southeast Asian Archaeology*. Oxford: Oxford University Press, 321-38.

Sagart, L. et al. (2019). “Dated Language Phylogenies Shed Light on the Ancestry of Sino-Tibetan”. *Proceedings of the National Academy of Sciences (PNAS*), 116(21), 10317-22. https://doi.org/10.1073/pnas.1817972116

Sakamoto, S. (1987). “Origin and Dispersal of Common Millet and Foxtail Millet”. *Japan Agricultural Research Quarterly,* 21(2), 84-9.

Saraswat, K.S. (1980). “The Ancient Remains of the Crop Plants at Atranjikhera (c. 2000-1500 BC)”. *Journal of the Indian Botanical Society,* 59, 306-19.

Saraswat, K.S. (1986). “Ancient Crop Plant Remains from Sringaverapura, Allahabad, U.P. (ca. 1,050-700 BC)”. *Geophytology*, 16(1), 97-106.

Saraswat, K.S. (1988). “Pre-Harappan Crop Economy at Ancient Rohira, Punjab (c. 2300-2000 BC)”. Ramachandran, K.S. (ed.), *Studies in Indian History and Culture*. New Delhi: Navchetna Press, 221-40.

Saraswat, K.S. (2002). “Banawali, District Hissar”. *Indian Archaeology 1996-1997 - A Review,* 203.

Saraswat, K.S. (2002). “Balu (29°40’N; 76°22’E), District Kaithal”. *Indian Archaeology 1996-97-A Review,* 198-203.

Saraswat, K.S. (1993a) “Seed and Fruit Remains at Ancient Imlidh-Khurd, Gorakhpur: A Preliminary Report”. *Pragdhara*, 3, 37-41.

Saraswat, K.S. (1993b). “Plant Economy of Late Harappans at Hulas”. *Purattatva*, 23, 1-12.

Saraswat, K.S. (1997). “Plant Economy of Barans at Ancient Sanghol (Ca. 1900-1400 B.C.), Punjab”. *Pragdhara*, 7, 97-114.

Saraswat, K.S. (2004a). *Plant Economy of Early Farming Communities. Early Farming Communities of the Kaimur (Excavations at Senuwar).* Jaipur: Publication Scheme, 416535.

Saraswat, K.S. (2004b). “Plant Economy at Mesolithic Damdama, Pratapgarh Distirct, Abstracts, U.P”. *National Seminar on the Archaeology of the Gange Plain, Joint Annual Conference of the Indian Archaeological Society, Indian Society of Prehistoric and Quaternary Studies, Indian History and Culture Society* (Uttar Pradesh Department of Archaeology, Lucknow, 28 December 2004).

Saraswat, K.S. (2005). “Agricultural Background of the Early Farming Communities in the Middle Ganga Plain”. *Pragdhara*, 15, 145-77.

Saraswat, K.S.; Pokharia, A.K. (2003). “Palaeoethnobotanical investigations at Early Harappan Kunal”. *Pragdhara*, 13, 105-40.

Sarjeant, C. (2014). “Mental Templates and Ceramic Manufacture at Neolithic An Son, Southern Vietnam”. *Cambridge Archaeological Journal*, 24(2), 269-88. https://doi.org/10.1017/s0959774314000468

Saseendran, S.A. et al. (2009). “Modeling Responses of Dryland Spring Triticale, Proso Millet and Foxtail Millet to Initial Soil Water in the High Plains”. *Field Crops Research,* 113(1), 48-63. https://doi.org/10.1016/j.fcr.2009.04.008

Sataev, R.; Sataeva, L. (2014). “Results of Archaeozoological and Archaeobotanical Research at the Bronze Age Gonur Depe site (Turkmenistan)”. Bieliński, P.M. et al. (eds), *Proceedings of the 8th International Congress on the Archaeology of the Ancient Near East. ICAANE 8.* Wiesbaden: Harrassowitz Verlag, 367-70.

Schmidt, P.W. (1906). “Die Mon-Khmer-Völker: ein Bindeglied zwischen Völkern Zentralasiens und Austronesiens”. *Archiv für Anthropologie*, 5, 59-109.

Schoeninger, M.J. (2014). “Stable Isotope Analyses and the Evolution of Human Diets”. *Annual Review of Anthropology*, 43(1), 413-30. https://doi.org/10.1146/annurev-anthro-102313-025935

SCIO, The State Council Information Office of The People’s Republic of China (2024). “Southwest China’s Yunnan Sees Tourism Boom in Q1”. http://english.scio.gov.cn/m/pressroom/2024-04/22/content_117141753.htm

Shaller, G.B. (1967). *The Deer and the Tiger. A Study of Wildlife in India*. Chicago: University of Chicago Press.

Shandong Sheng Wenwu Kaogu Yanjiu Suo 山东省文物考古研究所 et al. (1984). “Shandong Qixia Yangjiaquan Yizhi Fajue Jianbao 山东栖霞杨家圈遗址发掘简报 (Preliminary excavation report on the site of Yangjiaquan in Qixia, Shandong)”. *Shiqian Yanjiu*, 3, 91-4, 98, 118.

Shang Xue 尚雪 et al. (2012). “Shaanxi Xiahe Yizhi Xinshiqi Shidai de Zaoqi Nongye Huodong Chutan 陕西下河址新石器时代的早期农业活动初探 (Agricultural activities at the Early Neolithic site of Xiaohe, Shaanxi)”. *Kaogu yu Wenwu*, 4, 55-9, 103.

Shatilo, L. (2021). *Tripolye Typo-Chronology. Mega and Smaller Sites in the Sinyukha River Basin.* Leiden: Sidestone Press. Scales of Transformation 12.

Shelach-Lavi, G. (2015). *The Archaeology of Early China. From Prehistory to the Han dynasty.* Cambridge: Cambridge University Press.

Shelach-Lavi, G. et al. (2019). “Sedentism and Plant Cultivation in nNortheast China Emerged During Affluent Conditions”. *PLoS ONE* 14(7), e0218751. https://doi.org/10.1371/journal.pone.0218751

Shelach-Lavi, G.; Teng, M. (2013). “Earlier Neolithic Economic and Social Systems of the Liao River Region, Northeast China”. Underhill, A. (ed.), *A Companion to Chinese Archaeology*. Oxford: Blackwell, 37-54.

Shen, J. et al. (2005). “Lake Sediment Records on Climate Change and Human Activities since the Holocene in Erhai Catchment, Yunnan Province, China”. *Science in China Series D: Earth Sciences*, 48(3), 353-63. https://doi.org/10.1360/03yd0118

Shen, J. et al. (2006). “The Holocene Vegetation History of Lake Erhai, Yunnan province Southwestern China: The Role of Climate and Human Forcings”. *The Holocene*, 16(2), 265-76. https://doi.org/10.1191/0959683606hl923rp

Sheng, P. et al. (2019). “Archaeobotanical Evidence of Hazelnut (Corylus heterophylla, Betulaceae) Exploitation in the Neolithic Northern China”. S*AGE Open,* 9(2). https://doi.org/10.1177/2158244019858437

Sheng, P.F.; Allen, E.; Wang, T.Z. (2023-24). “Diversity of Late Yangshao Agricultural Intensification at Xishanping, Gansu”. *Research Square*. https://doi.org/10.21203/rs.3.rs-3416446/v1

Shi, S. et al. (2013). “Phylogeny and Classification of *Prunus* sensu lato (Rosaceae)”. *Journal of Integrative Plant Biology*, 55(11), 1069-79. https://doi.org/10.1111/jipb.12095

Shi Tao 石涛; Jiang Ming 姜铭; Xie Lin 谢林 (2020). “Chengdu Shi Xinjin Xian Huayuan Cun Lianhe Gongshe Shizu Tielu Yizhi Chutu Zhiwu Yicun Fenxi 成都市新津县花源镇联合公社十组铁路遗址出土植物遗存分析 (Analysis of plant remains unearthed from ten groups of railway sites in Lianhe Commune, Huayuan Town, Xinjin County, Chengdu City)”. Sichuan Daxue Bowuguan; Sichuan Daxue Kaogu Xi; Chengdu Wenwu Kaogu Yanjiusuo 四川大学博物馆、四川大学考古学系、成都文物考古研究院编著 (eds), *Nanfang Minzu Kaogu* 南方民族考古. Beijing: Science Press, 364-74.

Shimamoto, Y. et al. (2000). “Characterizing the Cytoplasmic Diversity and Phyletic Relationship of Chinese Landraces of Soybean, *Glycine max*, Based on RFLPs of Chloroplast and Mitochondrial DANN”. *Genetic Resources and Crop Evolution*, 47(6), 611-17. https://doi.org/10.1023/A:1026538907387

Shinde, V.; Osada, T.; Humar, M. (eds) (2011). *Excavations at Farmana, District Rohtak, Haryana, India 2006-2008.* Kyoto: Indus Project, Research Institute for Humanity and Nature Publications.

Shirazaka, S. (1995). “Changing Slash-and-Burn Cultivation in Xishuangbanna, Southwestern China”. *Geographical Review of Japan*, 68(2), 107-18. https://doi.org/10.4157/grj1984b.68.107

Shoocongdej, R. (2022). “The Hoabinhian: The Late and Post-Pleistocene Cultural Systems of Southeast Asia”. Higham, C.F.W.; Kim, N.C. (eds), *The Oxford Handbook of Early Southeast Asia*. Oxford: Oxford University Press, 149-81.

Sidwell, P.; Blench, R. (2011). “The Austroasiatic Urheimat: The Southeastern Riverine Hypothesis”. Enfield, N.J. (ed.), *Dynamics of Human Diversity: The Case of Mainland Southeast Asia*. Canberra: Pacific Linguistics, 317-45.

Silva, F. et al. (2015). “Modelling the Geographical Origin of Rice Cultivation in Asia Using the Rice Archaeological Database”. *PLoS ONE,* 10(9), e0137024. https://doi.org/10.1371/journal.pone.0137024

Simmons, F. (1990). *Food in China: A Cultural and Historical Inquiry*. Boca Raton: CRC Press.

Simoons, F.J.; Simoons, E.S. (1968). *Ceremonial Ox of India; the Mithan in Nature, Culture, and History, with Notes on the Domestication of Common Cattle.* Austin: Texas University Press.

Singh, H.; Thomas, T.A. (1978). *Grain Amaranthus, Buckwheat and Chenopods*. New Delhi: Indian Council of Agricultural Research.

Small, E. (2017). “54. Buckwheat – The World’s Most Biodiversity-Friendly Crop?”. *Biodiversity*, 18(2-3), 108-23. http://dx.doi.org/10.1080/14888386.2017.1332529

Smartt, J.; Simmonds, N.W. (1995). *Evolution of Crop Plants*. 2nd ed. London: Longmans.

Smith, B.D. (1992). “The Floodplain Weed Theory of Plant Domestication in Eastern North America”. Smith, B.D. (ed.), *Rivers of Change*. Washington, D.C: Smithsonian Institute Press, 19-34.

Smith, D.H. (1957). “Divine Kingship in Ancient China”. *Numen*, 4(3), 171. https://doi.org/10.2307/3269343

Snir, A. et al. (2015). “The Origin of Cultivation and Proto-Weeds, Long Before Neolithic Farming”. *PLoS ONE*, 10, e0131422. https://doi.org/10.1371/journal.pone.0131422

Song, J.X. (2011). *The Agricultural Economy during the Longshan Period: An Archaeobotanical Perspective from Shandong and Shanxi* [PhD dissertation]. London: University College London.

Song, J.X. et al. (2021). “Farming and Multi-Resource Subsistence in the Third and Second Millennium BC: Archaeobotanical Evidence from Karuo”. *Archaeological and Anthropological Sciences*, 13(3). https://doi.org/10.1007/s12520-021-01281-9

Song, J.X.; Wang, L.; Fuller, D.Q. (2019). “A Regional Case in the Development of Agriculture and Crop Processing in Northern China from the Neolithic to Bronze Age: Archaeobotanical Evidence from the Sushui River survey, Shanxi province”. *Archaeological and Anthropological Sciences*, 11, 667-82. https://doi.org/10.1007/s12520-017-0551-0

Song Jixiang 宋吉香; Zhou Mao 周懋; Lu Hongliang 吕红亮 (2022). “Changguogou Yizhi 2015 Nian Diaocha Fuxuan Jieguo Fenxi 昌果沟遗址2015年调查浮选结果分析 (Analysis of flotation results of the Changguogou site in 2015)”. *Xizang Daxue Xuebao*, 37(4), 38-43, 51.

Song, J.X. et al. (2017). “Archaeobotanical Remains from the Mid-First Millennium AD Site of Kaerdong in Western Tibet”. *Archaeological and Anthropological Sciences,* 10, 2015-26. https://doi.org/10.1007/s12520-017-0521-6

Sood, S. et al. (2015). “Barnyard Millet–A Potential Food and Feed Crop of Future”. *Plant breeding*, 134(2), 135-47. https://doi.org/10.1111/pbr.12243

Sopher, D.E. (1964). “Indigenous Uses of Turmeric (*Curcuma domestica*) in Asia and Oceania”. *Anthropos*, (H. 1./2), 93-127.

Spate, M. et al. (2017). “New Evidence for Early 4th Millennium BP Agriculture in the Western Himalayas: Qasim Bagh, Kashmir”. *Journal of Archaeological Science: Reports*, 11, 568-77. https://doi.org/10.1016/j.jasrep.2016.12.038

Spengler, R.N. (2015). “Agriculture in the Central Asian Bronze Age”. *Journal of World Prehistory,* 28(3), 215-53. https://doi.org/10.1007/s10963-015-9087-3

Spengler, R.N. III et al. (2014). “Agriculturalists and Pastoralists: Bronze Age Economy of the Murghab Alluvial Fan, Southern Central Asia”. *Vegetation History and Archaeobotany*, 23(6), 805-20. https://doi.org/10.1007/s00334-014-0448-0

Spengler, R.N. III et al. (2018). “The Breadth of Dietary Economy in Bronze Age Central Asia: Case Study from Adji Kui 1 in the Murghab Region of Turkmenistan”. *Journal of Archaeological Science: Reports*, 22, 372-81. https://doi.org/10.1016/j.jasrep.2016.03.029

Spengler, R.N. III et al. (2021). “An Imagined Past? Nomadic Narratives in Central Asian Archaeology”. *Current Anthropology*, 62(3), 251-86. https://doi.org/10.1086/714245

Spengler, R.N. III; Frachetti, M.D.; Doumani, P.N. (2014). “Late Bronze Age Agriculture at Tasbas in the Dzhungar Mountains of Eastern Kazakhstan”. *Quaternary International*, 348, 147-57. https://doi.org/10.1016/j.quaint.2014.03.039

Spengler, R.N. III; Willcox, G. (2013). “Archaeobotanical Results from Sarazm, Tajikistan, an Early Bronze Age Settlement on the Edge: Agriculture and Exchange”. *Environmental Archaeology*, 18(3), 211-21. https://doi.org/10.1179/1749631413y.0000000008

Sterckx, R. (2018). “Food and Agriculture”. Goldin, P.R. (ed.), *Routledge Handbook of Early Chinese History*. New York: Routledge, 300-18.

Stevens, C.J. et al. (2016). “Between China and South Asia: A Middle Asian corridor of crop dispersal and agricultural innovation in the Bronze Age”. *The Holocene*, 26(10), 1541-55. https://doi.org/10.1177/0959683616650268

Stevens, C.J. et al. (2020). “A Model for the Domestication of *Panicum miliaceum* (Common, Proso or Broomcorn Millet) in China”. *Vegetation History and Archaeobotany,* 30(1), 21-33. https://doi.org/10.1007/s00334-020-00804-z

Stevens, C.J.; Fuller, D.Q. (2017). “The Spread of Agriculture in Eastern Asia: Archaeological Bases for Hypothetical farmer/Language Dispersals”. *Language Dynamics and Change*, 7(2), 152-86. https://doi.org/10.1163/22105832-00702001

Stevens, C.J.; Fuller, D.Q. (2024). “Can or Did Domestication Occur Without Regular Tillage?”. https://hal.science/hal-04482932v2

Stevens, C.J.; Zhuang, Y.; Fuller, D.Q. (2024). “Millets, Dogs, Pigs and Permanent Settlement: Productivity Transitions in Neolithic Northern China”. *Evolutionary Human Sciences*, 6. https://doi.org/10.1017/ehs.2024.31

Stewart, R.B.; Robertson, W.I.V. (1973). “Application of Flotation Technique in Arid Areas”. *Economic Botany,* 27, 114-16. https://doi.org/10.1007/bf02862223

Streuver, S. (1968). “Flotation Techniques for the Recovery of Small-Scale Archaeological Remains”. *American Antiquity,* 3, 353-62. https://doi.org/10.2307/278703

Su, C.-F. et al. (2010). “A Novel MYBS3-Dependent Pathway Confers Cold Tolerance in Rice” . *Plant Physiology*, 153(1), 145-58. https://doi.org/10.1104/pp.110.153015

Su, T. et al. (2015). “Peaches Preceded Humans: Fossil Evidence from SW China”. *Scientific Reports*, 5(1). https://doi.org/10.1038/srep16794

Sun Binggui 孙炳桂 et al. (2022). “Huanghuai Xibu Yangshao Shidai Nongye Jiegou Yanjiu – Laizi Henan Shigu he Jiazhuang Yizhi de Zhiguiti Zhengju 黄淮西部仰韶时代农业结构研究 – 来自河南石固和贾庄遗址的植硅体证据 (Prehistoric agriculture and its development during the period of Yangshao culture in the western huanghuai plain: phytolith evidence from the sites of Shigu and Jiazhuang, Henan)”. *Weitigu Shengwu Xuebao*, 39(3), 263-75.

Sun Dehai 孙德海; Liu Yong 刘勇; Chen Guangtang 陈光唐 (1981). “Hebei Wu’an Cishan Yizhi 河北武安磁山遗址 (The Cishan site in Wu’An, Hebei province)”. *Acta Archaeologica Sinica*, 3, 303-38, 407-14.

Sun, G.P. (2013). “Recent Research on the Hemudu Culture and the Tianluoshan Site”. Underhill, A. (ed.), *A Companion to Chinese Archaeology*. Oxford: WileyBlackwell, 555-73.

Sun Hua 孙华 (2008). “Qingzang Gaoyuan de Dongyuan Guzu Nanqian de Zoulang – Guanyu Suowei Nanfang Sichou Zhilu de Jige Wenti 青藏高原的东缘 古族南迁的走廊 – 关于所谓“南方丝绸之路”几个问题 (Some questions about the so-called Southern Silk Road- The eastern rim of the Qinhai Tibetan Plateau, a corridor for the southern dispersal of ancient populations)”. *Zhonghua Wenhua Luntan*, 2, 67-73.

Sun, T.C.; Xiong, X. (1983). “Chronology”. Rawson, J. (ed.), *The Chinese Bronzes of Yunnan*. London: Sidgwick and Jackson in association with Beijing: The Cultural Relics Publishing House, 243-52.

Sun Taichu 孙太初 (1956). “Yunnan Jinning Shizhaishan Guyizhi ji Muzang 云南晋宁石寨山古遗址及墓葬 (Ancient Shizhaishan site and cemetery in Jinning, Yunnan)”. *Kaogu Xuebao*, 1, 43-63, 146-55.

Sun, X.J. et al. (1986). “Late Pleistocene and Holocene Vegetation History at Kunming, Yunnan Province, Southwest China”. *Journal of Biogeography*, 13(5), 441. https://doi.org/10.2307/2844967

Sun Yonggang (2016). “Dama Zaipei Qiyuan yu Liyong Fangshi de Kaoguxue Tansuo 大麻栽培起源与利用方式的考古学探索 (Archaeological exploration of the origin and utilization of cannabis cultivation)”. *Nongye Kaogu*, 143(1), 16-20.

Sun Yonggang 孙永刚 (2021). *Liaoxi Diqu Xinshiqi Shidai Zhiwu Kaogu Yanjiu* 辽西地区新石器时代植物考古研究 (Research on the Neolithic Botanical Archeology in Western Liaoning Province). Shanghai: Shanghai Ancient Books Publishing House.

Sun Yonggang; Zhao Zhijun 赵志军; Ji Ping 吉平 (2016). "Hamin Mangha Shiqian Juluo Yizhi Chutu Zhiwu Yicun Yanjiu 哈民忙哈史前聚落遗址出土植物遗存研究 (The study on the plant remains from flotation of Hamin Mangha site)". *Huaxia Kaogu*, 2, 45-52.

Sun, Z.Y.; Hein, A. (forthcoming). "The Development and Working Practice of Local-Level Chinese Archaeological Institutions". Hein, A.; Lovell, J. (eds), *Oxford Handbook on the History and Practice of Chinese Archaeology*. Oxford: Oxford University Press.

Suzhou Shi Kaogu Yanjiusuo 苏州市考古研究所 (ed.) (2011). *Kunshan Chuodun Yizhi* 昆山绰墩遗址 (The site of Chuodun in Kunshan). Beijing: Cultural Relics Press.

Suzhou Shi Kaogu Yanjiusuo (ed.) (2012). "Kunshan Chuodun Yizhi 昆山绰墩遗址 (The site of Chuodun in Kunshan)". *Wenwu*, 3, 58.

Takahashi, Y. et al. (2023). "Domestication of Azuki Bean and Soybean in Japan: From the Insight of Archeological and Molecular Evidence". *Breeding Science*, 73(2), 117. `https://doi.org/10.1270/jsbbs.22074`

Takase, K. (2010). *Prehistoric and Protohistoric Plant Use in the Japanese Archipelago*. Tokyo: Meiji University Premodern Japan Research Exchange.

Tanaka, K. et al. (2016). "Seed Size and Chloroplast DNA of Modern and Ancient Seeds Explain the Establishment of Japanese Cultivated Melon (*Cucumis melo* L.) by Introduction and Selection". *Genetic Resources and Crop Evolution*, 63, 1237-54. `https://doi.org/10.1007/s10722-015-0314-7`

Tang, C.Q. (2015). *The Subtropical Vegetation of Southwestern China: Plant Distribution, Diversity and Ecology*. Plant and Vegetation: Springer Netherlands.

Tang, L. et al. (2019). "New Discovery of Plant Remains in The West of Tibet". Abstracts of The 84th Annual Meeting of the Society for American Archaeology. Albuquerque, New Mexico.

Tang, L. et al. (2021). "The Transition to a Barley-Dominant Cultivation System in Tibet: First Millennium BC Archaeobotanical Evidence from Bangga". *Journal of Anthropological Archaeology*, 61, 101242. `https://doi.org/10.1016/j.jaa.2020.101242`

Tang, L. et al. (2022). "Prehistoric Agricultural Decision Making in the Western Himalayas: Ecological and Social Variables". *Antiquity*, 96(389), 1214-31. `https://doi.org/10.15184/aqy.2022.80`

Tang Liya 唐丽雅 (2014). *Jianghan Diqu Xinshiqi Shidai Wanqi zhi Qingtong Shidai Nongye Shengchan Dongtai de Zhiwu Kaoguxue Guangcha* 江汉地区新石器时代晚期至青铜时代农业生产动态的植物考古学观察 (Botanical archaeological observation of agricultural production dynamics from the late Neolithic Age to the Bronze Age in the Jianghan area) [PhD dissertation] Beijing: Chinese Academy of Social Sciences.

Tang Liya et al. (2020). "Nongzuowu Chuanbo Yanjiu: Yi Shaanxi Hanzhong Longgangsi Yizhi Xinshiqi Shidai Tanhua Zhiwu Yicun wie Lie 农作物传播研究:以陕西汉中龙岗寺遗址新石器时代炭化植物遗存为例 (The dispersals of crops: A study on the remains of carbonized plants in the Neolithic age at Longgangsi site in Hanzhong, Shaanxi Province)". *Quaternary Sciences*, 40(2), 512-24. `http://www.dsjyj.com.cn/article/doi/10.11928/j.issn.1001-7410.2020.02.20`

Tang Liya et al. (2021). "Hubei Shishou Zoumaling Yizhi Shiqian Zhiwu Yicun Jianding yu Yanjiu 湖北石首走马岭遗址史前植物遗存鉴定与研究 (Identification and research on prehistoric plant remains at Zomaling site in Shishou, Hubei)". *Jianghan Kaogu*, 174(03), 109-15.

Tang Liya et al. (2022). "Qingtong Shidai Zhongyuan Diqu Nongye Tedian zai Sikao-Yixinzheng Wangjinglou he Xingyang Chezhuang Yizhi wei Lie 青铜时代中原地区农业特点再思考 – 以新郑望京楼和荥阳车庄遗址为例 (Rethinking the characteristics of the Bronze age agriculture in the Central Plain, China: two cases from the sites of Wangjinglou,in Xinzheng and Chezhuang, in Xingyang)". *Zhongguo Nongshi*, 41(5), 39-51.

Tang, L.Y. et al. (2024). "Deciphering Domestication: Unique Soybean Pods at Wangjinglou". PREPRINT (Version 1) available at Research Square `https://doi.org/10.21203/rs.3.rs-4571188/v1`

Tang, L.Y. et al. (2025). "Early Evidence of Naked Barley in Western Tibet: Cereal Cultivation at Extreme Altitude along the Upper Sutlej River, c. 3500 BP". *Antiquity*, 99(404), 392-406. `https://doi.org/10.15184/aqy.2024.227`

Tang, Y.; Marston, J.M.; Fang, X. (2022). "Early Millet Cultivation, Subsistence Diversity, and Wild Plant Use at Neolithic Anle, Lower Yangtze, China". *The Holocene*, 32(10), 1003-14. `https://doi.org/10.1177/09596836221109004`

Tanno, K.-I.; Willcox, G. (2006). "How Fast Was Wild Wheat Domesticated?". *Science*, 311, 1886. `https://doi.org/10.1126/science.1124635`

Tanno, K.-I.; Willcox, G. (2012). "Distinguishing Wild and Domestic Wheat and Barley Spikelets from early Holocene Sites in the Near East". *Vegetation History and Archaeobotany*, 21, 107-15. https://doi.org/10.1007/s00334-011-0316-0

Tao, L. et al. (2023). "Ancient Genomes Reveal Millet Farming-Related Demic Diffusion from the Yellow River into Southwest China". *Current Biology*, 33(22), 4995-5002.e7. https://doi.org/10.1016/j.cub.2023.09.055

Tayles, N.; Domett, K.; Nelsen, K. (2000). "Agriculture and Dental Caries? The Case of Rice in Prehistoric Southeast Asia". *World Archaeology*, 32(1), 68-83. https://doi.org/10.1080/004382400409899

Tengberg, M. (1999). "Crop Husbandry at Miri Qalat Makran, SW Pakistan (4000-2000 B.C.)". *Vegetation History and Archaeobotany*, 8(1-2), 3-12. https://doi.org/10.1007/bf02042836

Tewari, R. et al. (2000). "Excavations at Malhar, District Chandauli (U.P.) 1999: A Preliminary Report". *Pragdhara*, 10, 69-98.

Tewari, R. et al. (2006). "Second Preliminary Report of the excavations at Lahuradewa District Sant Kabir Nagar, U.P. 2002-2003-2004 & 2005-06". *Pragdhara*, 16, 35-68.

Tewari, R. et al. (2008). "Early Farming at Lahuradewa". *Pradghara*, 18, 347-73.

Thomas, K.D. (1983a). "Agricultural and Subsistence Systems of the Third Millennium B.C. in North-West Pakistan: a Speculative Outline". Jones, M.K. (ed.), *Integrating the Subsistence Economy.* Oxford: BAR International Series 181, 279-314.

Thomas, K.D. (1983b). "Tarakai Qila: Site, Economy and Environment". Proudfoot, B. (ed.), *Site, Environment and Economy*. Oxford: BAR International series 173, 127-44.

Thompson, G.B. (1996). "Subsistence and Environment: The Botanical Evidence (pt. 2). The Biological Remains Part III". Higham, C.F.W.; Tayles, N.G. (eds), *The Excavations of Khok Phanom Di, a Prehistoric Site in Central Thailand*, vol. 4. London: The Society of Antiquaries of London: Oxbow Books, 265-314.

Thompson, G.B. (1997). "Archaeobotanical Indicators of Rice Domestication – A Critical Evaluation of Diagnostic Criteria". Ciarla, R.; Rispoli, F. (eds), *South-East Asian Archaeology 1992*. Rome: Istituto Italiano per l'Africa e l'Oriente, 159-74.

Tong Weihua 佟伟华 (1984). "Cishan Yizhi de Yuanshi Nongye Yicun ji qi Xiangguang de Wenti 磁山遗址的原始农业遗存及其相关的问题 (Agricultural remains at Cishan and associated issues)". *Nongye Kaogu*, 1, 194-207, 2.

Trigger, B.G. (2006). *A History of Archaeological Thought*. 2nd ed. Cambridge: Cambridge University Press.

Tykot, R.H.; Merwe, N.J. van der; Hammond, N. (1996). "Stable Isotope Analysis of Bone Collagen, Bone Apatite, and Tooth Enamel in the Reconstruction of Human Diet: A Case Study from Cuello, Belize". Orna, M.V. (ed.), *ACS symposium series,* 625. *Archaeological Chemistry. Organic, Inorganic, and Biochemical Analyses.* Washington, D.C.: American Chemical Society, 355-65.

Underhill, A.P. (ed.) (2013). *A Companion to Chinese archaeology*. Oxford: WileyBlackwell.

van Driem, G. (2011). "Rice and the Austroasiatic and Hmong-Mien homelands". Enfield, N.J. (ed.), *Dynamics of human diversity in mainland Southeast Asia.* Canberra: Pacific Linguistics, 361-89.

van Driem, G. (2012). "The Ethnolinguistic Identity of the Domesticators of Asian Rice". *Comptes Rendus Palevol*, 11(2-3), 117-32. https://doi.org/10.1016/j.crpv.2011.07.004

van Driem, G. (2017). "The Domestications and the Domesticators of Asian Rice". Robbeets, M.; Savelyev, A. (eds), *Language Dispersal Beyond Farming*. John Benjamins Publishing Company, 183-214. https://doi.org/10.1075/z.215.08van

Van Heekeren, H.R. (1972). *The Stone Age of Indonesia*. 2nd ed. Leiden: Brill.

Vanna, L. (2002). "Rice Remains in the Prehistoric Pottery Tempers of the Shell Midden Site of Samrong Sen: Implications for Early Rice Cultivation in Central Cambodia". *Aséanie*, 9(1), 13-34. https://doi.org/10.3406/asean.2002.1067

Vavilov, N.I. (1951). *The Origin, Variation, Immunity, and Breeding of Cultivated Plants*. Chester, K.S. (transl. from Russian). Waltham (MA); New York: Stechert-Hafner; Chronica Botanica.

Villa, T.C.C. et al. (2005). "Defining and Identifying Crop Landraces". *Plant Genetic Resources,* 3(3), 373-84. https://doi.org/10.1079/pgr200591

Vincent, B. (2002). "Ceramic Technologies in Bronze Age Thailand". *Bulletin of the Indo-Pacific Prehistory Association,* 6, 72-83. https://doi.org/10.7152/bippa.v22i0.11808

Vishnu-Mittre (1972). “Neolithic Plants Economy at Chirand, Bihar”. *Journal of Palaeosciences*, 21(1-3), 18-22. https://doi.org/10.54991/jop.1972.1463
Vishnu-Mittre; Sharma, A.; Chanchala, S. (1986). “Palaeobotanical and pollen analytical investigations”. *Indian Archaeology 1983-1984 – A Review*, 17-~8.
Vishnu-Mittre; Savithri, R. (1976). “Ancient Plant Economy at Inamgaon”. *Puratattva*, 8, 55-63.
Vishnu-Mittre; Savithri, R. (1979a). “Palaeobotanical and Pollen Analytical Investigations”. *Indian Archaeology 1976-76 – A Review.* New Delhi: Archaeological Survey of India, Government of India, 78-81.
Vishnu-Mittre; Savithri, R. (1979b). “Further Contribution on Protohistoric Ragi - Eleusine coracana Gaertn”. *The Palaeobotanist*, 26, 10-15.
Vishnu-Mittre; Savithri, R. (1982). “Food Economy of the Harappans”. *Harrapan Civilization*. New Delhi: Oxford and IBH Publishing, 205-21.
Walker, D. (1986). “Late Pleistocene-Early Holocene Vegetational and Climatic Changes in Yunnan Province, Southwest China”. *Journal of Biogeography,* 13(5), 477. https://doi.org/10.2307/2844968
Walters, T.W. (1989). “Historical Overview on Domesticated Plants in China with Special Emphasis on the Cucurbitaceae”. *Economic Botany*, 43, 297-313. https://doi.org/10.1007/BF02858729
Wan Jiao 万娇 (2013). *Canger Diqu Shiqian Wenhua* 苍洱地区史前文化 (Prehistoric Culture in the Cang’er region). Beijing: Cultural Relics Press.
Wan Zhiwei 万智巍 (2012). *Quanxinshi Zhongguo Nangfang Zhiwu Liyong ji Qihoubianhua Beijingxia Renlei Shiying Fangshi Yanjiu* 全新世中国南方植物利用及气候变化背景下人类适应方式研究 (Plant utilization in South China during Holocene and human adaptation to climate change) [PhD dissertation]. Beijing: Zhongguo Shehui Kexue Yuan Kaogu Yanjiusuo.
Wang, B. et al. (2023). “Patterns of Spread and Adoption of Millet Agriculture Along the Eastern Rim of the Tibetan Plateau: Archaeobotanical Evidence from Houzidong, Southwest China (4200-4000 Cal. BP)”. *Archaeological Research in Asia*, 35, 100448. https://doi.org/10.2139/ssrn.4192365
Wang Bingyan 王冰言 (2021). *Zangyi Zoulang Zaoqi Hanzuo Nongye de Nanchuan Jiyu Huili Houzidong ji Dapingzi Yizhi Zhiwu Yicun Fenxi* 藏彝走廊早期旱作农业的南传基于会理猴子洞及大坪子遗址植物遗存分析 (The southern spread of early dry farming agriculture in the Tibetan-Yi Corridor as seen from the analysis of plant remains at Houzidong and Dapingzi sites) [Master’s thesis]. Jinan: Shandong University.
Wang, C. et al. (2017). “The Spatial Pattern of Farming and Factors Influencing It During the Peiligang Culture Period in the Middle Yellow River Valley”. *China Science Bulletin,* 62, 1565-8. https://doi.org/10.1016/j.scib.2017.10.003
Wang, C. et al. (2018). “Temporal Changes of Mixed Millet and Rice Agriculture in Neolithic-Bronze Age Central Plain, China: Archaeobotanical Evidence from the Zhuzhai site”. *The Holocene,* 28, 738-54. https://doi.org/10.1177/0959683617744269
Wang, C. et al. (2019b). “The Development of Yangshao Agriculture and its Interaction with Social Dynamics in the Middle Yellow River Region, China”. *The Holocene,* 29(1), 173-80. https://doi.org/10.1177/0959683618804640
Wang, C.F. et al. (2012). “Genetic Diversity and Population Structure of Chinese Foxtail Millet [*Setaria italica*(L.) Beauv.] Landraces”. *G3 Genes|Genomes|Genetics,* 2(7), 769-77. https://doi.org/10.1534/g3.112.002907
Wang, C.-C. et al. (2021). “Genomic Insights into the Formation of Human Populations in East Asia”. *Nature*, 591(7850), 413-19. https://doi.org/10.1038/s41586-021-03336-2
Wang Cailin 王才林 et al. (1996). “Chugoku ine no A-shu hanbetsu ni okeru kido saibo keisan-tai keijo to momi no keitai seiri keishitsu no kankei ni tsuite 中国イネの亜種判別における機動細胞珪酸体形状と籾の形態・生理形質の関係について (Relationship between the shape of silica body from motor cells and morphological and physiological characters of grain for the discriminations of indica and japonica rice in China)“. *Japanese Journal of Breeding*, 46(1), 61-6.
Wang Can 王灿 et al. (2019). “Quanxinshi Zhongqi Zhengzhou Diqu Gudai Nongye De Shikong Yanbian ji qi Yingxiang Yinsu 全新世中期郑州地区古代农业的时空演变及其影响因素 (Spatial-temporal evolution of agriculture and factors influencing it during the mid-Holocene in Zhengzhou area, China)”. *Quaternary Science*, 39(1), 108-22.

Wang Fan 王芬 et al. (2011). “Shandong Jimo Shi Beiqian Yizhi 2007 Nian Fajue Jianbao 山东即墨市北阡遗址2007年发掘简报 (Unearthing report of Beiqian site in Jimo city, Shandong)”. *Kaogu*, 11, 3-23, 97-100, 113.
Wang, F. et al. (2012). “Reconstructing the Food Structure of Ancient Coastal Inhabitants from Beiqian Village: Stable Isotopic Analysis of Fossil Human Bone”. *Chinese Science Bulletin,* 57, 2148-54. https://doi.org/10.1007/s11434-012-5029-y
Wang, F. (2013). “The Houli and Beixin Cultures”. Underhill, A. (ed.), *A Companion to Chinese Archaeology*. Oxford: WileyBlackwell, 389-472.
Wang Guodao 王国道 (1995). “Xining Shi Shenna Qijia Wenhua Yizhi 西宁市沈那齐家文化遗址 (The Qijia Culture Site of Shenna in Xining City)”. Zhonggou Kaogu Xuehui 中国考古学会 (ed.), *Zhongguo Kaoguxue Nianjian* 中国考古学年鉴 1993 (Annals of Chinese Archaeology 1993). Beijing: Science Press, 260-1.
Wang Haiyu 王海玉; He Deliang 何德亮; Jin Guiyun (2013). “Cangshan Houyangguangzhuang Yizhi Zhiwu Yicun Fenxi Baogao 苍山后杨官庄遗址植物遗存分析报告 (Report on the plant remains from the Houyangguangzhuang site in Cangshan”. *Haidai Kaogu*, 6, 133-8.
Wang Haiyu 王海玉; Liu Yangchang 刘延常; Jin Guiyun (2011). “Shandong Linshu Dongpan yizhi 2008nian Zhiwu Kaogu Baogao (An archaeobotanical report of Dongpan site (2008) in Linshu, Shandong)”. Shandong Daxue Dongfang Kaogu Yanjiu Zhongxin 山东大学东方考古研究中心 (ed.), *Dongfang Kaogu (dibaji)* 东方考古 (第八辑) (East Asian Archaeology (8th vol.)). Beijing: Science Press, 357-72, 455-9.
Wang, J. (2018). *A Zooarchaeological Study of the Haimenkou Site, Yunnan Province, China.* Oxford: BAR Publishing. BAR International Series 2602. Archaeology of East Asia 1.
Wang, J. et al. (2023). “C_4 Expansion of Central Asia in the Middle Miocene Linked to the Strengthening Indian Monsoon”. *Global and Planetary Change*, 224, 104096. https://doi.org/10.1016/j.gloplacha.2023.104096
Wang, J.; Jiang, L. (2022). “intensive Acorn Processing in the Early Holocene of Southern China”. *The Holocene,* 32(11), 1305-16. https://doi.org/10.1177/09596836211041732
Wang Jihuai 王吉怀 (1983). “Henan Xinzheng Shawoli Xinshiqi Shidai Yizhi 河南新郑沙窝李新石器时代遗址 (The Neolithic site of Shawoli in Xinzheng, Henan)”. *Kaogu*, 12, 1057-65, 1153-4.
Wang, M. et al. (2024). “Vegetation Dynamics since the Last Glacial Maximum in Central Yunnan, Southwest China”. *Forests*, 15(7), 1075. https://doi.org/10.3390/f15071075
Wang Ningsheng 汪宁生 (1977). “Yuangu Shiqi Yunnan de Daogu Zaipei-Yunnan Shaoshu Minzu Kexue Shi Xuexi Zhaji 远古时期云南的稻谷栽培 – 云南少数民族科学史学习札记 (Rice cultivation in Ancient Yunnan-notes on the study of the history of science of ethnic minorities in Yunnan)”. *Sixiang Zhanxian*, 1, 98-102.
Wang Qi 王祁 (2014). *Yunnan Dengjiang Xian Xueshan Yizhi Zhiwu Yicun Fenxi* 云南登江县学山遗址植物遗存分析 (Analysis of the archaeobotanical remains found at Xueshan site, in Dengjiang county, Yunnan) [Master thesis] Jinan: Shandong University.
Wang Qi et al. (2019). “Yunnan Chengjiang Xueshan Yizhi Zhiwu Yicun Fuxuan Jieguo ji Chubu Yanjiu 云南澄江学山遗址植物遗存浮选结果及初步研究 (Preliminary study on plant remains obtained through flotation from Xueshan, Chengjiang, Yunnan)”. *Zhongguo Nongshi*, 38, 2, 3-11.
Wang Rui 王睿; Gu, Rongzhen 郭荣臻, Jin Guiyun (2018). “Henan Hebi Dalaidian Yizhi Longshan Shiqi Zhiwu Yicun Fenxi 河南鹤壁大赉店遗址龙山时期植物遗存分析 (The archaeobotanical analysis on the floatation results of Longshan period from the Dalaidian site, Hebi, Henan)”. Shandong Daxue Wenhua Yichan Yanjiuyuan 山东大学文化遗产研究院 (ed.), *Dongfang Kaogu (dishisiji)* 东方考古 (第十四辑) (East Asian Archaeology vol. 4). Beijing: Science Press, 184-201.
Wang, R.Z. (2006). “The Occurrence of C_4 Photosynthesis in Yunnan Province, a Tropical Region in South-western China”. *Photosynthetica*, 44(2), 286-92. https://doi.org/10.1007/s11099-006-0020-y
Wang, S.; Gong, D. (2000). “Climate in China during the Four Special Periods in Holocene”. *Progress in Natural Science*, 10(5), 379-86.
Wang, T. et al. (2022). “Microfossil Analysis of Dental Calculus and Isotopic Measurements Reveal the Complexity of Human-Plant Dietary Relationships in Late Bronze Age Yunnan”. *Archaeological and Anthropological Sciences*, 14(5). https://doi.org/10.1007/s12520-022-01557-8

Wang, W. et al. (2022). "Rice and Millet Cultivated in Ha Long Bay of Northern Vietnam 4000 Years Ago". *Frontiers in Plant Science*, 13. https://doi.org/10.3389/fpls.2022.976138

Wang, W. et al. (2024). "Early Holocene Exploitation of Taro and Yam among southern East Asian Hunter-Gatherers". *Antiquity*, 98(399), 597-615. https://doi.org/10.15184/aqy.2024.67

Wang, X. et al. (2018). "Millet Manuring as a Driving Force for the Late Neolithic Agricultural Expansion of North China". *Scientific Reports*, 8(1). https://doi.org/10.1038/s41598-018-23315-4

Wang, Y.L. et al. (2019). "Molecular Insights on the Domestication of Barley (*Hordeum vulgare* L.)". *Critical Reviews in Plant Sciences*, 38(4), 280-94. https://doi.org/10.1080/07352689.2019.1658856

Wang Yuqian 王玉茜 et al. (2011). "Henan Xichuan Gouwan Yizhi 2007 Niandu Zhiwu Fuxuan Jieguo yu Fenxi 河南淅川沟湾遗址 2007年度植物浮选结果与分析 (Plant flotation results and analysis in 2007 at the Gouwan site in Xichuan, Henan)". *Sichuan Wenwu*, 2, 80-92.

Wang, Y.R. et al. (2024). "The Evolution of Cropping Structure in Prehistoric Xizang". *Science Bulletin*, 69(24), 3959-67. https://doi.org/10.1016/j.scib.2024.06.025

Wang Yongji 王永吉 et al. (1992). "Woguo Gudai Zhufan, Hongshaotu Zhong de Zhiwu Guisuanti Yanjiu ji qi Yiyi 我国古代铸范、红烧土中的植物硅酸体研究及其意义 (The significance and use of phytoliths analysis in China)". *Kexue Tongbao,* 4, 342-5.

Wang Zenglin 王增林; Wu Jia'an 吴加安 (1998). "Yuchisi Yizhi Guisuanti Fenxi – Luntun Yuchisi Yizhi Shiqian Nongye Jingji Tedian 尉迟寺遗址硅酸体分析 – 兼论尉迟寺遗址史前农业经济特点 (Phytolith analysis of the Yuchisi site and economic traits of prehistoric agriculture)". *Kaogu*, 4, 87-93.

Watson, B. (1971). *Records of the Grand Historian of China (translated from the Shih chi of Ssu-ma Ch'ie),* vol. 2. New York: Columbia University Press.

Watson, P.J. (1976). "In Pursuit of Prehistoric Subsistence: A Comparative Account of Some Contemporary Flotation Techniques". *Mid-Continental Journal of Archaeology,* 1(1), 77-100. https://www.jstor.org/stable/20707785

Weber, S.A. (2003). "Archaeobotany at Harappa: Indications for Change". Weber, S.A.; Belcher, W.R. (eds), *Indus Ethnobiology: New Perspectives from the Field.* Oxford: Lexington Books, 175-98.

Weber, S.A.; Fuller, D.Q. (2008). "Millets and Their Role in Early Agriculture". *Pragdhara,* 18(69), e90.

Weber, S. et al. (2010). "Rice or Millets: Early Farming Strategies in Prehistoric Central Thailand". *Archaeological and Anthropological Sciences*, 2(2), 79-88. https://doi.org/10.1007/s12520-010-0030-3

Weber, S.A. (1989). *Plants and Harappan Subsistence: An Example of Stability and Change from Rojdi*. Philadelphia: University of Pennsylvania.

Wei Ting 宫玮 et al. (2019). "Shangmo Qihou Bianhua duiyu Daozuo Nongye de Yingxiang – Jiyu Jinan Daxinzhuang, Liujiazhuang Yizhi Shangdai Zhiwu Yicun Guangcha 商末气候变化对于稻作农业的影响 – 基于济南大辛庄、刘家庄遗址商代植物遗存观察 (The impact of climate change on rice agriculture during the end of the Shang period: Results of the plant remains from Daxinzhuang and Liujiazhuang sites, Jinan, Shandong Province). *Quaternary Sciences*, 1, 170-82.

Wei Xingtao 魏兴涛 (2014). "Yuxi Jixinan Diqu Xinshiqi Shidai Zhiwu Yicun de axian yu Chubu Yanjiu 豫西晋西南地区新石器时代植物遗存的发现与初步研究 (The Preliminary Research and Discovery of Neolithic Remains of Plants in Western Henan Province and Southwestern Shanxi Province)". Shandong Daxue Wenhua Yichan Yanjiuyuan 山东大学文化遗产研究院 (ed.), *Dongfang Kaogu (dishiji)* 东方考古 (第十集) (East Asian Archaeology (Vol. 10)). Beijing: Science Press, 343-63.

Wei, Y.M. (2019). "Buckwheat Remains from the Late Neolithic Site of Donghuishan, Gansu Province, China". *Cereal Chemistry*, 96(2), 332-7. https://doi.org/10.1002/cche.10130

Wei Yimin 魏益民 (2019). "Donghuishan Yizhi Qianmai Zili de Faxian ji Niandai Fenxi 东灰山遗址荞麦子粒的发现及年代分析(Discovery and Chronological Analysis of Buckwheat Kernel in Donghuishan Ruins)". *Zuowu Zazhi*, 1, 85-9.

Wei Yimin et al. (2020). "Zhongguo Hexi Zoulang Donghuishan he Xihuishan Zuowu Yicun Yanjiu 中国河西走廊东灰山和西灰山作物遗存研究 (Research on the crop remains from the sites of Donghuishan and Xihuishan in the Hexi Corridor, China)". *Mailei Zuowu Xuebao*, 40(11), 1327-33.

Weide, A. et al. (2018). "A Systematic Review of Wild Grass Exploitation in Relation to Emerging Cereal Cultivation Throughout the Epipalaeolithic and Aceramic Neolithic of the Fertile Crescent". *PLoS ONE*, 13, e0189811. https://doi.org/10.1371/journal.pone.0189811

Weide, A. et al. (2022). "A New Functional Ecological Model Reveals the Nature of Early Plant Management in Southwest Asia". *Nature Plants,* 8, 623-34. https://doi.org/10.1038/s41477-022-01161-7

Weisskopf, A.R. (2014). *Millets, Rice and Farmers: Phytoliths as Indicators of Agricultural, Social and Ecological Change in Neolithic and Bronze Age Central China*. Oxford: BAR Publishing. BAR International Series 2589.

Weisskopf, A.R.; Fuller, D.Q. (2014a). s.v. "Apricot: Origins and Development". Smith, C. (ed.), *Encyclopedia of Global Archaeology*. Cham: Springer. https://doi.org/10.1007/978-1-4419-0465-2_813

Weisskopf, A.R.; Fuller, D.Q. (2014b). s.v. "Citrus Fruits: Origins and Development". Smith, C. (ed.), *Encyclopedia of Global Archaeology*. New York: Springer. https://doi.org/10.1007/978-1-4419-0465-2_2173

Weisskopf, A.R.; Fuller, D.Q. (2014c). s.v. "Buckwheat: Origins and Development". Smith, C. (ed.), *Encyclopedia of Global Archaeology*. New York: Springer. https://doi.org/10.1007/978-1-4419-0465-2_2310

Weisskopf, A.R.; Fuller, D.Q. (2020). s.v. "Buckwheat: Origins and Development". Smith, C. (ed.), *Encyclopedia of Global Archaeology*. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-30018-0_2310

Weisskopf, A.R. et al. (2015). "Phytoliths and Rice: From Wet to Dry and Back Again in the Neolithic Lower Yangtze". *Antiquity,* 89(347), 1051-63. https://doi.org/10.15184/aqy.2015.94

Wen, Z. et al. (2009). "Genetic Diversity, Geographic Differentiation and Evolutionary Relationship among Ecotypes of *Glycine max* and *G. soja* in China". *Chinese Science Bulletin,* 54(23), 4393-403. https://doi.org/10.1007/s11434-009-0696-z

Wenwu ju 文物局 (1984). *Tianye Kaogu Gongzuo Guicheng* 田野考古工作规程 (Field Archaeology Work Protocol). Beijing: Cultural Relics Press.

White, J.C. (1982). *Ban Chiang. Discovery of a Lost Bronze Age*. Philadelphia: University of Philadelphia Press.

White, J.C.; Hamilton, E.G. (2019). *Ban Chiang, Northeast Thailand, volume 2C: The metal remains in regional context.* Philadelphia: University of Pennsylvania Museum of Archaeology and Anthropology.

Willcox, G. (1991). "Carbonised plant remains from Shortughai". Renfrew, J.M. (ed.), *New Light on Early Farming: Recent Developments in Paleoethnobotany.* Edinburgh: Edinburgh University Press, 139-53.

Willcox, G. (1992). "Some Differences Between Crops of Near Eastern Origin and Those from the Tropics". Jarrige, C. (ed.), *South Asian Archaeology 1989.* Madison: Prehistory Press, 291-9.

Willcox, G. (1996). "Evidence for Plant Exploitation and Vegetation History from Three Early Neolithic Pre-Pottery Sites on the Euphrates (Syria)". *Vegetation History and Archaeobotany*, 5(1-2), 143-52. https://doi.org/10.1007/bf00189445

Willcox, G. (2012). "The Beginnings of Cereal Cultivation and Domestication in Southwest Asia". Potts, D.T. (ed.), *A Companion to the Archaeology of the Ancient Near East*. Wiley Online Library: Blackwell Publishing Ltd, 161-80.

Williams, J.T. (1963). "*Chenopodium album* L.". *Journal of Ecology*, 51(3), 711-25. https://doi.org/10.2307/2257758

Willis, A. et al. (2022). "Living in the Dry Zone: Stable Isotope Insights into Palaeodiet in Ancient Myanmar". *Journal of Archaeological Sciences: Reports*, 48, 103900. https://doi.org/10.2139/ssrn.4237291

Winkler, M.G.; Wang, P.K. (1993). "The Late-Quaternary Vegetation". Wright, H.E. et al. (eds), *Global Climates Since the Last Glacial Maximum*. Minneapolis: University of Minnesota Press, 221-64.

Wohlfarth, B. et al. (2016). "Human Adaptation to Mid- to Late-Holocene Climate Change in Northeast Thailand". *The Holocene*, 26(11), 1875-86. https://doi.org/10.1177/0959683616645947

Wu Chuanren 吴传仁; Liu Hui 刘辉; Zhao Zhijun (2010). "Cong Xiaogan YejiamiaoYizhi Fuxuan Jieguo Tan Jianghan PIngyuan Shiqian Nongye 从孝感叶家庙遗址浮选结果谈江汉平原

史前农业 (Discussing prehistoric agriculture in the Jianghan Plain based on the flotation results of the Yejiamiao site in Xiaogan)". *Nanfang Wenwu*, 4, 64-9.

Wu, D. et al. (2023). "Out-of-Phase Relationship of Holocene Moisture Variations between the Northeastern and Southeastern Tibetan Plateau and its Societal Impacts". *Fundamental Research*, 5(1), 241-8. https://doi.org/10.1016/j.fmre.2023.02.014

Wu Jing 吴敬; Jiang Zhilong 蒋志龙; Feng Enxue 冯恩学 (2010). "Yunnan Chengjiang Xueshan Yizhi Shiju Jianbao 云南澄江县学山遗址试掘简报 (Preliminary report on the trial excavation of Xueshan, in Changjing, Yunnan)". *Kaogu*, 10, 18-24, 99.

Wu, M.-S.; Bodt, T.A.; Tresoldi, T. (2022). "Bayesian phylogenetics Illuminate Shallower Relationships among Trans-Himalayan Languages in the Tibet-Arunachal Area". *Linguistics of the Tibeto-Burman Area*, 45(2), 171-210. https://doi.org/10.1075/ltba.21019.wu

Wu Ruijing 吴瑞静 (2018). *Dawenkou Wenhua Shengye Jingji Yanjiu – Lai zi Zhiwu Kaogu de Zhengju* 大汶口文化生业经济研究 – 来自植物考古的证据 (Research on the livelihood economy of Dawenkou Culture - Evidence from botanical archeology) [Master's Thesis]. Jinan: Shandong University.

Wu Wenwan 吴文婉 et al. (2013). "Zhangqiu Xihe Yizhi (2008) Zhiwu Yicun Fenxi 章丘西河遗址(2008)植物遗存分析 (Analysis of the 2008 plant remains from Xihe, Zhangqiu)". *Dongnan Kaogu*, 373-90, 477-8.

Wu Wenwan; Zhang Juhua 张继华; Jin Guiyun (2014). "Henan Dengfeng Nanwa Yizhi Erlitou Dao Haodai Juluo Nongye de Zhengju 河南登封南洼遗址二里头到汉代聚落农业的植物考古证据 (Erlitou to Han Dynasty archaeobotanical evidence for agricultural settlement from the Nanwa Site, Dengfeng, Henan)". *Zhongyuan Wenwu*, 1, 109-17.

Wu Wenwan et al. (2018). "Zouping Dinggong Yizhi 2014 Longshan Wenhua Zhiwu Dayicun de Chubu Fenxi 邹平丁公遗址(2014)龙山文化 植物大遗存的初步分析 Preliminary analysis of large plant remains of Longshan Culture at Zouping Dinggong Site)". *Zhongguo Nongshi*, 3, 14-20.

Wu Wenwan; Jin Guiyun; Wang Xinghua 王兴华 (2015). "Haidai Diqu Houli Wenhua de Zhiwu Liyong he Zaipei: Lai zi Jinan Zhangmatun Yizhi de Zhengju 海岱地区后李文化的植物利用和栽培:来自济南张马屯遗址的证据 (Houli culture plant cultivation and subsistence: evidence from Zhangmatun, Jinan)". *Zhongguo Nongshi*, 34(2), 3-13.

Wu Xin 武欣 (2016). *Henan Dalaidian Yizhi Longshan Shiqi Zhiwu Yicun Fenxi* 河南大赉店遗址龙山时期植物遗存分析 (The research of plant remains in Longshan period from the Dalaidian site in Henan) [Master's thesis]. Jinan: Shandong University.

Wu, X. et al. (2012). "Early Pottery at 20,000 Years Ago in Xianrendong Cave, China". *Science*, 336(6089), 1696-700. https://doi.org/10.1126/science.1218643

Wu, X. et al. (2019). "Resettlement strategies and Han Imperial Expansion into southwest China: A Multimethod Approach to Colonialism and Migration". *Archaeological and Anthropological Sciences*, 11(12), 6751-81. https://doi.org/10.1007/s12520-019-00938-w

Wu, X.; Institute of Botany, Chinese Academy of Sciences (ed.) (1977-2006). *Yunnan Zhiwuzhi* 云南植物志(Flora Yunnanica). Vols. 1-21. Beijing: Science Press.

Wu, Y. et al. (2022a). "Dedan Cave: Extending the evidence of the Hoabinhian technocomplex in southwest China". *Journal of Archaeological Science: Reports,* 44, 103524.

Wu, Y. et al. (2022b). "High-Precision U-Series Dating of the Late Pleistocene – Early Holocene Rock Paintings at Tiger Leaping Gorge, Jinsha River valley, southwestern China". *Journal of Archaeological Science*, 138, 105535. https://doi.org/10.1016/j.jas.2021.105535

Wu, Y. et al. (2023). "The Hoabinhian Technocomplex in Yunnan Province, Southwest China: Recent Discoveries and Future Perspectives". Preprint available at SSRN https://doi.org/10.2139/ssrn.4468167

Wu, Y.L. (1996). "Prehistoric Rice Agriculture in the Yellow River Valley". *Bulletin of the Indo-Pacific Prehistory Association*, 15, 223-4. https://doi.org/10.7152/bippa.v15i0.11552

Wu, Y.-M. et al. (2025). "Recognizing *Prunus persica* (Peach) and Allied Rosaceae by the Morphological Characteristics of their Fruitstones". *Vegetation History and Archaeobotany*. https://doi.org/10.1007/s00334-025-01043-w

Wu Yaoli 吴耀利 (1994). "Shuifuxuan zai Woguo Kaoguxue Fajue zhong de Yingyong 水浮选在我考古学发掘中的应用 (The use of flotation in archaeological excavations in China)". *Nongye Kaogu,* 4, 363-6, 392.

Wu Yaoli; Chen Xingcan 陈星灿 (1994a). " Henan ruzhou lilou yizhi de fajue 河南汝州李楼遗址的发掘 (Excavation of the Lilou Site at Ruzhou, Henan)". *Acta Archaeologica Sinica*, 1, 63-96.

Wu Yaoli; Chen Xingcan (1994b). "Shui xuan fa zai woguo kaogu fajue zhong de shouci yingyong 水选法在我国考古发掘中的首次应用 (The first application of the water separation technique in an archaeological excavation in China)". *Wenwu Tiandi,* 3, 389.

Wu Zhuanren 吴传仁; Liu Hui 刘辉; Zhao Zhijun (2010). "Cong Xiaoganyemiao Yizhi Fuxuan Jieguo Tan Jianhan Pingyuan Shiqian Nongye 从孝感叶家庙遗址浮选结果谈江汉平原史前农业 (Prehistoric Agriculture in the Jianghan Basin from the perspective of the flotaton results of the site of Xiaoganyemiao)". *Nanfang Wenwu*, 4, 64-9.

Wu Zilin 吴梓林 (1983). "Gu Su Kao 古粟考 (Studies on ancient millet)". *Shiqian Kaogu*, 1, 150-5.

Xia Nai 夏鼐 (1960). "Changjiang Liuyu Kaogu Wenti – 1959 Nian 12 Yue 26 Ri zai Zhangban Wenwu Kaogudui Duizhang Huiyi Shang de Fayan 长江流域考古问题 – 1959年12月26日在长办文物考古队队长会议上的发言 (Archaeological problems of the Yangzi Area-Speech given at the Yangzi Cultural Relics team meeting held in December 26, 1959)". *Kaogu*, 2, 1-3.

Xiang Anqiang 向安強 et al. (2015). "Yunnan Baoshan Changning Daping Yingpanshan Xinshiqi Yizhi Chutu Gudao Yanjiu 云南保山昌宁达丙营盘山新石器遗址出土古稻研究 (Study on the ancient rice remains unearthed from the Neolithic Yingpanshan site in Daping, Changning, Baoshan, Yunnan)". *Huaxia Kaogu*, 1, 41-5.

Xiao Minghua 肖明华 (2001). "Yunnan Kaogu Shulu 云南考古述略 (Yunnan Archaeology)". *Kaogu*, 12, 1063-75.

Xiao Minghua; Wan Chang 万杨 (2013). "Yunnan Gejiushi Mayutian Qingtong Shidai Mudi de Fajue 云南个旧市麻玉田青铜时代墓葬的发掘 (The excavation of the Mayutian cemetery, in Gejiu, Yunnan)". *Kaogu*, 3, 15-25.

Xiao Shuguo 萧树国 (2006). "Cong Yingpanshan Yizhi Kan Gu Yingpanshan Renshehui – dui Ailaoguo Qujing Geti Quyu Shehui Fazhan Shuiping de Fenxi 从营盘山遗址看古营盘山人社会 – 对哀牢国区境个体区域社会发展水平的分析 (People and Society in Ancient Yingpanshan)". *Baoshan shizhuan Xuebao*, 6, 27-35.

Xiao, X. et al. (2017). "Evidence of Holocene Climatic Change and Human Impact in Northwestern Yunnan Province: High-Resolution Pollen and Charcoal Records from Chenghai Lake, Southwestern China". *The Holocene*, 28(1), 127-39. `https://doi.org/10.1177/0959683617715692`

Xiao, X. et al. (2020). "Vegetation, Climate and Human Impact since 20 ka in Central Yunnan Province Based on High-Resolution Pollen and Charcoal Records from Dianchi, Southwestern China". *Quaternary Science Reviews*, 236, 106297. `https://doi.org/10.1016/j.quascirev.2020.106297`

Xie, G.M. (2022). "Later Hunter-Gatherers in Guangxi Province". Higham, C.F.W.; Kim, N.C. (eds), *The Oxford Handbook of Early Southeast Asia*. Oxford: Oxford University Press, 182-93. `https://doi.org/10.1093/oxfordhb/9780199355358.013.5`

Xiong Haitang 熊海堂 (1989). "Kaogu Fajuezhong Shuifuxuan Biefa de Yingyong 考古发掘中水浮选别发的应用 (The use of water flotation in archaeological excavations)". *Nongye Kaogu*, 2, 155-74, 413-14.

Xu, D. et al. (2002). "Diversity of Chloroplast DNA SSRs in Wild and Cultivated Soybeans: Evidence for Multiple Origins of Cultivated Soybean". *Theoretical and Applied Genetics,* 105(5), 645-53. `https://doi.org/10.1007/s00122-002-0972-7`

Xu, P.F. (1999). "Archaeological Research on the Origins of Chinese Civilisation". Whitfield, R.; Wang, T. (eds), *Exploring China's Past. New Discoveries and Studies in Chinese Archaeology and Art*. London: Saffron, 33-40.

Xu Tingwen 徐廷文 (1982). "Zhongguo Zaipei Damai de Qiyuan yu jinhua 中国栽培大麦的起源与进化 (Origin and Evolution of Cultivated Barley in China)". *Acta Genetica Sinica*, 6, 440-6.

Xu Wangsheng 徐旺生 (1998). "Cong Nonggeng Qiyuan de Jiaodu Kan Zhongguo Daozuo de Qiyuan 从农耕起源的角度看中国稻作的起源 (The origin of rice from the perspective of the origins of cultivation in China)". *Nongye Kaogu*, 1, 70-7, 86.

Xu, Y. et al. (2019). "Domestication and Spread of Broomcorn Millet (*Panicum miliaceum* L.) Revealed by Phylogeography of Cultivated and Weedy Populations". *Agronomy*, 9(12), 835. `https://doi.org/10.3390/agronomy9120835`

Xue, Y.N. et al. (2022). "Post-Neolithic Broadening of Agriculture in Yunnan, China: Archaeobotanical Evidence from Haimenkou". *Archaeological Research in Asia*, 30, 100364. `https://doi.org/10.1016/j.ara.2022.100364`

Xue Yining 薛轶宁 (2010). *Yunnan Jianchuan Haimenkou Yizhi Zhiwu Yicun Chubu Yanjiu* 云南剑川海门口遗址植物遗存初步研究 (A preliminary investigation on the archaeobotanical material from the site of Haimenkou in Jianchuan County, Yunnan) [Master thesis] Beijing: Peking University.

Yabuno, T. (1962). "Cytotaxonomic Studies on the Two Cultivated Species and the Wild Relatives in the Genus *Echinochloa*". *Cytologia*, 27, 296-305. `https://doi.org/10.1508/cytologia.27.296`

Yabuno, T. (1987). "Japanese Barnyard Millet (*Echinochloa utilis*, Poaceae) in Japan". *Economic Botany*, 41(4), 484-93. `https://doi.org/10.1007/bf02908141`

Yabuno, Tomosaburo (1966). "Biosystematic Dtudy of the Genus *Echinochloa* (Gramineae)". *Japanese Journal of Botany*, 19, 277-323 (in Japanese).

Yadav, D.S.; Yadav, V.K. (2005). *Pulse Crops: Production Technology*. New Delhi: Kalyani Publishers.

Yamaguchi, H. et al. (2005). "A Molecular Phylogeny of Wild and Cultivated *Echinochloa* in East Asia Inferred from Non-Coding Region Sequences of trnT-L-F". *Weed Biology and Management*, 5(4), 210-18. `https://doi.org/10.1111/j.1445-6664.2005.00185.x`

Yan Wenming 严文明 (1964). *Xin Shiqi Shidai* 新石器时代 (The Neolithic). Beijing: Beijing University Press.

Yan Wenming (1982a). "Zhongguo Daozuo Nongye de Qiyuan 中国稻作农业的起 (The origin of rice agriculture in China)". *Nongye Kaogu*, 1, 1-4.

Yan Wenming (1982b). " Zhongguo Daozuo Nongye de Qiyuan (Xu)中国稻作农业的起源(续) [On the origin of rice agriculture in China (cont.)]". *Nongye Kaogu*, 2, 50-4.

Yan Wenming (1983). "Zhongguo Xinshiqi Shidai Zaoqi Wenhua de Faxian Yu Yan 中国新石器时代早期文化的发现与研 (Discovery and research of early Neolithic Culture in China)". *Zhongguo Baike Nianjian* 中国百科年鉴 (Encyclopedia of China, Yearbook). Beijing: Encyclopedia of China publishing house.

Yan Wenming (1987). "Zhongguo Shiqian Wenhua de Tongyi yu Duoyangxing 中国史前文化的统 – 性与多样性 (The unity and diversity of Chinese prehistoric culture)". *Cultural Relics*, 3, 38-50.

Yan Wenming (2000). "Dongfang Wenming de Yaolan 东方文明的摇篮(The cradle of oriental civilization)". Yan Wenming (ed.), *Nongye Fasheng yu Wenming Qiyuan* 农业发生与文明起源 (The Origins of Agriculture and the Rise of Civilization). Beijing: Sciences Press, 148-74.

Yan Wenming (2008). *Zhongguo Kaoguxue Yanjiu de Shiji Huigu* 中国考古学研究的世纪回顾 – 新石器时代考古卷 (A century of retrospect on Chinese archaeology: The Neolithic period). Beijing: Science Press.

Yan Wenming et al. (1984). "Shandong Qixia Yangjiaquan Yizhi Fajue Jianbao 山东栖霞杨家圈遗址发掘简报 (Brief excavation of the Yangjiaquan site in Qixia, Shandong)". *Shiqian Yanjiu* 史前研究, 3, 91-4, 99, 118.

Yan, D.; Wünnemann, B.; Jiang, Z. (2020). "Hydrological Variations of a Lake-Catchment and Human Interaction during the last 6 ka in Yunnan, China". *Journal of Hydrology*, 587, 124932. `https://doi.org/10.1016/j.jhydrol.2020.124932`

Yan, W.M. (1992). "Origins of Agriculture and Animal Husbandry in China". Aikens, C.M.; Song, N.R. (eds) *Pacific Northeast Asia in Prehistory: hunter fisher gatherers, farmers, and sociopolitical elites.* Pullman. Washington, D.C.: Washington State University Press, 113-23.

Yan Xue 闫雪; Zhou Zhiqing 周志清; Jiang Ming 姜铭. (2014). "Chengdu Shi Zhonghai Guoji Shequ Yizhi Fuxuan Jieguo ji Chubu Fenxi 成都市中海国际社区遗址浮选结果及初步分析 (Flotation Results and Preliminary Analysis of Zhonghai International Community Site in Chengdu)". *Chengdu Kaogu Faxian* 成都考古发现 (Archaeolgical Discoveries in Chengdu). Chengdu: Cultural Relics Press, 240-52(257).

Yang, F. et al. (2022). "The Agriculture and Society in the Yiluo River Basin: Archaeobotanical Evidence From the Suyang Site". *Frontiers in Earth Science,* 10. `https://doi.org/10.3389/feart.2022.885837`

Yang Fan 杨帆 (2014). "Weixi Zongzan Xizhou zhi Handai Yizhi 维西宗咱西周至汉代遗址 (Eastern Zhou to Han dynasty site of Zongzan, Weixi)". Wang, Wei 王巍 (ed.) *Zhongguo Kaoguxue Nianjian*. *Yunnan Sheng* 中国考古学年鉴. 云南省 (Yearbook of Archaeology in China. Yunnan Province). Beijing: China Social Sciences Press, 415.

Yang Fan 杨凡; Gu Wanfa 顾万发; Jin Guiyun (2020). "Henan Zhengzhou Wanguo Yizhi Tanhua Zhiwu Yicun Fenxi 河南郑州汪沟遗址炭化植物遗存分析 (Analysis of carbonized plant remains at the Wanggou site in Zhengzhou, Henan)". *Zhongguo Nongshi,* 39, 2, 3-12.

Yang, J.S. et al. (2022). “Sustainable Intensification of Millet–Pig Agriculture in Neolithic North China”. *Nature Sustainability*, 5(9), 780-6. https://doi.org/10.1038/s41893-022-00905-9

Yang, J.S. et al. (2024a). “Early Intensive Millet-Pig Agriculture in the High-Elevation Tibetan Plateau”. *Quaternary Science Reviews*, 345, 109048. https://doi.org/10.1016/j.quascirev.2024.109048

Yang, J.S. et al. (2024b). “The δ^{15}N Values of Foxtail Millet (*Setaria italica*) and Common Millet (*Panicum miliaceum*) are Reliable Indicators of Manuring Practices”. *Science China Earth Sciences*, 67(9), 2910-23. https://doi.org/10.1007/s11430-023-1376-y

Yang, L. et al. (2020). “How Did Trans-Eurasian Exchanges Affect Spatial-Temporal Variation in Agricultural Patterns during the Late Prehistoric Period in the Yellow River Valley (China)?” *The Holocene*, 1, 095968362094114. https://doi.org/10.1177/0959683620941140

Yang, M.A. et al. (2020). “Ancient DNA Indicates Human Population Shifts and Admixture in Northern and Southern China”. *Science*, 369(6501), 282-8. https://doi.org/10.1126/science.aba0909

Yang, Q. et al. (2016). “Summer Precipitation Reconstructed Quantitatively Using a Mid Holocene δ_{13}C Common Millet Record from Guanzhong Basin, Northern China”. *Climate of the Past*, 12, 2229-40.

Yang, Q.; et al. (2020). “Prehistoric Agriculture and Social Structure in the Southwestern Tarim Basin: Multiproxy Analyses at Wupaer”. *Scientific Report*s, 10, 14235. https://doi.org/10.1038/s41598-020-70515-y

Yang, S. et al. (2008). “Sequence Polymorphisms and Phylogenetic Relationships of hina Gene in Wild Barley from Tibet, China”. *Agricultural Sciences in China*, 7(7), 796-803. https://doi.org/10.1016/s1671-2927(08)60116-9

Yang, W. et al. (2023). “Food Production and Agricultural Systems on the Southwestern Frontier of the Han Empire: Archaeobotanical Remains from the 2016 Excavation of Hebosuo, Yunnan”. *Archaeological and Anthropological Sciences,* 15(5). https://doi.org/10.1007/s12520-023-01766-9

Yang Wei 杨微 (2016). *Yunnan Hebosuo he Yubeidi Yizhi Zhiwu Yicun Fenxi* 云南河泊所和玉碑地遗址植物遗存分析 (Analyses on the archaeobotanical remains from Hebosuo and Yubeidi) [PhD dissertation]. Jinan: Shandong University.

Yang Wei et al. (2019). “Yunnan Jinning Hebosuo he Xiwangmiao Qingtong Shidai Beiqiu Yizhi Shijue Jianbao 云南晋宁河泊所和西王庙青铜时代贝丘遗址试掘简报 (Preliminary report on the excavation of Hebosuo and Xiwangmiao in Jinning, Yunnan)”. *Jianghan Kaogu*, 2, 17-29.

Yang Wei; Jiang Zhilong; Chen Xuexiang (2020). “Yunnan Dongchuan Yubeidi Yizhi (2013 Niandu) Zhiwu Yicun Fuxuan Jieguo ji Chubu Fenxi 云南东川玉碑地遗址（2013年度）植物遗存浮选结果及初步分析 (Preliminary analysis of the flotation results from the 2013 excavation campaign of Yubeidi, in Dongchuan, Yunnan)”. *Zhongguo Nongshi*, 39, 1, 3-11.

Yang, X.D.; et al. (2005). “Pollen Evidence of Early Human Activities in Erhai Basin, Yunnan Province”. *Chinese Science Bulletin*, 50(6), 569-77. https://doi.org/10.1007/bf02897482

Yang, X.N. (1999). “A History of Modern Chinese Archaeology”. Yang, X.N. (ed.), *The Golden Age of Chinese Archaeology: Celebrated Discoveries from The People’s Republic of China*. New Haven and London: Yale University Press, 25-45.

Yang, X.Y. et al. (2012). “Early Millet Use in Northern China”. *Proceedings of the National Academy of Sciences*, 109(10), 3726-30. https://doi.org/10.1073/pnas.1115430109

Yang, X.Y. et al. (2013). “Sago-Type Palms Were an Important Plant Food Prior to Rice in Southern Subtropical China”. *PLoS ONE*, 8: e63148. https://doi.org/10.1371/journal.pone.0063148

Yang, X.Y. et al. (2015a). “Comparing Subsistence Strategies in Different Landscapes of North China 10,000 years Ago”. *The Holocene*, 25(12), 1957-64. https://doi.org/10.1177/0959683615596833

Yang, X.Y. et al. (2015b). “Barnyard Grasses Were Processed with Rice around 10000 Years Ago”. *Scientific Reports*, 5(1). https://doi.org/10.1038/srep16251

Yang, X.Y. et al. (2017). “New Radiocarbon Evidence on Early rice Consumption and Farming in South China”. *The Holocene*, 27(7), 1045-51. https://doi.org/10.1177/0959683616678465

Yang, X.Y. et al. (2018). "New Radiocarbon and Archaeobotanical Evidence Reveal the Timing and Route of Southward Dispersal of Rice Farming in South China". *Science Bulletin*, 63(22), 1495-501. https://doi.org/10.1016/j.scib.2018.10.011

Yang Xiaoyan 杨晓燕 et al. (2009). "Han Yangling Waizengkeng Nongzuowu Yicun Fenxi ji Xihan Zaoqi Nongye 汉阳陵外藏坑农作物遗存分析及西汉早期农业 (Early Agriculture in the Western Han: Analysis of the Agricultural Products of from the Han Yanling Tomb)". *Kexue Tongbao*, 54, 1917-21.

Yang Xinpeng 杨新鹏 et al. (2017). "Yunnan Kunming Jinnning Shangxihe Yizhi 云南昆明晋宁上西河遗址 (The site of Shangxihe in Jinning, Kunming, Yunnan)". *Dazhong Kaogu*, 9, 12-13.

Yang, Y. et al. (2016). "The Emergence, Development and Regional Differences of Mixed Farming of Rice and Millet in the Upper and Middle Huai River Valley, China". *Science China Earth Science,s* 59(9), 1779-90. https://doi.10.1007/s11430-015-5340-3

Yang, Y. et al. (2017). "Characteristics and Development of Agriculture during Xia and Shang Dynasties Based on Carbonized Plant Analysis at the Dongzhao Site, Central China". *Acta Anthropologica Sinica,* 1, 119-30. https://www.anthropol.ac.cn/EN/Y2017/V36/I01/119

Yang Zhengchun 杨正纯 (1993). "Kunming Dabanqiao Shiqian Dongxue Yizhi Shijue Baogao 昆明大板桥史前洞穴遗址试掘报告(Archeological remains from Dabanqiao Cave Site, Kunming, Yunnan)". *Renleixue Xuebao*, 4, 305-18.

Yao, A. (2010). "Recent Developments in the Archaeology of Southwestern China". *Journal of Archaeological Research*, 18(3), 203-39. https://doi.org/10.1007/s10814-010-9037-7

Yao, A. (2016). *The Ancient Highlands of Southwest China: from the Bronze Age to the Han Empire*. Oxford: Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199367344.001.0001

Yao, A. et al. (2015). "Bronze Age Wetland/Scapes: Complex Political Formations in the Humid Subtropics of Southwest China, 900-100 BC". *Journal of Anthropological Archaeology*, 40, 213-29. https://doi.org/10.1016/j.jaa.2015.08.005

Yao, A. et al. (2020). "Bridging the time gap in the Bronze Age of Southeast Asia and Southwest China". *Archaeological Research in Asia*, 22, 100189. https://doi.org/10.1016/j.ara.2020.100189

Yao, A.; Jiang, Z.L. (2012). "Rediscovering the Settlement System of the 'Dian' Kingdom, in Bronze Age Douthern China". *Antiquity*, 86(332), 353-67. https://doi.org/10.1017/s0003598x00062815

Yao, Y.F. et al. (2020). "Archaeobotanical Evidence Reveals the Human–Environment Interactions during the 9th–13th Centuries at Turpan, Xinjiang on the Ancient Silk Road". *Vegetation History and Archaeobotany*, 29, 539-52. https://doi.org/10.1007/s00334-019-00764-z

Yao, Y.F. et al. (2022). "New Insights into the Origin of Buckwheat Cultivation in Southwestern China from Pollen Data". *New Phytologist*, 237(6), 2467-77. https://doi.org/10.1111/nph.18659

Yazbek, M.; Oh, S.-H. (2013). "Peaches and Almonds: Phylogeny of Prunus subg. Amygdalus (Rosaceae) based on DNA Sequences and Morphology". *Plant Systematics and Evolution*, 299(8), 1403-18. https://doi.org/10.1007/s00606-013-0802-1

Ye, C. et al. (2009). "Cold Tolerance in Rice Varieties at Different Growth Stages". *Crop and Pasture Science*, 60(4), 328. https://doi.org/10.1071/cp09006

Yen, D.E. (1982). "Ban Chiang Pottery and Rice". *Expedition*, 24(1), 51-64.

Ye Fangsong 叶万松 et al. (2000). "Zaojiaoshu Yizhi Gu huanjing yu Guwenhua Chubu Yanjiu 皂角树遗址古环境与古文化初步研究 (Paleoenvironment and ancient culture of the Zaojiaoshu site)". Zhou Kunshu (ed.), *Huanjing Kaogu Yanjiu. Di er ji* 环境考古研究. 第二辑 (Issues in environmental archaeology,vol. 2). Beijing: Science Press, 34-40.

Yin Da 尹达 (2011). "Anhui Bengbu Yihuicun Yizhi Chutu Zhiwu Yicun Fenxi 安徽蚌埠禹会村遗址出土植物遗存分析 (Analysis of Plant Remains from Yuhuicun Site in Bengbu City, Anhui Province)". http://kaogu.cssn.cn/zwb/xszl/sztsg/zylwjsk/yjslwk/201107/t20110722_3921797.shtml

Yin Da (2013). "Yuhuicun Yizhi Fuxuan Jieguo Fenxi Baogao 禹会村遗址浮选结果分析报告 (Report on the flotation results of the Yuhuicun site)". Zhongguo Shehui Kexue Yuan Kaogu Yanjiusuo 中国社会科学院考古研究所; Anhui Sheng Bangbu Shi Bowuguan 安徽省蚌埠市博物馆编著 (eds), *Yuhuicun Bangbu* 蚌埠禹会村 (The site of Yuhuicun at Bangbu). Beijing: Science Press, 250-67.

Yin, S.T. (2015). "Shifting cultivation and its changes in Yunnan province, China". Cairns, M.F. (ed.), *Shifting cultivation and environmental change*. London and New York: Routledge; Taylor and Francis Group, 122-33.

Yin Shaoting 尹绍亭 (2001). "*Ren yu Senlin – Shengtai Renleixue Shiye Zhong de Daogeng Huozhong* 人与森林 – 生态人类学视野中的刀耕火种 (People and Forests: Yunnan Swidden Agriculture In Human-Ecological Perspective)". Kunming: Yunnan Education Press.

Yoshida, S. (1981). *Fundamentals of Rice Crop Science*. Los Banos, Philippines: IRRI.

You Xiuling 游修龄 (1976). "Dui Hemudu Yizhi Disi Wenhuaceng Chutu Daogu he Gusi de Jidian Kanfa 对河姆渡遗址第四文化层出土稻谷和骨耜的几点看法 (Some views on the recovery of rice and bone plows from the 4th cultural layer at the site of Hemudu)". *Wenwu*, 8, 20-3.

Yu, G. et al. (1998). "Pollen-Based Biome Reconstructions for China at 0 and 6000 Years". *Journal of Biogeography*, 25(6), 1055-69. https://doi.org/10.1046/j.1365-2699.1998.00237.x

Yu, G.; et al. (2000). "Palaeovegetation of China: a Pollen Data-Based Synthesis for the Mid-Holocene and Last Glacial Maximum". *Journal of Biogeography*, 27(3), 635-64. https://doi.org/10.1046/j.1365-2699.2000.00431.x

Yu, L.Z. et al. (1990). "Paleoenvironmental Implications of Magnetic Measurements on Sediment Core from Kunming Basin, Southwest China". *Journal of Paleolimnology*, 3(2), 95-111. https://doi.org/10.1007/bf00414065

Yuan, J.; Campbell, R. (2009). "Recent Archaeometric Research on 'the Origins of Chinese Civilization'". *Antiquity,* 83(319), 96-109. https://doi.org/10.1017/s0003598x00098112

Yuan Jiarong 袁家荣 (2013). *Hunan Jiushiqi Shidai yu Yuchanyan Yizhi* 湖南旧石器时代文化与玉蟾岩遗址 (Paleolithic Age of Hunan and Yuchanyan site). Changsha: Yuelu Shushe Press 长沙: 岳麓书社.

Yuan Sixun 原思训 et al. (1994). "Tanshisi Niandai Ceding Baogao (Jiu) 碳十四年代测定报告(九) (Radiocarbon dates in Chinese archaeology (ninth))". *Cultural Relics*; 4, 89-95.

Yuan Yuqian 袁宇倩; Sun Yonggang 孙永刚 (2019). "Liaoxi Diqu Shiqian Shiqi Zhiwu Kaoguxue Yanjiu Shulun 辽西地区史前时期植物考古学研究述论 (A review of the archaeobotany of the prehistoric western Liao region)". *Chifeng Xueyuan Xuebao*,40(7), 6-10.

Yuan, Z. et al. (2021). "Contrasting Ecosystem Responses to Climatic Events and Human Activity Revealed by a Sedimentary Record from Lake Yilong, Southwestern China". *Science of The Total Environment,* 783, 146922. https://doi.org/10.1016/j.scitotenv.2021.146922

Yun, Y.; Scott, D.A. (2020). "Characteristic Features of Metal Artifacts Excavated in Western Yunnan in the Bronze Age". *Archaeological and Anthropological Sciences*, 12(6). https://doi.org/10.1007/s12520-020-01074-6

Yunnan Kaogu 云南考古 (2009). *Yuanmou Dadunzi* 元谋大墩子遗址 (The site of Dadunzi in Yuanmou). http://www.ynkgs.com/view/ynkgPC/1/132/view/1264.html

Yunnan Kaogu 云南考古 (2011). *Chengjiang Xueshan Juluo Yizhi* 澄江学山聚落遗址 (The settlement site of Xueshan in Chengjiang). http://www.ynkgs.com/view/ynkgPC/1/136/view/1284.html

Yunnan Kaogu 云南考古 (2013). *Yuanmou Mopanshan Yizhi* 元谋磨盘山遗址 (The site of Mopanshan in Yuanmou). http://www.ynkgs.com/view/ynkgMO/2/50/view/1295.html

Yunnan Kaogu 云南考古 (2014). *Binchuan Baiyangcun Yizhi* 宾川白羊村遗址 (The site of Baiyangcun in Binchuan). http://www.ynkgs.com/view/ynkgPC/1/142/view/1301.html

Yunnan Kaogu 云南考古 (2015). *Yunnan Jinning Jinshashan Mudi Kaogu Fajuejieguo* 云南晋宁金砂山墓地考古发掘结束 (Results from the excavation of the Jinshashan cemetery in Jinning, Yunnan). http://kaogu.cssn.cn/zwb/xccz/201507/t20150720_3934233.shtml

Yunnan Kaogu (2016). *Qujing Batatai Mudi* 曲靖八塔台墓地 (The cemetery of Batatai in Qujing). http://www.ynkgs.com/view/ynkgPC/1/144/view/1356.html

Yunnan Kaogu 云南考古 (2017a). *Jinning Shangxihe Yizhi* 晋宁上西河遗址 (The site of Shangxihe in Jinning)". http://www.ynkgs.com/view/ynkgPC/1/146/view/1366.html

Yunnan Kaogu 云南考古(2017b). *Jinning Jinshashan Mudi 190 Hao Mu* 晋宁金砂山墓地190号墓 Grave no. 190 in the Jinshashan cemetery, Jinning). http://www.ynkgs.com/view/ynkgPC/1/144/view/1364.html

Yunnan Kaogu 云南考古 (2018). *Guangnan Dayingdong Yizhi* 广南大阴洞遗址 (The site of Dayingdong in Guangnan). `http://www.ynkgs.com/view/ynkgMO/2/50/view/1372.html`

Yunnan Kaogu 云南考古 (2019). Wuding Jiangxifen Yizhi 武定江西坟遗址 (The site of Jiangxifen in Wuding). `http://www.ynkgs.com/view/ynkgPC/1/150/view/1381.html`

Yunnan Kaogu 云南考古 (2024a). *Jinning Guchengcun Yizhi* 晋宁古城村遗址 (The Gucheng Village in Jinning). `http://www.ynkgs.com/view/ynkgPC/1/344/view/2040.html`

Yunnan Kaogu 云南考古 (2024b). *Jinning Guchengcun Yizhi* 晋宁古城村遗址 (The Gucheng Village in Jinning). `http://www.ynkgs.com/view/ynkgPC/1/342/view/2037.html`

Yunnan Kaogu 云南考古 (2024c). *Jinning Anjiang Bei Yizhi* 晋宁安江北遗址 (The site of Anjiang North in Jinning). `http://www.ynkgs.com/view/ynkgPC/1/342/view/2035.html`

Yunnan Sheng Bowuguan 云南省博物馆 (1981). "Yunnan Binchuan Baiyangcun Yizhi 云南宾川白羊村遗址 (The Baiyangcun site at Binchuan County, Yunnan Province)". *Acta Archaeologica Sinica,* 3, 349-68, 417-22.

Yunnan Sheng Bowuguan 云南省博物馆 (1963). "Yunnan Jijing Shizhaishan Gumu Disi Fajue Jianbao 云南寂静石寨山古墓发掘简报 (Preliminary report on the 4th excavation of the ancient cemetery of Shizhaishan, in Jijing, Yunnan)". *Kaogu*, 1, 480-8.

Yunnan Sheng Bowuguan 雲南省博物館 (1958). "Jianchuan Haimenkou Wenhua Yizhi Qingli Jianbao 劍川海門口文化遺址清理簡報 (Preliminary report on the excavation of Haimenkou cultural site in Jianchuan)". *Kaogu Tongxun*, 6, 5-12.

Yunnan Sheng Wenwu Kaogu Yanjiusuo 云南省文物考古研究所 (2002). "Yunnan Yongping Xinguang Yizhi Fajue Baogao 云南永平新光遗址发掘报告 (Excavation Report of the site of Xinguang, Yongping, Yunnan)". *Acta Archaeologica Sinica*, 2, 203-4.

Yunnan Sheng Wenwu Kaogu Yanjiusuo 云南省文物考古研究所 (2003). "Yunnan Yongren Caiyuanzi Mopandi Yizhi 2001 Nian Fajue Baogao 云南永仁菜园子磨盘地遗址2001年发掘报告 (Report on the 2001 excavation campaign of the sites of Caiyuanzi and Mopandi in Yongren, Yunnan)". *Acta Archaeologica Sinica*, 2, 263-96.

Yunnan Sheng Wenwu Kaogu Yanjiusuo 云南省文物考古研究所 (2013). "Yunnan Jiangchuan Guangfentou Yizhi Kaogu Fajue Shouhou 云南江川光坟头遗址考古发掘收获 (Important finds from the excavation of the Guangfenou site, in Jiangchuan Yunnan)". *Zhongguo Wenwubao*, 8.

Yunnan Sheng Wenwu Kaogu Yanjiusuo 云南省文物考古研究所 (2017). "Yunnan Tonghai Xingyi Yizhi 云南通海兴义遗址发掘 (Excavation of the Xingyi site in Tonghai)". *Zhongguo Wenwubao*, 8, 1-3.

Yunnan Sheng Wenwu Kaogu Yanjiusuo 云南省文物考古研究所; Meiguo Mixiegen Daxue Renleixue Xi 美国密歇根大学人类学系 (2012). "Yunnan Dianchi Diqu Juluo Yizhi 2008 Nian Diaochabao 云南滇池地区聚落遗址2008 年调查简报 (Report of the 2008 survey of the settlements in the Dian Basin, Yunnan)". *Kaogu*, 1, 23-33.

Yunnan Sheng Wenwu Kaogu Yanjiusuo 云南省文物考古研究所; Meiguo Zhijiage Daxue 美国芝加哥大学 (University of Chicago); Meiguo Mixiegen Daxue Renleixue Bowuguan 美国密歇根大学人类学博物馆 (Dept. of Archaeology, University of Michigan) (2014). "Yunnan Dianchi Pendi 2010 Nian Juluo Kaogu Diaocha Jianbao 云南滇池盆地2010 年聚落考古调查简报 (Report on the 2010 survey of the settlements in the Dian Basin, Yunnan)". *Kaogu*, 5, 29-36.

Yunnan Sheng Wenwu Kaogu Yanjiusuo 云南省文物考古研究所; Nujiang Zhou Wenwu Guanlisuo 怒江州文物管理所; Lanping Xian Wenwu Guanlisuo 兰坪县文物管理所编著 (eds) (2020). *Lanping Yushuiping* 兰坪玉水坪 (Yuhuiping Site of Lanping County). Beijing: Cultural Relics Press.

Yunnan Sheng Wenwu Kaogu Yanjiusuo 云南省文物考古研究所; Meiguo Zhijiage Daxue 美国芝加哥大学 (University of Chicago) (2019). "Yunnan Jinning Hebosuo He Shangxihe Yizhi Qingtong Shidai Beiqiu Yizhi Shijue Jianbao 云南晋宁河泊所和上西河遗址青铜时代贝丘遗址视觉简报 (Preliminary report on the excavation of the Bronze Age shellmidden sites of Hebosuo and Shangxihe in Jinning, Yunnan)". *Jianghan Kaogu*, 2, 17-29.

Zaw, K. et al. (2014). "Tectonics and Metallogeny of Mainland Southeast Asia – A Review and Contribution". *Gondwana Research*, 26, 5-30. `https://doi.org/10.1016/j.gr.2013.10.010`

Zeitoun, V.; Forestier, H.; Nakbunlung, S. (eds) (2008). *Préhistoires au Sud du Triangle d'Or.* Marseille: IRD Éditions.

Zeng, X. et al. (2015). "The Draft Genome of Tibetan Hulless Barley Reveals Adaptive Patterns to the High Stressful Tibetan Plateau". *Proceeding of the National Academy of Sciences (PNAS)*, 112, 1095-100. https://doi.org/10.1073/pnas.1423628112

Zhang, A. et al. (2023). "Geographic Distribution of C4 Species and its Phylogenetic Structure across China". *Frontiers in Plant Science*, 14. https://doi.org/10.3389/fpls.2023.1214980

Zhang, C.; Hung, H.-C. (2010). "The Emergence of Agriculture in Southern China". *Antiquity*, 84(323), 11-25. https://doi.org/10.1017/s0003598x00099737

Zhang, C.; Hung, H.-C. (2012). "Later Hunter-Gatherers in Southern China, 18 000-3000 BC". *Antiquity*, 86(331), 11-29. https://doi.org/10.1017/s0003598x00062438

Zhang, C.; Hung, H.-C. (2013). "Jiahu 1: Earliest Farmers Beyond the Yangtze River". *Antiquity*, 87(33), 46-63. https://doi.org/10.1017/s0003598x00048614

Zhang Delin 张德琳 et al. (2012). "Yunnan Yiliang Shamaoshan Dian Wenhua Mudi Fajue Baogao 云南宜良纱帽山滇文化墓地发掘报告 (Report on the excavation of the Dian culture Shamaoshan cemetery in Yiliang, Yunnan)". *Nanfang Minzu Kaogu*, 313-32, 479-86.

Zhang, E. et al. (2017). "Millennial-Scale Hydroclimate Variations in Southwest China Linked to ropical Indian Ocean since the Last Glacial Maximum". *Geology*, 45(5), 435-8. https://doi.org/10.1130/g38309.1

Zhang, H. et al. (2010). "Archaeobotanical and GIS-Based Approaches to Prehistoric Agriculture in the Upper Ying Valley, Henan, China". *Journal of Archaeological Science*, 37, 1480-9. https://doi.org/10.1016/j.jas.2010.01.008

Zhang, H. (forthcoming). "A Brief Introduction to the History of Field Archaeology in China". Hein, A.; Lovell, J. (eds), *Oxford Handbook on the History and Practice of Chinese Archaeology*. Oxford: Oxford University Press.

Zhang, J.; Cui, Q. (2013). "The Jiahu Site in the Huai River Area". Underhill, A.P. (ed.), *A Companion to Chinese Archaeology*. Oxford: Blackwell, 194-212.

Zhang, J. et al. (2011). "Holocene Monsoon Climate Documented by Oxygen and Carbon Isotopes from Lake Sediments and Peat Bogs in China: A Review and Synthesis". *Quaternary Science Reviews*, 30(15-16), 1973-87. https://doi.org/10.1016/j.quascirev.2011.04.023

Zhang, J. et al. (2012). "Early Mixed Farming of Millet and Rice 7800 Years Ago in the Middle Yellow River Region, China". *PLoS ONE,* 7(12), e52146. https://doi.org/10.1371/journal.pone.0052146

Zhang Juan 张娟 et al. (2018). "Anhui Diaoyutai Yizhi Tanhua Zhiwu Yicun Yanjiu 安徽蚌埠钓鱼台遗址炭化植物遗存研究 (Research on the charred plant remains from the Diaoyutai site in Bengbu City, Anhui Province)". *Quaternary Sciences*, 38(2), 393-405.

Zhang, J.Z.; Wang, X.K. (1998). "Notes on the Recent Discovery of Ancient Cultivated Rice at Jiahu, Henan Province: A New Theory Concerning the Origin of *Oryza japonica* in China". *Antiquity*, 72, 897-901. https://doi.org/10.1017/s0003598x00087536

Zhang, J.X.; Wang, W.M.; Gao, F. (2022). "Phytolith Analysis of Naminan Archaeological Site in Jinghong City, Yunnan Province". *JUSTC*, 52(3), 11-19. https://doi.org/10.52396/justc-2021-0265

Zhang Junna 张俊娜; Xia Zhengkai 夏正楷; Zhang Xiaohu 张小虎 (2014). "Luoyang Pendi Xinshiqi-Qingtong Shiqi De Tanhua Zhiwu Yicun 洛阳盆地新石器-青铜时期的炭化植物遗存 (Research on charred plant remains from the Neolithic to the Bronze Age in Luoyang Basin)". *Chinese Science Bulletin*, 59(34), 3388-97.

Zhang Juzhong 张居中 et al. (2004). "Huaihe Liuyu Shiqian Daozuo Nongye yu Wenming Jincheng de Guanxi 淮河流域史前稻作农业与文明进程的关系 (A sketch on the relation between prehistoric rice-agriculture and civilization progress in the Huai River valley)". Shandong Daxue Dongfang Kaogu Yanjiu Zhongxin 山东大学, 东方考古研究中心 (ed.), *Dongfang Kaogu (diyiji)* 东方考古 (第 – 辑) (East Asian Archaeology, Vol. 1). Beijing: Science Press, 198-209.

Zhang Juzhong; Wang Xiangshen 王象坤 (1998). "Jiahu yu Pengtoushan Daozuo Wenhua Bijiao Yanjiu 贾湖与彭头山稻作文化比较研究 (Comparative study of the rice cultures of Jiahu and Pengtoushan)". *Nongye Kaogu*, 1, 108-17.

Zhang Juzhong et al. (2018). "Henan Wuyang Jiahu Yizhi Zhiwu Kaogu Yanjiu de Xin Jinzhan 河南舞阳贾湖遗址植物考古研究的新进展 (New progress in archaeobotanical research of Jiahu site, Wuyang, Henan)". *Kaogu*, 4, 100-10.

Zhang Ke 张颖; Sun Yonggang 孙永刚(2022). "Zhaobaogou Wenhua Shengye Fangshi Yanjiu 赵宝沟文化生业方式研究 (Research on the Zhaobaogou culture subsistence)". *Chifeng Xueyuan Xuebao*, 43(3), 84-9.

Zhang, N.M. et al. (2017). "Diet Reconstructed from an Analysis of Plant Microfossils in Human Dental Calculus from the Bronze Age Site of Shilinggang, Southwestern China". *Journal of Archaeological Science,* 83, 41-8. https://doi.org/10.1016/j.jas.2017.06.010

Zhang Qiongmei 张琼梅 (2017). "Tonghai Xingyi Qiubei Yizhi Fajue Shou Zhongda Faxian 通海兴义贝丘遗址发掘获重大发现 (Major discoveries in the excavation of the Tonghai Xingyi Shellmound site)". Sun Jinhui 孙金会 (ed.), *Yuxi Nianjian* 玉溪年鉴 (Yuxi Yearbook). Kunming: Yunnan People Publishing House, 426.

Zhang Quanchao 张全超 (2011). "Yunnan Chengjiang Xian Jinlianshan Mudi Chutu Rengu Wending Tongweisu de Chubu Fenxi 云南澄江县金莲山墓地出土人骨稳定同位素的初步分析 (Prelimenary isotopic analysis of human skeletons recovered from Jinlianshan cemetery, Chengjiang county, Yunnan)". *Kaogu*, 1, 3-30.

Zhang Tao 张涛 (2016). "Shilun Yunnan Diqu Jiushiqi Shidai Wanqi Wenhua de Quyuxing Tedian 试论云南地区旧石器时代晚期文化的区域性特点 (On the regional characteristics of late Paleolithic culture in Yunnan region)". *Sichuan Wenwu*, 1, 61-71.

Zhang Wenxu 张文绪; Wang Lili 王莉莉 (1998). "Qi ge Daozhong Yepian Guisuanti de Yanjiu 7个稻种叶片硅酸体的研究 (Phytoliths in leaves of 7 *Oryza* species)". *Zhongguo Nongye Daxue Xuebao*, 3(3), 21-8.

Zhang Wenxu 张文绪; Yuan Jiarong 袁家荣 (1998). "Hunan Daoxian Yuchanyan Gu Zaipeidao de Chubu Yanjiu 湖南道县玉蟾岩古栽培稻的初步研究 (A Preliminary Study on the Ancient Rice Excavated from Yuchanyan, Daoxian, Hunan Province)". *Acta Agronomica Sinica*, 4, 416-20.

Zhang, X. et al. (2022a). "Plant Consumption by Early-Middle Neolithic Peoples in Guangxi, South China: Archaeobotanical Evidence From the Dingsishan Site". *Frontiers in Earth Science*, 10. https://doi.org/10.3389/feart.2022.879908

Zhang, X. et al. (2022b). "A Late Pleistocene Human Genome from Southwest China". *Current Biology*, 32(14), 3095-109, e5. https://doi.org/10.1016/j.cub.2022.06.016

Zhang, X.X. et al. (2014). "Isotope Studies of Human Remains from Mayutian, Yunnan Province, China". *Journal of Archaeological Science*, 50, 414-19. https://doi.org/10.1016/j.jas.2014.08.001

Zhang, Y.K. et al. (2020). "Early Holocene Phytolith Records for Three Shell Midden Sites, Yongjiang River, Guangxi Province, China". *The Holocene*, 31(1), 95-107. https://doi.org/10.1177/0959683620961483

Zhang, Y.K. et al. (2024). "A MicroCT Assessment of Archaeological Parenchyma from Three Riverine Shell Middens Dating to the Early Holocene, Yongjiang River Basin, Guangxi, southern China". *Journal of Archaeological Science: Reports*, 56, 104553. https://doi.org/10.1016/j.jasrep.2024.104553

Zhang Ye 张烨; He Jiana 何佳娜 (2022). "Yunnan Xinshiqi Shidai Muzang Yanjiu 云南新石器时代墓葬研究 (Study on the Neolithic burials in Yunnan)". *Wenwu Jianding yu Jianshang*, 7, 94-9.

Zhang Yekun 张烨昆 et al. (2021). "Guangxi Yongjiang Liuyu Zao Quanxinshi Baoqiu Yizhi de Shengye Xingtai he Dingju Moshi Fenxi: Lai zi Zhiwu Yicun de Zonghe Zhengju 广西邕江流域早全新世贝丘遗址的生业形态和定居模式分析: 来自植物遗存的综合证据 (Analysis of subsistence strategy and settlement pattern of the Early Holocene shell midden site in the Yong River basin, Guangxi: Comprehensive evidence from archaeobotanical remains)". *Quaternary Sciences*, 41(5), 1408-24.

Zhang Yu 张俞 et al. (2024). "Yunnan Dayingdong Yizhi MIS3 Jieduan Yilai de Huanjing Bianqian yu Renlei Huodong 云南大阴洞遗址 MIS3 阶段以来的环境变迁与人类活动 (Environment evolution and human activities since MIS3 at Dayingdong site, Yunnan)". *Quaternary Sciences*, 44(1), 29-47.

Zhang, Z.W. et al. (2019). "The Importance of Localized Hunting of Diverse Animals to Early Inhabitants of the Eastern Tibetan Plateau at the Neolithic site of Xiaoenda". *Quaternary International*, 529, 38-46. https://doi.org/10.1016/j.quaint.2019.09.019

Zhao, C.Q. (2013). "The Longshan Culture in Central Henan province". Underhill, A.P. (ed.), *A Companion to Chinese Archaeology*. Oxford: Blackwell, 236-54.

Zhao, C. et al. (2021a). "Paleoclimate Significance of Reconstructed Rainfall Isotope Changes in Asian Monsoon Region". *Geophysical Research Letters*, 48(12), e2021GL092460. https://doi.org/10.1029/2021gl092460

Zhao, C. et al. (2021b). "Possible Obliquity-Forced Warmth in Southern Asia During the Last Glacial Stage". *Science Bulletin*, 66(11), 1136-45. https://doi.org/10.1016/j.scib.2020.11.016

Zhao Chaohong 赵朝洪 (2006). "Beijing Shi Mentougou Qu Donghulin Shiqian Yizhi 北京市门头沟区东胡林史前遗址 (The Prehistoric Site of Donghulin, District of Mentougou in Beijing)". *Kaogu*, 7, 3-8, 97-8.

Zhao Dongyue 赵东月 et al. (2022). "Tongguo Weiding Tongweisu Fenxi Yunnan 通过稳定同位素分析云南大阴洞遗址先民的生业经济方式 (Analysis of the economy of Dayingdong people from stable isotopes data)". *Acta Anthropologica Sinica*, 4, 2, 295-307.

Zhao Dongyue 赵东月; Zhu Hong 朱泓; Min Rui (2016). "Yunnan Binchuan Baiyangcun Xinshiqi Shidai Yizhi Rengu Yanjiu 云南宾川白羊村新石器时代遗址人骨研究 (Study on the human bones from the Neolithic site of Baiyangcun in Binchuan, Yunnan)". *Nanfang Wenwu*, 1, 160-5.

Zhao Kelang 赵克良 et al. (2012). "Xinjiang 新疆新塔拉遗址农业活动特征及其影响的植物指标记 (Characteristics of agricultural activies and their impact on the environment at the Xintala Site, Xinjiang, as reconstructed from archaeobotanical remains)". *Quaternary Sciences*, 32(2), 219-25.

Zhao Min 赵敏 (2009). *Shandong Sheng Jimo Beiqian Yizhi Tanhua Zhiwu Yicun Yanjiu* 山东省即墨北阡遗址炭化植物遗存研究 (Research on the charred plant remains from the site of Beiqian in Jimo, Shandong) [Master's thesis]. Jinan: Department of Archaeology, Shandong University.

Zhao Min et al. (2008). "Shandong Sheng Jinan Shi Tangye Yizhi Fuxuan Jieguo 山东省济南市唐冶遗址浮选结果分析 (Results on the flotation at the site of Tangye, Jinan, Shandong)". *Nanfang Wenwu*, 2, 119-25.

Zhao, S.Q. (1986). *Physical geography of China*. New York: John Wiley and Sons Ltd.

Zhao, S.Q. (1994). *Geography of China: Environment, Resources, Population, and Development*. New York: John Wiley and Sons Ltd.

Zhao Wenyi 赵文艺 (1983). "Banpo Yizhi 半坡遗址 (The site of Banpo)". *Lishi Jiaoxue Wenti*, 6, 60-1.

Zhao Zhezhen 赵珍珍; Cao Yanpeng 曹艳朋; Jin Guiyun (2019). "Henan Shuiyang Pingliangtai Yizhi (2014-2015) Longshan Shiqi Tanhua Zhiwu Yicun Yanjiu 河南淮阳平粮台遗址 (2014-2015) 龙山时期炭化植物遗存研究 (Analysis of plant remains from Pingliangtai site in Longshan Period)". *Zhongguo Nongshi*, 38, 19-32.

Zhao, Z.J. (1998). "The Middle Yangtze Region in China is One Place Where Rice Was Domesticated: Phytolith Evidence from the Diaotonghuan Cave, Northern Jiangxi". *Antiquity,* 72(278), 885-97. https://doi.org/10.1017/s0003598x00087524

Zhao, Z.J. (2011). "New Archaeobotanic Data for the Study of the Origins of Agriculture in China". *Current Anthropology,* 52, Supplement 4, S295-304. https://doi.org/10.1086/659308

Zhao Zhijun 赵志军 (1992). "Zhiwu Kaoguxue Gaishu 植物考古学概述 (Archaeobotany: an overview)". *Nongye Kaogu*, 1, 26-31.

Zhao Zhijun (2001). "Zhiwu Kaoguxue de Xueke Dingwei yu Yanjiu Neirong 植物考古学的学科定位与研究内容 (Disciplinary Position and Research Content of Paleoethnobotany)". *Kaogu*, 7, 55-61.

Zhao Zhijun (2003a). "Yunnan Yongren Mopandi Xinshiqi Shidai Yizhi Chutu Daogu Yicun Fenxi Baogao 云南永仁磨盘地新石器时代遗址出土稻谷遗存分析报告 (Analytical report on the rice remains unearthed from the Neolithic site of Mopandi, in Yongren, Yunnan)". *Acta Archaeologica Sinica*, 2, 294-5.

Zhao Zhijun (2003b). "Fuxuanfa: Faxian he Yanjiu Gudai Zhiwu de Fangfa 浮选法：发现和研究古代植物的方法 (Flotation: a method for the discovery and research of ancient plant remains)". *Zhongguo Wenwubao*, 11 July. http://www.kaogu.cn/cn/xueshuyanjiu/yanjiuxinlun/kejikaogu/2013/1025/33517.html

Zhao Zhijun (2004a). "Zhiwu Kaoguxue de Tianye Gongzuo Fangfa Fuxuanfa 植物考古学的田野工作方法－浮选法 (Flotation: a Paleobotanic Method in Field Archaeology)". *Kaogu,* 3, 80-7, 2.

Zhao Zhijun (2004b). "Cong Xinglonggou Yizhi Fuxuan Jieguo Tan Zhongguo Beifang Hanzuo Nongye Qiyuan Wenti 从兴隆沟遗址浮选结果谈中国北方旱作农业起源问题 (The origins of dryland agriculture in North China: Inferrence from the flotation result at the Xinglonggou site)". *Dongya Wugu,* A, 188-99.

Zhao Zhijun (2004c). "Liangchengzhen yu Liaochangpu Longshan Shidai Nongye Shengchan Tedian de Duibi Fenxi 两城镇与教场铺龙山时代农业生产特点的对比分析 (A comparison of the archaeobotanical remains between the Liangchengzhen and Jiaochangpu). *Dongfang Kaogu*, 1, 210-24.

Zhao Zhijun (2005a). "Zhiwu Kaogu ji qi Xin Jinzhan 植物考古及其新进展 (Archaeobotany and its recent Advances)". *Kaogu*, 7, 42-9, 2.

Zhao Zhijun (2005b). "Youguan Nongye Qiyuan he Wenming Qiyuan de Zhiwu Kaoguxue Yanjiu 有关农业起源和文明起源的植物考古学研究 (Archaeobotanical research on the origins of agriculture and the rise of civilisation)". *Shehui Kexue Guanli yu Pinglun*, 2, 82-91.

Zhao Zhijun (2006a). "Dui Huanan Diqu Yuanshi Nongye de Renshi 对华南地区原始农业的再认识 (Recognition of the primitive agriculture in southern China)". Zhongguo Shehui Kexue Xueyuan Kaogu Yanjiusuo 中国社会科学院考古研究所 (ed.), *Huanan ji Dongnanya Diqu Shiqian Kaogu* 华南及东南亚地区史前考古 (The prehistoric archaeology of southern China and Southeast Asia). Beijing: Cultural Relics Press, 145-56.

Zhao Zhijun (2006b). "Taosi Chengzhi 2002 Niandu Fuxuan Jieguo ji Fenxi 陶寺城址2002年度浮选结果及分析 (Flotation Results from the Remains Excavated on the Taosi City-site in 2002 and Their Analysis). *Kaogu*, 5, 77-86, 104, 2.

Zhao Zhijun (2007). "Gongyuan Qian 2005 Nian – Gongyuan Qaun 1500 Nian Zhonyuan Diqu Nongye Jingji Yanjiu 公元前 2500 年– 公元前1500 年中原地区农业经济研究 (Research into the agricultural economy of the Central Plains 2500-1500 BC)". *Keji Kaogu*, 2, 1-11.

Zhao Zhijun (2009). "Xi'an Hanmu Taocang Chutu Zhiwu Yicunde Jianding he Fenxi 西安汉墓陶仓出土植物遗存的鉴定和分析 (Identification and analysis of plant remains unearthed from the pottery warehouse in Xi'an Han Tomb)". Xi'an Shi Wenwu Baohu Kaogusuo 西安市文物保护考古所 (ed.), *Xi'an Donghan Mu* 西安东汉墓 (Xi'an Eastern Han Dynasty Tomb). Beijing: Cultural Relics Press, 1077-88.

Zhao Zhijun (2010a). *Zhiwu Kaoguxue ~ Lilun, Fangfa he Shijian* 植物考古学〜理论、方法和实践 (Archaeobotany: Theory, Methods, and Practice). 1st ed. Beijing: Science Press.

Zhao Zhijun (2010b). "Shifodong Yizhi Zhiwu Yicun Fenxi Baogao 石佛洞遗址植物遗存分析报告 (Report on the analysis of the plant remains from the Shifodong site)". *Gengma Shifodong* 耿马石佛洞 (Shifodong in Gengma). Beijing: Science Press.

Zhao Zhijun (2011). "Zhonghua Wenming Xingcheng Shiqi de Nongye Jingji Fazhan Tedian 中华文明形成时期的农业经济发展特点 (Characteristics of agricultural economy during the formation of ancient Chinese civilization)". *Zhongguo Guojia Bowuguan Guankan*, 1, 19-31.

Zhao Zhijun (2017). "Yangshao Wenhua Shiqi Nonggeng Shengchan de Fazhan he Nongye shehui de Jianli Yuhuazhai Yizhi Fuxuan Jieguo de Fenxi 仰韶文化时期农耕生产的发展和农业社会的建立 – 鱼化寨遗址浮选结果的分析 (The development of agricultural production and the establishment of agricultural society during the Yangshao Culture Period – Analysis of flotation results at the Yuhuazhai site)". *Jianghan Kaogu*, 6, 98-108.

Zhao Zhijun (2019). "Weihe Pingyuan Gudai Nongye de Faxhan yu Bianhua – Hua Xian Dongyang Yizhi Chutu Zhiwu Yicun Fenxi 渭河平原古代农业的发展与变化 – 华县东阳遗址出土植物遗存分析 (Changes and Development of Ancient Agriculture on Weihe Plain: An Analysis of Plant Remnants Excavated from Dongyang Site in Huaxian District)". *Huaxia Kaogu*, 5, 70-84.

Zhao Zhijun (2022). Keynote speech at the "Jiangan Gudai Zhiwu Yu Shehui – Zhiwu Kaogu Guoji Xueshu Duihua 江南古代植物与社会 – 植物考古国际学术对话 (Ancient Plants and Society south of the Yangzi River –International Symposium on Archaeobotany)". *Symposium organized by the the School of Art and Archaeology of Zhejiang University and the Institute of Environmental Archeology of Nanjing Normal University, co-organized by Department of Archeology, University of Cambridge in Hangzhou* (Hangzhou, 26 November 2022).

Zhao Zhijun et al. (2020). "Bejing Donghulin Yizhi Zhiwu Yicun Fuxuan Jieguo ji Fenxi 北京东胡林遗址植物遗存浮选结果及分析 (Results of flotation and analysis of archaeobotanical remains from Donghulin site, Beijing)". *Kaogu*, 7, 99-106.

Zhao Zhijun; Chen Jian 陈剑 (2011). "Sichuan Maoxian Yingpanshan Yizhi Fuxuan Jieguo ji Fenxi 四川茂县营盘山遗址浮选结果及分析 (Results of the Flotation Carried out at the Site of Yingpanshan in Maoxian County, Sichuan)". *Nanfang Wenwu,* 3, 60-7.

Zhao Zhijun; Fang Yanming 方燕明 (2007). "Dengfeng Wangchenggang Yizhi Fuxuan Jieguo ji Fenxi 登封王城岗遗址浮选结果及分析 (Analysis and results of flotation samples from Wangchenggang site, Dengfeng)". *Huaxia Kaogu*, 2, 78-89.

Zhao Zhujin; Flad Rowan 傅罗文 (2013). "Zhongba Yizhi Fuxuan Jieguo Fenxi Baogao 中坝遗址浮选结果分析报告(Report on flotation results from the Zhongba site in Chongqing)". Li

Shuicheng 李水城; Falkenhausen, L. von 罗泰编 (eds), *Zhongguo Yanye Kaogu Disanji* 中国盐业考古 (第三辑) (Salt archaeology in China, vol. 3). Beijing: Science Press.

Zhao Zhijun; He Nu 何驽 (2006). "Taosi Chengzhi 2002 Niandu Fuxuan Jieguo ji Fenxi 陶寺城址2002 年度浮选结果及分析 (Results and analysis of flotation performed in 2002 at the site of Taosi)". *Kaogu*, 5, 77-86.

Zhao Zhijun; Jiang Leping 蒋乐平 (2016). "Zhejiang Pujiang Shangshan Yizhi Fuxuan Chutu Zhiwu Yicun 浙江浦江上山遗址浮选出土植物遗存分析 (Anlaysis of plant remains recovered through flotation at the Shangshan site, in Pujiang, Zhejiang)". *Nanfang Wenwu*, 3, 109-16.

Zhao Zhijun; Xu Lianggao 徐良高 (2004). "Zhouyuan Yizhi (Wangjiazui Didian) Changshixing Fuxuan de Jieguo ji Chubu Fenxi 周原遗址（王家嘴地点）尝试性浮选的结果及初步分析Results and preliminary analysis of trial flotation at the Zhouyuan site (Wangjiazui location)". *Wenwu*, 10, 89-96.

Zhao Zhijun; Zhang Juzhong 张居中 (2009). "Jiahu Yizhi 2001 Niandai Fuxuan Jieguo Fenxi Baogao 贾湖遗址 2001 年度浮选结果分析报告 (Report on the analysis of the flotation results from the site of Jiahu in 2001)". *Kaogu* 8, 84-93, 109.

Zhejiang Sheng Wenwu Guanli Anyuanhui 浙江省文物管理委员会; Zhejiang Sheng Bowuguan 浙江省博物馆 (1978). "Hemudu Yizhi Diyiqi Fajue Baogao 河姆渡遗址第 – 期发掘报告 (Report of the First Excavation at the Hemudu Site)". *Acta Archaeologica Sinica*, 1, 39-94.

Zhejiang Sheng Wenwu Kaogu Yanjiusuo 浙江省文物考古研究所 (2003). *Hemudu: Xinshiqi Shidai Yizhi Kaogu Fajue Baogao* 河姆渡：新石器时代遗址考古发掘报告 (Hemudu: an Excavation Report of the Neolithic Site). Beijing: Cultural Relics Publishing House.

Zhejiang Sheng Wenwu Kaogu Yanjiusuo 浙江省文物考古研究所 (2004). *Kuahuqiao* 跨湖桥 (Kuahuqiao Site Report). Beijing: Cultural Relics Publishing House.

Zheng, Y.F. (2009). "Rice Fields and Modes of Rice Cultivation Between 5000 and 2500 BC in East China". *Journal of Archaeological Science,* 36(12), 2609-16. `https://doi.org/10.1016/j.jas.2009.09.026`

Zheng, Y.F.; Crawford, G.W.; Chen, X. (2014). "Archaeological Evidence for Peach (*Prunus persica*) Cultivation and Domestication in China". *PLoS ONE*, 9(9), e106595. `https://doi.org/10.1371/journal.pone.0106595`

Zheng, Y.F.; Sun, G.P.; Chen, X.G. (2007). "Characteristics of the Short Rachillae of Rice from Archaeological Sites Dating to 7000 Years Ago". *Chinese Science Bulletin,* 52(12), 1654-60. `https://doi:10.1007/s11434-007-0258-1`

Zheng Yiqun 郑益群 et al. (2002). "Quyu Qihou Moshi Dui Moci Shengbingqi Dongya Jifeng Qihou de Moni Yanjiu 区域气候模式对末次盛冰期东亚季风气候的模拟研究 (Paleoclimate simulation of mid Holocene for East Asia, and discussion of the temperature change)". *China Science Series D*, 10, 871-80.

Zheng Yunfei 郑云飞 et al. (1994). "Longnan Yizhi Hongshaotu Zhiwu Danbaishi Fenxi 龙南遗址红烧土植物蛋白石分析 (Phytoliths analyses from the red soil of the site of Longnan)". *Zhongguo Shuidao Kexue,* 1, 55-6.

Zheng Yunfei et al. (1999). "Taihu Diqu Bufen Xinshiqi Shidai Yizhi Shuidao Guisuanti Xingzhuang Tezheng Chutan 太湖地区部分新石器时代遗址水稻硅酸体形状特征初探 (Investigation on the rice phytoliths from Neolithic sites in the Taihu area)". *Zhongguo Shuidao Kexue*, 1, 25-30.

Zheng Yunfei; Chen Xugao 陈旭高; Ding Pin 丁品 (2014). "Zhejiang Yuhang Maoshan Yizhi Gu Daotian Gengzuo yi ji Yanjiu 浙江余杭茅山遗址古稻田耕作遗迹研究(Studies on the archaeological paddy fields at Maoshan site in Zhejiang)". *Quaternary Sciences*, 34(1), 85-96.

Zhengzhou Shi Wenwu Kaogu Yanjiusuo 郑州市文物考古研究所 (1997). "Xiangyang Fangjinzhai Xinshiqi Shidai Yizhi Fajue Jianbao 荥阳方靳寨新石器时代遗址发掘简报 (A brief report on the excavation of the Neolithic site at Fangjinzhai, Xingyang). *Zhongyuan Wenwu*, 3, 2-13.

Zhong Hua 钟华 (2022). "Ye Tan "Wuwu Fengdeng" 也谈"五谷丰登" (Also talking about "a bumper harvest")". *Zhongguo Shehui Kexuebao*, 2457, 27 July 2022. `http://www.cass.cn/xueshuchengguo/xscg_lsyjy/202207/t20220727_5419944.shtml`

Zhong Hua et al. (2015). "Shaanxi Sheng Lantian Xian Xinjie yizhi Tanhua Zhiwu Yicun Yanjiu 陕西省蓝田县新街遗址炭化植物遗存研究 (Research on carbonized plant remains at the Xinjie site in Lantian County, Shaanxi Province)". *Nanfang Kaogu*, 3, 36-43.

Zhong Hua et al. (2016). "Henan Xinzhai Yizhi 2014 Nian Fuxun Jieguo ji Fenxi 河南新密新砦遗址2014年浮选结果及分析 (Flotation results and analysis of the Xinzhai site in Xinmi, Henan in 2014)". *Nongye Kaogu*, 1, 21-9.

Zhong Hua et al. (2018). “Henan Dengfeng Chaoyao Yizhi Fuxuan Jieguo yu Fenxi 河南登封程窑遗址浮选结果与分析 (Flotation results and analysis of the Chengyao site in Dengfeng, Henan)”. *Nongye Kaogu*, 6, 7-16.

Zhong Hua et al. (2020). “Zhongyuan Diqu Miaodgou Shiqi Nongye Shengchan Moshi Chutan 中原地区庙底沟时期农业生产模式初探 (Preliminary research of the farming production pattern in the Central Plain area during the Miaodigou Period)”. *Quaternary Sciences*, 40(2), 472-85.

Zhongguo Huanjing Baohuju 中国环境保护总局 (State Environmental Protection Administration) (ed.) (1998). *Zhongguo Shengwu Duoyangxing Guoqing Yanjiu Baogao* 中国生物多样性国情研究报告 (China’s biodiversity: a country study). Beijing: China Environmental Science Press.

Zhongguo Kexue Yuan Kaogu Yanjiusuo 中国科学院考古研究所 (1963). *Xi’an Banpo: Yuanshi* Minzu Gongshe Juluo Yizhi 西安半坡：原始氏族公社聚落遺址 (Banpo in Xi’an: settlement ruins of a communal primitive society). Beijing: Cultural Relics Press.

Zhongguo Shehui Kexueyuan Kaogu Yanjiusuo Henan Yidui 中国社会科学院考古研究所河南－队 (1984). “1979 Nian Peiligang Yizhi Fajue Baogao 1979年裴李岗遗址发掘报告 (Report on the 1979 excavation of the Peiligang site)”. *Acta Archaeologica Sinica*, 1, 23-52, 137-46.

Zhongguo Shehui Kexueyuan Kaogu Yanjiusuo 中国社会科学院考古研究所 (ed.) (1991). *Qinglongquan yu Dasi* 青龙泉与大寺(Qinglongquan and Dasi). Beijing: Science Press, 201-5.

Zhongguo Shehui Kexueyuan Kaogu Yanjiusuo 中国社会科学院考古研究所 (2010). *Zhongguo Kaoguxue: Xinshiqi Shidai Juan* 中国考古学: 新石器时代卷 (Chinese archaeology: Neolithic archaeology). Beijing: Chinese Social Sciences Press.

Zhongguo Shehui Kexueyuan Kaogu Yanjiusuo 中国社会科学院考古研究所 et al. (ed.) (2003). *Guilin Zengpiyan* 桂林甑皮岩 (The site of Zengpiyan in Guilin). Beijing: Cultural Relics Press.

Zhou, H.; Wang, X.; Zhao, Z. (2024). “Early Neolithic Plant Exploitation in North-Western China: Archaeobotanical Evidence from Beiliu”. *Antiquity,* 98(402), 1505-21. https://doi.org/10.15184/aqy.2024.190

Zhou Kunshu 周昆叔 (1963). “Xi’an Banpo Xinshiqi Shidai Yizhi de Baofenxi 西安半坡新石器時代遺址的孢粉分析 (Pollen Analysis from the Neolithic Banpo Site in Xi’An)”. *Kaogu*, 9, 520-2.

Zhou Kunshu (2002). *Huafen Fenxi yu Huanjing Kaogu* 花粉分析与环境考古 (Palynology and Environmental Archaeology). Beijing: Academy Press 北京: 文书学社.

Zhou Kunshun (1985). *Zhongguo Ziran Dili* 中国自然地理 (The Natural Geography of China). Beijing: Science Press.

Zhou Kunshun (1993). “Kuatuo Huanjing Kaoguxue Xin Lingyu 开拓环境考古学新领域 (Exploration of the new field of Environmental Archaeology)”. *Zhongguo Kexue Jichu*, 4, 266-9.

Zhou Kunshun; Hu Jilan 胡继兰 (1988). “Shuidonggou Yizhi de Huanjing yu Diceng 水洞沟遗址的环境与地层 (Environment and Stratigraphy at the Shuidonggousite)”. *Acta Archaeologica Sinica*, 3, 263-9.

Zhou Kunshun; Yan Fuhua 严富华; Xie Yongying 叶永英 (1975). “Huafen Fenxifa ji qi zai Kaoguxue zhong de Yinyong 花粉分析法及其在考古学中的运用 (The application of pollen studies in Archaeology)”. *Kaogu*, 1, 64-70.

Zhou, X.Y. (2024). “The Climate Transition in the Middle Holocene and the Response of Ancient Civilizations in Central Asia”. *Environment, Land Use and Urbanization in Ancient Central Asia Conference* (Jena, Germany, 22-26 January 2024).

Zhou, X.Y. et al. (2020). “5,200-Year-Old Cereal Grains from the Eastern Altai Mountains Redate the Trans-Eurasian Crop Exchange”. *Nature Plants*, 6(2), 78-87. https://doi.org/10.1038/s41477-019-0581-y

Zhou Xinying 周新郢 et al. (2011). “Longdong Diqu Xinshiqi Shidai de Zaoqi Nongye ji Huanjing Xiaoying 陇东地区新石器时代的早期农业及环境效应 [Early agricultural development and environmental effects in the Neolithic Longdong Basin(East Gansu)]”. *Kexue Tongbao*, 56(4), 318-26.

Zhou, Y. (2021). *Diversity and Homogeneity: The Lithic Technology in Southwest China from the Late Pleistocene to Early Holocene and its Implication to Southeast Asia Prehistory* [PhD dissertation]. Paris: Muséum National d’Histoire Naturelle.

Zhou, Y. et al. (2020). “Tangzigou Open-Air Site: A Unique Lithic Assemblage during the Early Holocene in Yunnan Province, Southwest China”. *Quaternary International*, 563, 105-18. https://doi.org/10.1016/j.quaint.2019.11.011

Zhou, Y. et al. (2024). “Extraordinary Large Hoabinhian Tools from Xiaodong Rockshelter, Southwest China”. *L’Anthropologie*, 128(1), 103235. https://doi.org/10.1016/j.anthro.2024.103235

Zhu, H.; Tan, Y. (2022). “Flora and Vegetation of Yunnan, Southwestern China: Diversity, Origin and Evolution”. *Diversity*, 14(5), 340. https://doi.org/10.3390/d14050340

Zhu, R.X. et al. (2008). “Early Evidence of the Genus *Homo* in East Asia”. *Journal of Human Evolution*, 55, 1075-1085. https://doi.org/10.1016/j.jhevol.2008.08.005

Zhu, Y. (2013). “The Early Neolithic in the Central Yellow River Valley, c. 7000-4000 BC”. Underhill, A.P. (ed.), *A Companion to Chinese Archaeology*. Oxford: Blackwell, 171-93.

Zhu Zhiyong 朱之勇; Ji Xueping 吉学平(2010). “Yunnan Baoshan Laoshu Dong Jiushiqi Shidai Yizhi Shiqi Yanjiu 云南保山老虎洞旧石器遗址石器研究 (Study on the stone artifacts from the Laohu Cave Paleolithic Site, Baoshan County, Yunnan)”. *Bianjiang Kaogu Yanjiu* 边疆考古研究 (Research of China’s Frontier Archaeology). Beijing: Cultural Relics Press, 1-8.

Zhu Zhiyong; Wang Hao 王赫; Ji Xueping 吉学平 (2020). “Yunnan Baoshan Tangzigou Yizhi Chutu Shizhipin Yanjiu 云南保山塘子沟遗址出土石制品研究 (The stone products research of Tangzigou Site in Baoshan, Yunnan)”. *Bianjiang Kaogu Yanjiu* 边疆考古研究 (Research of China’s Frontier Archaeology). Beijing: Cultural Relics Press, 85-100.

Zhuang Lina 庄丽娜 et al. (2018). “Jiangsu Sihong Hanjing Yizhi 2015-2016 Nian Fajue Jianbao 江苏泗洪韩井遗址2015 – 2016年发掘简报 (Report on the 2015-2016 excavations of the Hanjing site in Sihong, Jiangsu Province)”. *Dongnan Wenhua*, 1, 28-39, 66, 127-8.

Zhuang, Y.J. (2020). “Trajectories of Agricultural Development in Prehistoric China”. Hollander, D.; Howe, T. (eds), *A Companion to Ancient Agriculture.* Hoboken: John Wiley & Sons, Inc., 611-32.

Zhuang, Y.J.; Ding, P.; French, C. (2014). “Water Management and Agricultural Intensification of Rice Farming at the Late-Neolithic Site of Maoshan, Lower Yangtze River, China”. *The Holocene,* 24(5), 531-45. https://doi.org/10.1177/0959683614522310

Zohary, D. (1999). “Monophyletic vs. Polyphyletic Origin of the Crops on which Agriculture Was Founded in the Near East”. *Genetic Resources and Crop Evolution*, 46, 133-42. https://doi.org/10.1023/A:1008692912820

Zohary, D.; Hopf, M.; Weiss, E. (2012). *Domestication of Plants in the Old World*. Oxford: Oxford University Press.

Zou, G. et al. (2017). “Investigation of Early Bronze Age Civilizations in Yunnan: A Scientific Analysis of Metallurgical Relics Found at the Guangfentou Ruins in Jiangchuan”. *Archaeological and Anthropological Sciences*, 11(1), 15-31. https://doi.org/10.1007/s12520-017-0530-5

Zou, H.B. et al. (2002). “Findings in the Paddies of Majiabang Culture at Caoxieshan, Jiangsu province)”. Yan, W.M.; Yasuda, Y. (eds), *The Origins of Rice Agriculture, Pottery and Cities*. New Delhi: Roli Books, 97-114.

Zumbroich, T.J. (2008). “The Origin and Diffusion of Betel Chewing: A Synthesis of Evidence from South Asia, Southeast Asia and beyond”. *E-Journal of Indian Medicine*, 1(3), 87.

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Today Yunnan is a major agricultural region in China, despite having just 6% of land originally deemed suitable for farming. This book traces the roots of Yunnan's agriculture, drawing on archaeological finds and direct evidence of ancient crops to show how farming first emerged in the third millennium BCE and grew after the Han conquest of the Dian. It also explores how migration, local innovation, and regional connections shaped the development of Yunnan's economy. Focusing on the Sanjiang area and Dian Basin, the book reveals how communities adapted to – and were influenced by – Yunnan's diverse landscapes, offering insights into how Yunnan's past has shaped its agricultural success.

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