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Linguistic, archaeological and genetic evidence suggests multiple agriculture-driven migrations of Sino-Tibetan speakers from Northern China to the Indian subcontinent

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ABSTRACT

The spread of language families is hypothesized to have occurred via agricultural and demographic transitions that drove populations outwards from agricultural centres of origin, "demic diffusion". However, the geographical origins of language families are often tied to where greatest linguistic diversity is seen. For the Sino-Tibetan language family this creates a conflict, as maximal linguistic diversity lies in North-Eastern India and Nepal, whereas centres of Neolithic crop domestication in the Yellow and Yangtze River Basins have low linguistic diversity today. Therefore either Sino-Tibetan languages originated in North-Eastern India, and spread by means other than demic diffusion; or multiple diffusions of agriculturalists occurred from a once linguistically diverse homeland, in which linguistic diversity was maintained or increased as peoples spread westwards, but was lost in the homeland.

To explore these two hypotheses, using evidence from linguistics, archaeology and genetics, we compiled existing data on Chinese millets, cultivated trees, and agricultural tools (harvesting knives, shouldered spades) alongside data for wheat and barley from Western Eurasia. These elements were explored alongside existing information from genetic studies and for West Asian animal domesticates.

We differentiate a northern cultural and southern demic diffusion for various elements originating in East Asia. In Central Asia a small number of eastern Eurasian elements (millets by 2500 BC, spades by 1st millennium BC) spread west through pre-existing agricultural populations by cultural-diffusion, but significantly did not include language families nor genetic lineages. The southern dispersal driven by demic diffusion of millet farmers carried a more expansive range of eastern cultural elements; millets, spades, hairpins, harvesting knives, house plans, and significantly languages and genetic lineages. We hypothesize a period of demic diffusion beginning c.2500-2000 BC from the southeastern Plateau through Eastern Tibet and the Himalayan foothills, brought peoples, languages and Eastern Eurasian cultural elements eventually to the Kashmir region. We conclude two routes, the Sichuan–Tibet–Kashmir and Yunnan–Assam ones, are the most plausible pathways linking Northern China and Northern India during this period.

1. Introduction

As stated by Bellwood (2024), 'Through their reconstructed phylogenetic history, the Sino-Tibetan languages record one of the greatest Holocene human dispersals in global prehistory', and has been argued to constitute a major example of the farming/language dispersal hypothesis (Bellwood, 2002; Sagart et al., 2019; Zhang et al., 2019b; Bradley, 2022; Bradley et al., 2024).

While evidence from genetics, archaeology and linguistics has been seen as supporting a Neolithic demic diffusion from the Yellow River Basin to the current areas where Sino-Tibetan languages are spoken (Sagart, 2008; Fuller and Stevens, 2017; Wang et al., 2021b; Liu et al., 2022a; Yang et al., 2024; Bradley et al., 2024), it has been proposed in some cases that agriculture and other aspects of Neolithic Culture were spread through cultural rather than demic diffusion (Ren et al., 2020; d'Alpoim Guedes and Aldenderfer, 2020).

Further there is a question of the direction of linguistic diffusion; be it from China to the west, with millet agriculture; or from Northeast India to China (Blench and Post, 2014).

Currently a main driver of agricultural spread is seen to be demic diffusion (Bellwood, 2005; Stevens et al., 2022), both for millet

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agriculture in East Asia (Fuller and Stevens, 2017) and for wheat and barley in the Eastern Fertile Crescent into Europe (Vander Linden and Silva, 2021). Such diffusion is then hypothesized to spread genetic lineages and language families from a homeland that generally equates with where these crops were first brought into cultivation (Bellwood and Renfrew, 2002). Present archaeological evidence argues that millets diffused to the north of the Tibetan Plateau through Central Asia into Western Eurasia, with wheat dispersing eastwards through this same region (Spengler, 2015; Stevens et al., 2016). However, there is some discussion, particularly for barley, that the westwards dispersal also took a southern route (Liu et al., 2017a). The mode of diffusion of crops, and other aspects of culture, is not always clearly distinguished in the literature, be it though exchange, cultural diffusion or demic diffusion. However, the earliest spread of language families is only likely to be associated with demic diffusion (Diamond and Bellwood, 2003).

In the case of the Sino-Tibetan family, the fact that only one subgroup (Sinitic), is found in the domestication centre of millets in the Yellow River Basin, and the absence of any Early Neolithic centre of domestication for a major crop in Nepal and North-Eastern India (where the majority of the basal subgroups are located), contradicts the view that the geographical area of maximal diversity within a language family corresponds to its original homeland Sagart et al. (2019).

In order to solve this contradiction, this paper reviews and attempts to reconcile evidence from all three disciplines, linguistics, archaeology, and genetics, regarding the possible routes of diffusion from China to the north of the India subcontinent during the last three millennia BC. After presenting this issue from the point of view of linguistic phylogenies, we turn to archaeological evidence, including cultivated plants (millets, wheat, barley, peach and apricots), agricultural tools (harvesting knives and shouldered spades), and other cultural implements (hairpins), (Supplementary databases). This is discussed alongside evidence for domesticated animals (sheep, goat and cattle). Finally we summarize the most recent work on aDNA pertinent to question of the origin of the Sino-Tibetan speaking people, and ancient populations within Central Asia.

2. Linguistic phylogenies and inferred migrations

2.1. Were Proto-Sino-Tibetan speakers farmers or hunter gatherers?

The Sino-Tibetan (ST) or Trans-Himalayan family, is the second largest language family in the world in terms of the number of speakers, comprising some 500 languages spread over China, Burma, Northern Thailand, Bangladesh, North-Eastern India, Nepal, Bhutan, and the northernmost states of India and Pakistan (Sikkim, Uttarakhand, Himachal Pradesh, Ladakh and Baltistan). One single subgroup, Sinitic languages (or 'Chinese dialects'), constitutes the overwhelming majority of ST language speakers, spread over most of the present-day People's Republic of China.

Given the large geographical extent of this family, its original homeland is the topic of an ongoing controversy. Some linguists argue for the primacy of linguistic evidence to resolve this issue, and favour North-Eastern India as the point of origin of the Sino-Tibetan family (Blench and Post, 2014), following the idea that the most likely localization of the homeland of a family corresponds to its area of maximal diversity (Heggarty, 2014).

In this hypothesis, Sino-Tibetan languages spoken in China (including Sinitic languages) originated in the north of the South Asian subcontinent. Blench and Post (2014) also propose that proto-ST speakers were foragers, based on the fact that some Sino-Tibetan people of North-East India (in particular Puroik, Idu and Milang) are thought to have adopted rice agriculture relatively recently (Stonor, 1952; Deuri, 1982; Post and Modi, 2011), and continue to consume sago as a staple food and manage semi-domesticated mithuns (*Bos frontalis*). In their view, these people have preserved an archaic lifestyle and have never developed agriculture. They also suggest that agriculture was a late development among speakers of ST languages, and that ST speakers only reached China by 3000 BC.

This view is rejected by scholars such as Sagart et al. (2019) who follow the Renfrew–Bellwood model of demic diffusion, according to which the expansion of agriculture is largely correlated to that of language families (Diamond and Bellwood, 2003), and therefore seek the homeland of ST in the areas where the crops used by ST speakers, most importantly the millets (*Setaria italica* and *Panicum miliaceum*) were first cultivated, and where pigs were first domesticated.

In the following section, we examine evidence from phylogenies and reconstructed vocabulary to evaluate the plausibility of the North-Eastern Indian vs. the Yellow River hypotheses.

2.2. Phylogenetic analysis

In order to evaluate whether the diversity of Sino-Tibetan languages spoken in North-Eastern India arose due to a recent diversification, or reflects a split that occurred early in the history of Sino-Tibetan, we analysed the tree distributions from Wu et al. (2022). This study on North-Eastern India ST languages expands the dataset of Sagart et al. (2019), and the authors provide two phylogenies in their supplementary materials https://osf.io/9x4s8/, a partial one comprising most of the subgroups of Arunachal Pradesh, excluding most Sino-Tibetan languages outside of North-Eastern India (such as Sinitic and Kiranti), and a second with the complete set of data. However, Wu et al. (2022) themselves only discuss the partial phylogeny, and the phylogeny of the complete set has never been analysed in previous publications.

Using the method described in Pellard et al. (2024) on the Covarion relaxed clock analysis of the ST phylogeny in this materials (bodtst.full80.BDSKY-vfrequency.tinymodify.tree), we analysed the dates at which the lineages spoken in North-Eastern India split from each other.

Fig. 1 represents the majority-rule (50%) consensus tree of this distribution, while Fig. 2 plots the distribution of the ages of the MRCA (most-recent common ancestor) of the entire Sino-Tibetan family, of the subgroups spoken in North-Eastern India (including Sal, Macro-Kuki-Chin, and the Arunachal groups) and of the languages of Arunachal Pradesh (Kho-Bwa, Mishmi, Tani and Hrusish).

The topology of the complete Sino-Tibetan phylogenies from the supplementary materials of Wu et al. (2022) in Fig. 1 is very rake-like, with little evidence for one single outgroup. These results are generally compatible with those of Sagart et al. (2019), with the exception of the placement of West-Himalayish and Tshangla, which appears as basal subgroups in Sagart et al. (2019), while they are clustered with Tibetic languages in Fig. 1. This discrepancy is due to the fact that these two subgroups contain a significant quantity of Tibetan loanwords, which have been excluded from the cognate sets by Sagart et al. (2019), but included by Wu et al. (2022). While this difference has incidence on the topology and dating of the phylogeny, it is less critical for the languages of North-Eastern India, which have only received a limited influence from Tibetan.

Fig. 1 shows that languages of North-Eastern India and Nepal cannot be clustered in a single subgroup. In North-Eastern India, at least three subgroups need to be posited Sal (Bodo-Garo and Jinghpo), Macro-Kuki-Chin (Tangkhul, Karbi, Kuki-Chin) and an Arunachal group (with moderate support of 82% posterior probabilities) comprising Tani, Kho-Bwa, Hru and Mishmi. The dataset is however incomplete, and subgroups such as Ao Naga, Angami-Pochuri, Zeliangrong, Milang-Koro and Meyor Zakhring have not been included (Post and Burling, 2017), and it is possible that some of them represent yet further basal subgroups. These groups are themselves all very distinct from Kham, Magar, Chepang and Kiranti, which are spoken in Nepal.

Although there is evidence for an Arunachal clade (Wu et al., 2022), the age of this clade itself is surprisingly early. The phylogeny provides a date of 8421 BP [11428 BP-5613 BP] for Proto-Sino-Tibetan, 7996

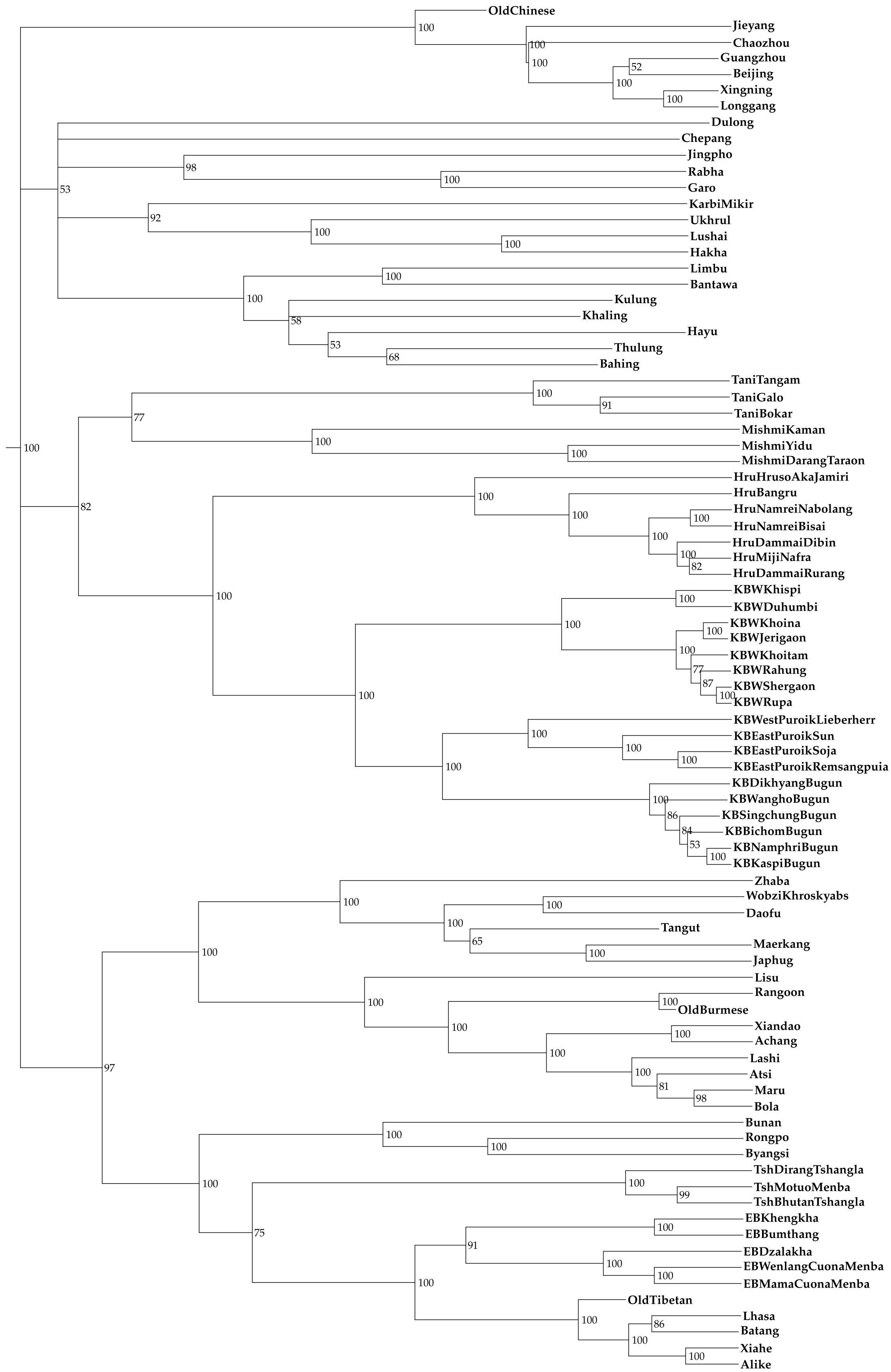


Fig. 1. Majority-rule consensus tree of the Sino-Tibetan family (bodtst.full80.BDSKY-vfrequency.tinymodify.tree).

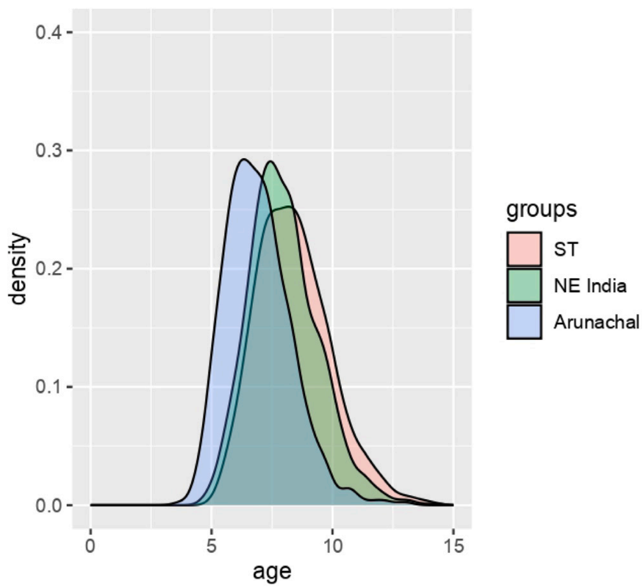


Fig. 2. Distribution of the ages (in millennia) of the entire Sino-Tibetan family, the subset of Sino-Tibetan languages spoken in North-Eastern India, and the languages of Arunachal Pradesh (bodtst.full80.BDSKY-vfrequency.tinymodify.tree). See also S4 of the supplementary materials.

BP [10693 BP-5350 BP] for the most recent common ancestor (MRCA) of Sal, Arunachal and Macro-Kuki-Chin and 6929 BP [9737 BP-4807 BP] for the Arunachal group. Moreover, in view of the complex contact situation in Arunachal (Post, 2013), it is possible that some of the etyma coded as cognates reflect ancient intra-group loanwords or borrowings from unknown subtratum languages, in which case the age of the MRCA of Arunachal would be more ancient and the support for the Arunachal clade lower. Moreover, future progress in the historical phonology of the languages of North-Eastern India in particular may reveal cognates that have been overlooked in phylogenetic studies. Therefore, the results presented here will need to be continuously updated and improved upon in future studies.

From these results, the age range of the MRCA of all languages of North-Eastern India largely overlaps with that of proto-ST, implying that the subgroups in this region started to diverge in the early Neolithic. Moreover, even if the four Arunachal subgroups could be a monophyletic group, their age of divergence goes back to the fifth millennium BC.

These results are in part compatible with the North-Eastern India hypothesis (Blench and Post, 2014). In this framework, proto-Sino-Tibetan was located in North-Eastern India, and started diverging locally long before any evidence of agriculture in this region. The subgroups located in China, in particular Sinitic and Burmo-Rgyalrongic, would then have resulted from later migrations out of North-Eastern India.

The results also refute one version of the Yellow River hypothesis, in which all languages of North-Eastern India and Nepal have diversified locally after one single migration (Bradley, 2022).

They are however also compatible with another, less parsimonious, version of the Yellow River hypothesis: that various subgroups of Sino-Tibetan located in North-Eastern India ultimately came from an already linguistically diversified population situated the Yellow River through numerous migrations, possibly along different pathways. In this view, even the (possibly paraphyletic) Arunachal group could not have diversified in North-Eastern India, and would be the result of independent migrations. In the following discussion, it is this second version of the Yellow River hypothesis that is explored.

Table 1
Correspondences of the rhyme *-áʔ* in Bulu Puroik (Lieberherr, 2017) with selected Sino-Tibetan languages.

Puroik	Japhug	Dulong	Tibetan	Chinese
ljáʔ ‘lick’		*laʔ*^{55}	*ldag*	食 **mlək* ‘eat’
avjáʔ ‘cliff’	*praʁ*	*a*^{31}*pɹăʔ*^{55}	*brag*	
wáʔ ‘pig’	*paʁ*	*waʔ*^{55}	*p*^{h}*ag*	
ʦáʔ ‘do’				作 **tsˤak*
nəʧáʔ ‘millet’		*tɕaʔ*^{55}		稷 **tsək*

2.3. Etymological evidence for agriculture and animal domestication in Sino-Tibetan languages of North-Eastern India

The North-Eastern India hypothesis predicts that the languages of North-Eastern populations lacking (or having only recently converted to) agriculture should not have any inherited terms for crops, domesticated animals or agricultural activities, and should rather have innovated these recently, possibly through loanwords from other languages. By contrast, the Yellow River hypothesis implies that these languages should have some trace of inherited agricultural vocabulary related to Sino-Tibetan languages, originating outside of North-Eastern India and not explainable as borrowings.

Historical linguistics provides a methodology to identify words inherited from a common ancestor (cognates) and distinguish them from borrowings or chance resemblance. This method however requires a precise understanding of sound correspondences, which is available for some families, such as Indo-European and Austronesian, but not at the same level of granularity for Sino-Tibetan (Fellner and Hill, 2019).

However, solid reconstruction systems are available for Western Kho-Bwa (Bodt and List, 2019; Bodt, 2021) and Tani (Sun, 1993; Post, 2022), and for these two groups at least it is possible to distinguish between inherited words and recent borrowings. In addition, using methodology developed for Rgyalrongic (Jacques, 2004), we can identify with confidence the majority of borrowings from Tibetic languages using our knowledge of Tibetan historical phonology and morphology.

2.3.1. Puroik and Kho-Bwa

Puroik, which belongs to the Kho-Bwa subgroup (Lieberherr and Bodt, 2017, see also the phylogeny in Fig. 1), is the language of one of the populations cited by Blench and Post (2014) as evidence for the idea that proto-Sino-Tibetans lacked agriculture. Table 1 shows that the rhyme *-áʔ* in Bulu Puroik regularly corresponds to *-aʁ* in Japhug, *-aʔ* in Dulong, *-ag* in Tibetan and **-ak* or **-ək* in Old Chinese (the Old Chinese vowels **a* and **ə* both correspond to *a* in non-Sinitic languages, Handel, 2008).

This correspondence supports the idea that the resemblance between these forms is not due to chance, but rather should be ascribed to either common inheritance or borrowing. This list contains two nouns that are relevant to the current question: ‘pig’ and ‘foxtail millet’.

Puroik *wáʔ* ‘pig’ reflects the most common etymon to designate this animal in Sino-Tibetan. This form cannot have been borrowed from Tibetan (no Tibetic language has the change *p*^{h}*-* > **w-*), Tshangla or Tani, and there is no evidence that it is not an inherited word.

In proto-Western Kho-Bwa, a group closely related to Puroik, (Bodt, 2021) reconstructs **s*^{j}*a.pak* ‘pig’, and analysed it as inherited.

Puroik *nəʧáʔ* ‘foxtail millet’ is phonetically compatible with Old Chinese 稷 *tsik* ← **[ts]ək* and Dulong *tɕaʔ*^{55} ‘foxtail millet’, a comparison which supports the reconstruction of a root for ‘foxtail millet’ in proto-Sino-Tibetan (Sagart et al., 2017, 196). It is also related to Proto-Western Kho-Bwa **n*^{j}*iŋ.ts*^{hj}*ak* ‘broomcorn millet’ (Duhumbi *nyingchak* ‘broomcorn millet’, Bodt, 2020, 28). The first syllable *nə-* in Puroik corresponds to the proto-West Kho-Bwa **n*^{j}*iŋ-* grain prefix (Bodt, 2024). Bradley (2022), Bradley et al. (2024) also propose that Burmic **ts*^{h}*ap* ‘foxtail millet’ is related to Old Chinese 稷 *tsik* ← **[ts]ək*, though the correspondence of the coda remains difficult to explain.

Table 2
The Tani cognate set for ‘peach’, compared to the near homophone ‘speech’, illustrating the sound correspondences across languages.

Language	‘peach’	‘speech’	Reference
proto-Tani	**(ta-)kom*	**agom*	
Galo	*‘kompə*	*agom*	Ribaa et al. (2009)
Apatani	*takũ*	*agũ*	Bouchery (2009)
Tangam	*tekon*	*agon*	Post et al. (2017)
Lower Adi	*kompɨ*	*agom*	Post et al. (2017)

Since millet cultivation has largely been replaced by rice, wheat, barley as the main staple crops among speakers of Sino-Tibetan languages, inherited terms for millets are rare, but Puroik seems to be one of the few languages that preserve the ancient root.

The Puroik word *nətʃá?* ‘best sago variety’ is homophonous with the etymon for ‘foxtail millet’, though the resemblance is fortuitous, as the first syllable *nə-* is a match for Western Kho-Bwa **nuk* instead (Lieberherr, 2017, 93, Bodt, 2020, 7).

2.3.2. Tani

There is no lack of reconstructible terms for crops in Tani (for instance **jak* for ‘foxtail millet’) but few are comparable to languages outside of North-Eastern India.

Unlike Kho-Bwa, Tani languages lack the etymon for ‘pig’ illustrated in Table 1, and instead present a root **rjek*, which Sun (1993, 199) proposes to be borrowed from Austroasiatic (Shorto, 2006, #417). However, Sagart et al. (2019, SI:31) shows that since proto-Tani **rj-* originates in part from **lj-* (Sun, 1993, 293-298), and since Old Chinese **-ʔ* can correspond to velar stop codas in the non-Sinitic languages, this etymon can be compared with Old Chinese 豕 **l̥[e]ʔ* ‘pig, boar’, and may reflect another proto-Sino-Tibetan root for pigs, without any need to suppose an Austroasiatic influence.

Previous work on Sino-Tibetan etymology did not mention any reconstructible etymon for ‘peach’. However, the data in Table 2 (from Ribaa et al., 2009; Bouchery, 2009; Post et al., 2017) show that a term for ‘peach’ is reconstructible in Tani languages, one of the subgroups of Sino-Tibetan spoken in North-Eastern India, as **kom*, following the sound laws in Sun (1993), whose regularity is illustrated by comparison with the near-homophone ‘speech’.

This etymon is a phonetic match with Tibetan *kʰam.bu* ‘peach, apricot’: Tibetan *-a* corresponds to both proto-Tani **a* and **o* in syllables with a labial coda, as shown by examples such as proto-Tani **pop* ‘yeast’ to Tibetan *pʰabs* ‘yeast’. The formative *-pə* in Galo and *-pɨ* in Adi goes back to proto-Tani **pɨ* ‘globe; pellet; fruit (apple-like)’ (Mark Post, p.c.) and is unrelated to the diminutive suffix *-bu* in Tibetan, despite superficial resemblance.

This etymon is also attested in other branches of Sino-Tibetan, including Kiranti (Thulung *kʰamsi*, Allen, 1975, 248 and Limbu *khaːmb'rɛk*, Michailovsky, 2002).

While a borrowing from Tibetan into proto-Tani or Kiranti may not be completely excluded, it is possible that a word for ‘peach’ is reconstructible to the common ancestor of Tibetan and Tani (dated 5996 BP [7895 BP-4250 BP] in the results of Sagart et al., 2019).

This etymology supports the idea that the spread of peach in the Neolithic (Section 3.5) could be related in part to migrations of Sino-Tibetan-speaking people.

3. Archaeological evidence

Strong archaeological evidence for cultural affiliations between the Yellow River Basin into the Kashmir and Swāt area, south of the Himalayas, via Eastern Tibet has been identified in the last decades (Sharif and Thapar, 1992; Lü, 2016). Such evidence includes stone harvesting knives, bone hairpins, painted pottery, cord-marked ceramic tripods, spindle whorls, jade pendants, stone adzes, axes and semi-subterranean houses, to which millets can be potentially added. However, many authors attribute the presence of East Asian cultural elements in the Kashmir and Swāt area, as resulting from contact or trans-Himalayan trade rather than population movement.

Not all of these data constitute equally compelling evidence of cultural influence from China to India, as some implements (spindles whorls, adzes and axes) are not sufficiently specific and are found in other neighbouring Neolithic cultures of the Indian subcontinent (most notably the Indus civilization) and the degree of similarity of the pottery styles between Kashmir/Swāt and Northern China is difficult to establish.

In the present paper, we focus on the evidence for Neolithic contacts between Northern China and the Indian subcontinent that are specific, clearly datable, and potentially point to demic diffusion as opposed to cultural diffusion or trade. They include farming implements (stone harvesting knives and shouldered spades), crops (millet, wheat and barley), domesticated animals (sheep, goats and cattle), fruit trees (peach and apricot), and hairpins.

3.1. Millets

Two millets, foxtail (*Setaria italica*) and broomcorn millet (*Panicum miliaceum*) were domesticated in Northern China. Current evidence places their earliest cultivation at c.8300 BC, although the main body of evidence demonstrates domestication as occurring between 6000 and 4000 BC (Fuller and Stevens, 2017; Stevens et al., 2024). The process of millet domestication is also tied to the appearance of long-term sedentary settlement across Northern China. From 6000 to 5300 BC broomcorn millet dominates these early sites, which in the west are associated with the Dadiwan 大地湾 culture of the Upper Wei Valley of Gansu, with the Laoguantai 老官台 culture in the eastern Wei Valley. To the east, in the Central Plains region of the Middle Yellow River Valley, are the Peiligang 裴李岗 cultures, with the Houli 后李 culture located in the lower Yellow Valley region of western Shandong. Finally, to the north of this region, are further sites associated with the Xinglongwa 兴隆洼 culture, located in northern Hubei, Liaoning, and the adjacent region of Inner Mongolia (Stevens et al., 2021).

Whilst these cultures form distinctive entities, some genetic interchange between partially to fully domesticated crops spanning wide regions has been postulated (Allaby et al., 2022). Not all of these regions necessarily witnessed the full evolution to fully domesticated millets, and a period of population decline between 5500 to 5000 BC in many regions of Northern China has been noted (Ren et al., 2021). For the Dadiwan culture a break in cultural continuity is seen, with the later demic diffusion of Early Yangshao culture from the lower Wei Valley into this region bringing with it fully domesticated foxtail and broomcorn millet around 4400-4000 BC (Fuller and Stevens, 2017). The end of Houli culture in Shandong is dated to around 5500 BC, with the succeeding Beixin 北辛 culture dated from 5000-4100 BC. While the extent of cultural continuity is uncertain, it has been proposed that some degree of demic diffusion from Peiligang/Early Yangshao 仰韶 cultures eastwards towards Shandong may have occurred (Wang, 2013).

The earliest evidence for substantial demic diffusion, dating to between 4500-4000 BC (Fig. 3), likely coincides with the emergence of more fully domesticated millets, with a change from the dominance of broomcorn to foxtail millet (He et al., 2022) signifying the development of a larger more productive panicle in the latter compared to the former (Stevens et al., 2024). The dispersal of millets into Qinghai and the establishment of millet growing communities on the edge of the Tibetan Plateau largely dates from 3500 BC (Dong et al., 2013). It is notable that the spread of millet agricultural systems, in which wheat and barley are absent initially stops at the eastern edge of the Tibetan Plateau and the eastern edge of the Tarim Basin. The subsequent movement of agriculturalists onto Tibetan Plateau is then aided by the integration of wheat and barley into this subsistence system during

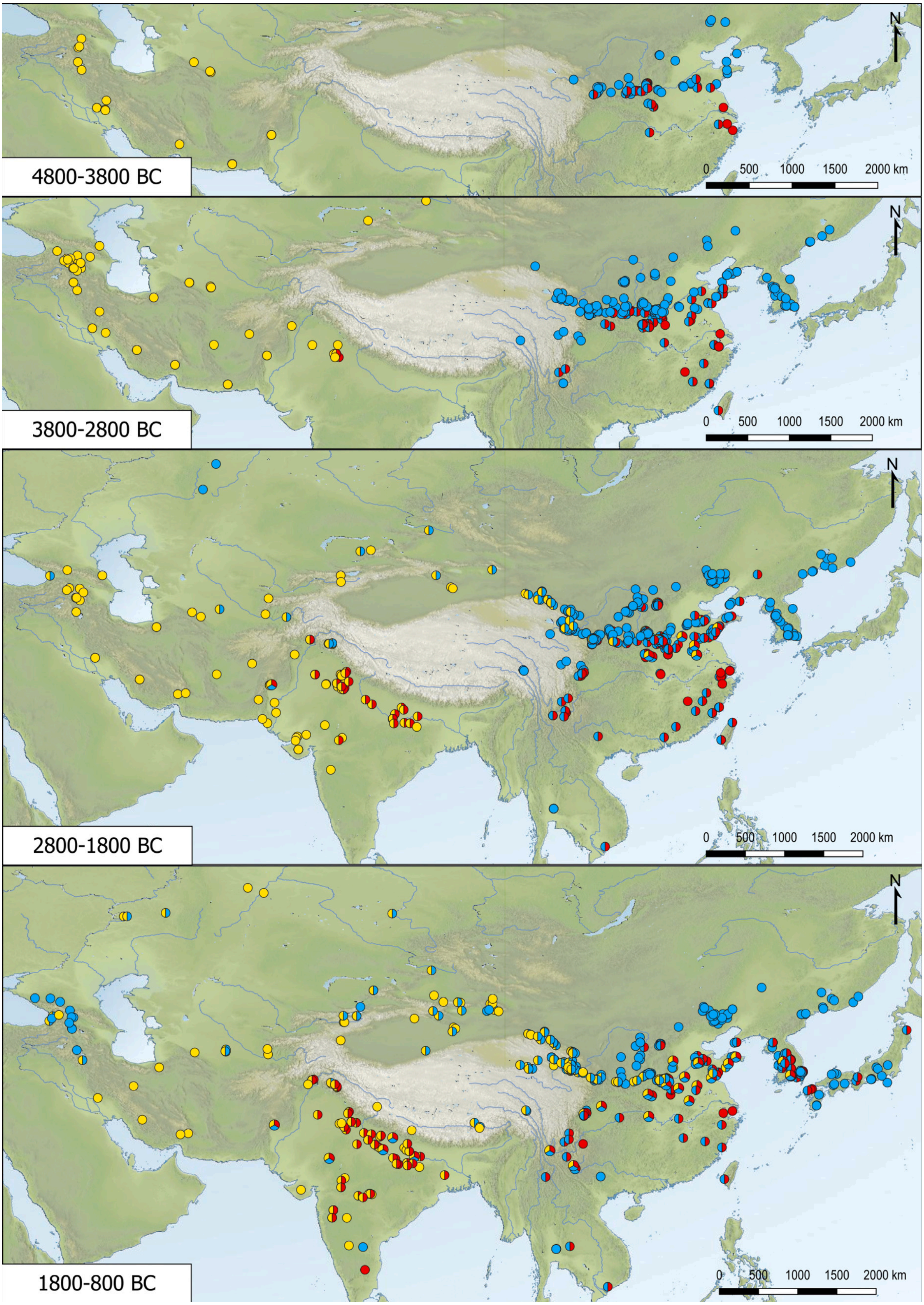


Fig. 3. Spread of millet and wheat/barley in Eastern Eurasia in the Middle to Late Neolithic (cyan = foxtail and broomcorn millet, yellow = wheat/barley, red = rice, but is only recorded where it occurs with wheat/barley, millet, peach or apricot). Data is available in Table S3.

the second millennium BC (d'Alpoim Guedes et al., 2015; Fahu et al., 2015).

While agricultural societies based primarily on millet spread eastwards into the Korean Peninsula and the Russian Primorye by 3500 BC (Stevens et al., 2022), their westwards spread into Central Asia is tied to the emergence of agro-pastoral systems based on wheat, barley and domesticated animals originating in the west. Currently the earliest millet outside China, specifically broomcorn millet was directly-dated at Pethpuran Teng, Kashmir to 2500 BC (Yatoo et al., 2020), prior to the earliest dates for millets in Central Asia. These early millet dates in Central Asia come from a handful of sites, where they are always accompanied by finds of wheat and/or barley; for example, Tongtian Cave 通天洞 in the far northern Altai region of Xinjiang at 2200-2000 BC (Zhou et al., 2020), Begash, Kazakhstan dating to 2280-2030 BC (Spengler, 2015), and Togolok 1, Turkmenistan at 2200-1980 BC (Billings et al., 2022).

The spread of millets west to the edge of the Tibetan Plateau in Sichuan, is dated to c.3300 BC, at Yingpanshan 营盘山 (Zhao and Chen, 2011). Several sites on the edge of the Tibetan Plateau, dating between 3300-2800 BC, have only millets, and combined millet and rice agriculture was initially proposed to only appear later in Sichuan after c.2700 BC (d'Alpoim Guedes et al., 2015; Lee et al., 2019), with rice coming from the Middle Yangtze valley. However, recent evidence from Guijiabao 皈家堡, in central Sichuan yielded both millet and rice at 3000 BC, and the authors of this study propose an early southern dispersal of mixed rice–millet agriculture from the Majiayao/Late Yangshao cultures of the Yellow River Valley Basin Huan et al. (2022).

The earliest sites in Eastern Tibet, Mkhar-ro/Karuo 卡若 and Gsho-rngul-mda/Xiaoenda 小恩达, dating to 2800 BC, have only millets, with wheat present only after c.1770 BC (d'Alpoim Guedes et al., 2014; Zhang et al., 2019a; Song et al., 2021). The earliest phases at Gsho-rngul-mda yielded remains of hunted wild animals including wild caprines, however, zooarchaeological examination of these sites has not yet revealed any domesticated animals, and although domesticated pigs might be present the evidence is not conclusive (Zhang et al., 2019a).

In Yunnan, as with Guijiabao 200 km to the north, the site of Baiyangcun 白羊村, supports the dispersal of rice and millet together into southwest China by 2600 BC (Dal Martello et al., 2018), expanding into Southeast Asia by 2500-2200 BC (Stevens et al., 2016). In Central Tibet the earliest millets are found at Chu-gong/Qugong 曲贡 and 'Phreng-po-lung/Changguogou 昌果沟, 580 km southwest of Mkhar-ro/Karuo, from after 1500 BC, where they are accompanied by wheat, barley, and pea (Gao et al., 2020).

For Kashmir, evidence for broomcorn millet continues after 2500 BC into the 1st millennium BC, at Qasim Bagh (1900-1859 BC) (Spate et al., 2017), Yunteng (1620-1500 BC) (Betts et al., 2019), and Semthan (200-1 BC) (Lone et al., 1993). However, it is only in the historic period at Kanispur (100-300 AD) (Pokharia et al., 2018) and Semthan (1-500 AD) that foxtail millet is recorded. Away from Kashmir broomcorn millet is found at Late Harappan Pirak (c.1950-1550 BC) and more significantly at Charda (900-600 BC), Uttar Pradesh, in the middle Ganges Basin. A number of specimens of possible foxtail millets are known from earlier second millennium BC Harappan sites in India, but issues arise due to distinguishing it from locally domesticated yellow foxtail millet (*Setaria pumila*) (Stevens et al., 2016). Presently, only five sites with Chinese millets, dating from the late 2nd to the 1st millennium BC, are known in the Gangetic region of Uttar Pradesh and central western India in Maharashtra (Stevens et al., 2016).

The cultural origins of the people in southwest China, are widely accepted to originate with the Majiayao 马家窑 culture of Gansu, themselves derived from the later Yangshao cultures of the Middle Yellow River Basin d'Alpoim Guedes (2018), Huan et al. (2022). However, rice is present at very few Majiayao sites in Gansu between 3500-2500 BC (Fig. 3), an exception being Xishanping 西山坪, where rice has been recovered and radiocarbon dated from at least 3000 BC (Li et al., 2007).

There is evidence for the dispersal of foxtail millet southwards to the Middle Yangtze, where they were farmed alongside rice, in Daxi 大溪 culture sites in Hubei (Fuller and Stevens, 2017), and Zhejiang by around 4000 BC (Tang et al., 2022). However, there is no cultural evidence that these people subsequently dispersed westwards into southwest China (Huan et al., 2022).

3.2. *Harvesting knives*

3.2.1. *Basic characteristics and function*

Harvesting knives are a very distinctive crop-reaping implement found on Neolithic and Bronze age sites in China, Korea, Japan, as well as on the flanks of the Tibet Plateau in Northern India and Pakistan (Luo, 2004), but are absent from other areas of the world.

First discovered by Torii (1915) in Liaoning, they were originally interpreted as meat-cutting knives, like those used by Eskimo people, but were later hypothesized to be used for harvesting crops (Andersson, 1923), and detailed studies of blade wear confirm this view (Harada, 2015). However, there is also evidence of secondary uses such as for scraping wood and bones and cutting meat according to Chen et al. (2023).

Stone and ceramic (reused potsherds) harvesting knives appear early at Yangshao culture sites around 4600 BC in the Yellow River Basin and Guanzhong (An, 1955), considerably later than stone sickles, which are found in sites of the preceding Peiligang culture (6500-5000 BC) (for instance, Kaifeng wenguanhui 1978).

In the earliest Yangshao period (4600-3900 BC), ceramic knives were more common than stone ones. At Banpo 半坡 for instance, the proportion of ceramic to stone knives is 119:35, but by the second period (3900-2900 BC), at Miaodigou 庙底沟, the proportion falls to 80:92 (Luo, 2007, 74), and subsequently, ceramic knives progressively disappear.

Stones knives have a much wider temporal and spatial range than ceramic knives, being attested up to the Tang dynasty (Luo, 2004), although becoming superseded by metal harvesting knives. Harvesting knives are mentioned in the oldest Chinese texts (An, 1955), and were still used in Miao areas up into the 1990s (Luo and Li, 2013).

Not all stone or ceramic knives qualify as harvesting knives, which are quite specific in form. These implements are held in the hand, between the middle and the ring fingers, or between the ring and the little fingers, with a cord attached around all fingers opposing the thumb, and fixed on the blade of the knife by a hole in the middle (Luo and Li, 2013)

This arrangement serves to stabilize the blade while cutting the ears, which are kept in the palm after being cut. Although no direct evidence remains of these cords, their existence can nevertheless be inferred from the presence of holes, or of notches on both sides of the knives. For this reason, Chinese archaeologists, such as Luo (2004), favour the term 'cord-attached stone knife' (*jìshéng shídāo* 系绳石刀) to designate this type of implement from other tools with a stone blade.

3.2.2. *The spread of harvesting knives from the Yellow River to Swāt*

We compiled a database of stone harvesting knives (Table S5 of the supplementary materials), based on Luo's (2004) survey (which includes references on Chinese sites published up to 1999), expanded with data from Kashmir and Swāt, and Chinese references published after 1999. This database excludes stone knives without either notches or holes, which lack a handling cord.

The map in Fig. 4 shows the spread of stone knives in the Neolithic up to the Han dynasty.

In the fifth millennium BC, harvesting knives are only found in a core area along the Yellow River, and the Loess Plateau, mainly in Shaanxi, Gansu and Inner Mongolia.

By the late 4th millennium, harvesting knives have extended into three areas; to the east into Shandong and the Liaodong peninsula, in

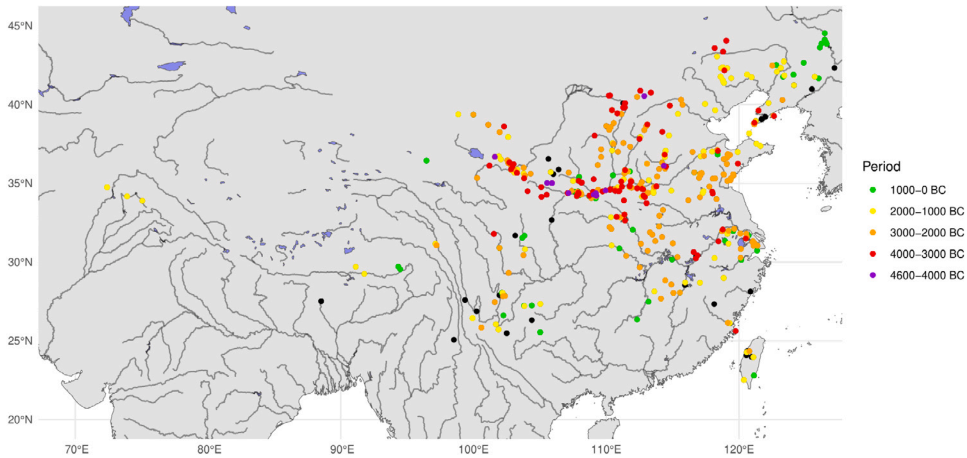


Fig. 4. The spread of stone harvesting knives from the Middle Yellow river valley to Kashmir/Swāt (the black dots are undated or AD). Data is available in Table S5.

the southeast towards Jiangsu and Fujian, and in the west into Qinghai and Northwestern Sichuan (Liujiazhai 刘家寨).

In the third millennium, harvesting knives reach Yunnan at Baiyangcun (whose earliest phase of occupation was 2650-2450 BC, Dal Martello, 2020, 167), and East Tibet, at the Mkhar-ro/Karuo site (dated 2700-2400 BC, d'Alpoim Guedes et al., 2014).

By the second millennium BC harvesting knives are present in Central Tibet (Chu-gong/Qugong, 1800-1550 BC), Kashmir (Burzahom II and Gufkral IC, 2000-1500 BC, Fonia, 2022, 199-207) and slightly Later Swāt (Kalakoderay and Loebanr III, 1700-1400 BC, Stacul, 1993b).

Harvesting knives are however largely absent in Xinjiang, Central Asia or North-Eastern India. Chen and Zhang (1991) do report stone knives from Xinjiang, but they lack perforations or notches, and appear therefore not to be cord-attached harvesting knives of the type discussed in this section. In South Asia, perforated or notched stone knives are only attested in Swāt and Kashmir, and absent from sites of the Harappan civilization for instance, suggesting some cultural separation. Given that such knives are made from local stone (Stacul, 1993a) indicates production by local craftsmen as opposed to being products of trade, supporting the hypothesis of a demic diffusion of peoples, at least by the early 2nd millennium BC, whose lineages originated in the Yangshao cultures of the east (Stevens et al., 2016).

Thus, the highly specialized technique for making the harvesting knives found in Swāt and Kashmir probably ultimately originated in Northern China and spread with millet agriculturalists through the Tibetan Plateau (Mkhar-ro and then Chu-gong). The alternative possibility, first south to Yunnan, then west through Northern Burma and North-Eastern India presently appears unlikely in view of the absence of harvesting knives in the Neolithic sites of Assam and Meghalaya, such as Daojali Hading or Law Nongthroh.

3.3. Wheat and barley

Wheat and barley were domesticated in Western Asia, with agricultural communities reaching western Turkmenistan by at least 6000 BC (Harris et al., 1993). While further agricultural sites dating to the 4th millennium BC in this region of west Turkmenistan are known, sites with wheat and barley further east in Central Asia dating from the later 4th to 3rd millennium BC are relatively rare (Fig. 3). Within East Asia and Central Asia archaeobotanical assemblages are dominated by free-threshing, likely hexaploid, wheat, along with barley (Stevens et al., 2016). Currently the earliest site with evidence for wheat and barley, along with sheep, is Tongtian Cave, at 3350-2900 BC (Zhou et al., 2020), with 3rd to 2nd millennium dates for wheat and barley coming from Kazakhstan (Tasbas I 2840-2490 BC, Spengler et al., 2014), Tajikistan (Sarazm, 2600-2000 BC, Spengler and Willcox, 2013), Uzbekistan (Djarkutan, 2200-1700 BC) (Miller, 1999), Turkmenistan (Togolok 1, 2200-1980 BC, Billings et al., 2022) and Kyrgyzstan (Uch-Kurbu 1600-1120 BC, Motuzaite Matuzeviciute et al., 2018). Presently the earliest dates in China, aside from Tongtian, suggest an introduction of wheat agriculture around 2200-1800 BC (Stevens et al., 2016), while slightly earlier dates in Shandong, c.2400 BC, potentially relate to importation or exchange with agro-pastoral communities to the north (Long et al., 2018). However, the wider uptake and contribution of wheat to the diet is only clearly seen after c.1000 BC during the Zhou Dynasty (Deng et al., 2020).

The introduction particularly of barley, along with wheat, to existing subsistence systems, appears to have played a significant role in enabling larger populations to be supported on the Tibetan Plateau after c.1650 BC (Fahu et al., 2015). As adopted crops, wheat and barley appear to have spread within likely pre-existing farming communities situated around the edge of the Tibetan Plateau in the 2nd millennium BC (d'Alpoim Guedes et al., 2015) and are recorded at the site of Haimenkou 海门口 in Yunnan after 1450 BC, where they play an increasingly important role comparatively to rice and millet over the following millennium (Xue et al., 2022).

Also during the 2nd millennium BC, it has been proposed based on cultural similarities, that the southwards dispersal of wheat and barley into southwest China, is associated with the movement of peoples of the Qijia 齐家 culture, of northern Gansu (Jin et al.). Notably, on earlier Qijia sites (2500-2000 BC) wheat and barley are generally rare, and it is only in the 2nd millennium BC after their adoption and incorporation into existing millet dominated agricultural regimes, that their presence in archaeobotanical assemblages becomes commonplace (Chen et al., 2019). As such we might hypothesize that the introduction of these crops drove a second wave of demic diffusion into southwest China in the 2nd millennium BC, following that of the Majiayao culture which began a millennium (some 40 human generations) earlier.

While there is significant evidence for the movement of wheat and barley eastwards across Central Asia into China from the late 4th to 3rd millennium BC, the movement of these two crops to the south of the Tibetan Plateau is less well established. The earliest agricultural site in southeastern Iran, with wheat and barley, Tepe Yahya, is dated to around 5500-5000 BC (Meadow, 1986), while the recently excavated Neolithic site at Tell-e Atashi is dated from 5500-4500 BC, during which it remained aceramic (Mutin and Garazhian, 2020). The earliest well dated site with wheat, barley, sheep/goat and cattle, in Southwest Pakistan, Shari Tump, is also aceramic in its earliest phase 4500-4000 BC (Tengberg, 1999). The subsequent dispersal of agriculturalists bringing wheat, barley, sheep, and goat into the Indus Valley and Northern India, can be placed around the start of the 4th millennium BC. Wheat and barley were to form the basis of the Harappan culture (3300-1900 BC), and appear at pre-Harappan sites in the southern

Indus, such as Balakot, along with sheep and goat from around 4000 BC, and in the northern Indus at Sheri Khan Tarakai from 3800 BC, along with zebu cattle (Khan et al., 2010). In Gujarat from around 3500 BC western domesticated crops mix with locally domesticated beans and millets (Kingwell-Banham et al., 2015), with the first evidence for barley seen around the Early Harappan Period 3300-3000 BC at Datura IV (García-Granero et al., 2015).

While broomcorn millet in Kashmir dates from 2500 BC, wheat and barley, along with western animal domesticates potentially date some 500 years or more earlier (Betts et al., 2019; Pokharia et al., 2018). These late 4th to early 3rd millennium BC settlements are aceramic, and include Kanispur, Gufkral and possibly Burzahom. At Gufkral aceramic levels dating from 2700-2400 BC yielded barley and wheat, but only a small amount of sheep/goat in comparison to wild animal remains (Betts et al., 2019). Later ceramic levels from 2500 to 2000 BC, from direct dating demonstrate the presence of Chinese millets at Pethpuran Teng, and Qasim Bagh, along with free-threshing wheat and barley, while emmer wheat is also present at Kanispur. Wheat and barley are the dominant crops at these sites, often accompanied by lentil and pea, with rice appearing during the 1st millennium BC. As discussed below, of particular interest at these sites, dating at least to the early 2nd millennium BC, are the earliest potential identifications of stones of both peach and apricot outside China.

Regarding the movement of wheat and barley beyond the Indus Valley Cultures, across Northern India to the south of the Himalayas, the earliest dates place this event around the middle to later 3rd millennium BC. A direct date on cereal remains of 2400-2200 BC comes from Lahuradewa, Uttar Pradesh (Pokharia, 2011) and similarly dated evidence for these West Asian crops is seen to the south at Senuwar, Bihar (Saraswat, 2004). These dates signal the first diffusion of agriculturalists with western crops eastwards along the middle Ganges basin. It is however, not until after 2000 BC that an increase in settlements associated with rice, wheat, barley, indigenous Indian domesticates and West Asian animal domesticates is seen to spread more widely across the Gangetic Plain Kingwell-Banham and Fuller (2012).

3.4. Sheep, goat and cattle

Three main animal domesticates, sheep, goat and cattle, accompanied wheat and barley eastwards out from the Fertile Crescent. Carried by successive generations of early agriculturalists, animal domesticates reached Western Turkmenistan by at least 6000 BC at the site of Jeitun (Harris et al., 1993). An aDNA analysis has recently identified domesticated sheep bones at broadly the same date from a cave site, Obishir V, lying on the border with Uzbekistan, in Southern Kyrgyzstan, some 1140 km east of Jeitun (Taylor et al., 2021). Faunal remains from a further site, Kaynar Kamar, Uzbekistan, were interpreted on size ratios as representing potential domesticated sheep and goat, from around 4200 to 2900 BC, and possibly a millennia earlier (Nishiaki et al., 2022). The earliest well established agricultural culture in this region is that of the Afanasievo, spanning the period from 3500-2500 BC, representing the first definitive expansion of agro-pastoralists eastwards across the Inner Asian Steppe.

Within China itself the earliest proposed evidence for domesticated sheep, comes from the site of Shihushan 石虎山, in Inner Mongolia, where direct dating on their bones placed their introduction at around 4700-4450 cal. BC, associated with the Hougang 后冈, Early Yangshao culture (Dodson et al., 2014). However, this same study was only able to confirm the presence of domesticated sheep through aDNA analysis for Youyao 游邀, Shanxi at 2292-2029 BC. As such the early presence of domesticated sheep at Shihushan is still open to question (Brunson, 2015; Owlett, 2016), and the earliest reliable current evidence for domesticated sheep, along with wheat and barley in China is that from Tongtian Cave, at 3350-2900 BC, in northern Xinjiang (Zhou et al., 2020) associated with the earliest easternmost extent of the Eurasian Afanasievo Steppe culture. Reliable evidence for the integration of domesticated sheep into indigenous Chinese archaeological cultures comes from Taosi 陶寺, Shanxi (2550-1950 BC) (Brunson et al., 2016), Haojiatai 郝家台 and Wadian 瓦店, Henan (2500-1850 BC) (Li et al., 2021).

By the late 3rd to early 2nd millennium BC, at Huoshiliang 火石梁 (ca. 2150-1900 BC) in Yulin, northern Shaanxi, sheep, as well as goat have become relatively commonplace (Hu et al., 2008). Taurine cattle have been proposed to have been introduced into Northern China, most likely through the Hexi Corridor, at a similar date, 3600-2000 BC and into in Yellow River Basin by 2550-2050 BC at Shantaisi 山台寺, Henan (Flad et al., 2007; Brunson et al., 2016; Lu et al., 2017; Peters et al., 2005). On this basis current evidence generally supports a dispersal of sheep, goat and cattle from Central Asia into China around 3000-2000 BC.

Sheep play an important role, along with wheat, barley and millets, in enabling increased settlement and permanency of agropastoral communities at higher altitudes, after 1600 BC, in the northeastern Tibetan Plateau region centred on Qinghai (Fahu et al., 2015). This development is associated with the division of the Qijia culture into that of the Kayue 卡约 of Qinghai and the Siwa 寺洼 culture of Gansu (Chen, 2013).

The dispersal and adoption of sheep, goat and cattle within southwest China, remains currently more elusive. Baiyangcun and Dadunzi 大墩子 have recorded cattle, goat and sheep from 2650-1690 BC and 2140-1630 BC, respectively (Dal Martello et al., 2018; Dal Martello, 2020). However, the identification of these animals as domesticated is questionable (Wang, 2017, II, 295-296). Further, even if confirmed, it might be that they only date to the final stages of both sites. At Haimenkou, sheep and goat are potentially present from c.1600 BC, and the increase of sheep/goat remains with wheat after 1450 BC seems in keeping with the presence of domesticated animals, coming from northwest China, based on similarities in ceramics (Xue et al., 2022).

To the southwest of the Tibetan Plateau, sheep, goat and zebu cattle are recorded in the Upper Indus at Sheri Khan Tarakai by the 4th millennium BC (Khan et al., 2010). Within the region of Kashmir sheep and goat, are present in the lowest levels of Gufkral and Burzahom within the 3rd millennium BC becoming dominant after 2000 BC (Coningham and Young, 2015, 101-278). As with wheat and barley, domesticated sheep, goat and zebu cattle, form an important component of early Harappan Indus valley sites within the 4th millennium BC, but their spread eastwards into the Gangeric plains, and through the Ganges River basin, is only securely dated from 2500-2000 BC (Coningham and Young, 2015).

Moving to sites in the southeast of the Tibetan Plateau, bones of domesticated yaks were recovered from an ash-pit dated to 1700 BC (Qugong excavation report 1999; 237–243), and linguistic evidence also supports yak domestication as occurring in the mid-second millennium BC (Jacques et al., 2021). This same pit contained bones of sheep that have been theorized along with more definitive evidence for barley, wheat and foxtail millet to provide evidence for agro-pastoral communities in the mid 2nd millennium BC (Tang et al., 2021; Lü et al., 2021). Sheep and goat are both attested at Spang-dkar/Bangga 邦嘎 (c.1000-200 BC), and while wheat and barley were present notably millets were absent, signifying a shift in economy compared to earlier sites in the region.

As such the dates for domesticated Asiatic animals in the southeastern Tibetan Plateau are later than those of the Hexi corridor. But appear broadly contemporary if not slightly earlier than those presently confirmed for southwest China and for the movement of sheep/goat and barley onto the northeastern Tibetan Plateau in Qinghai c.1650 BC (Fahu et al., 2015). Significantly, they are somewhat later than dates on sites in the Ganges Basin to the southwest, and as such their route to this part of the Tibetan Plateau, coming either from the southwest or from the east, appears uncertain Wang et al. (2023a).

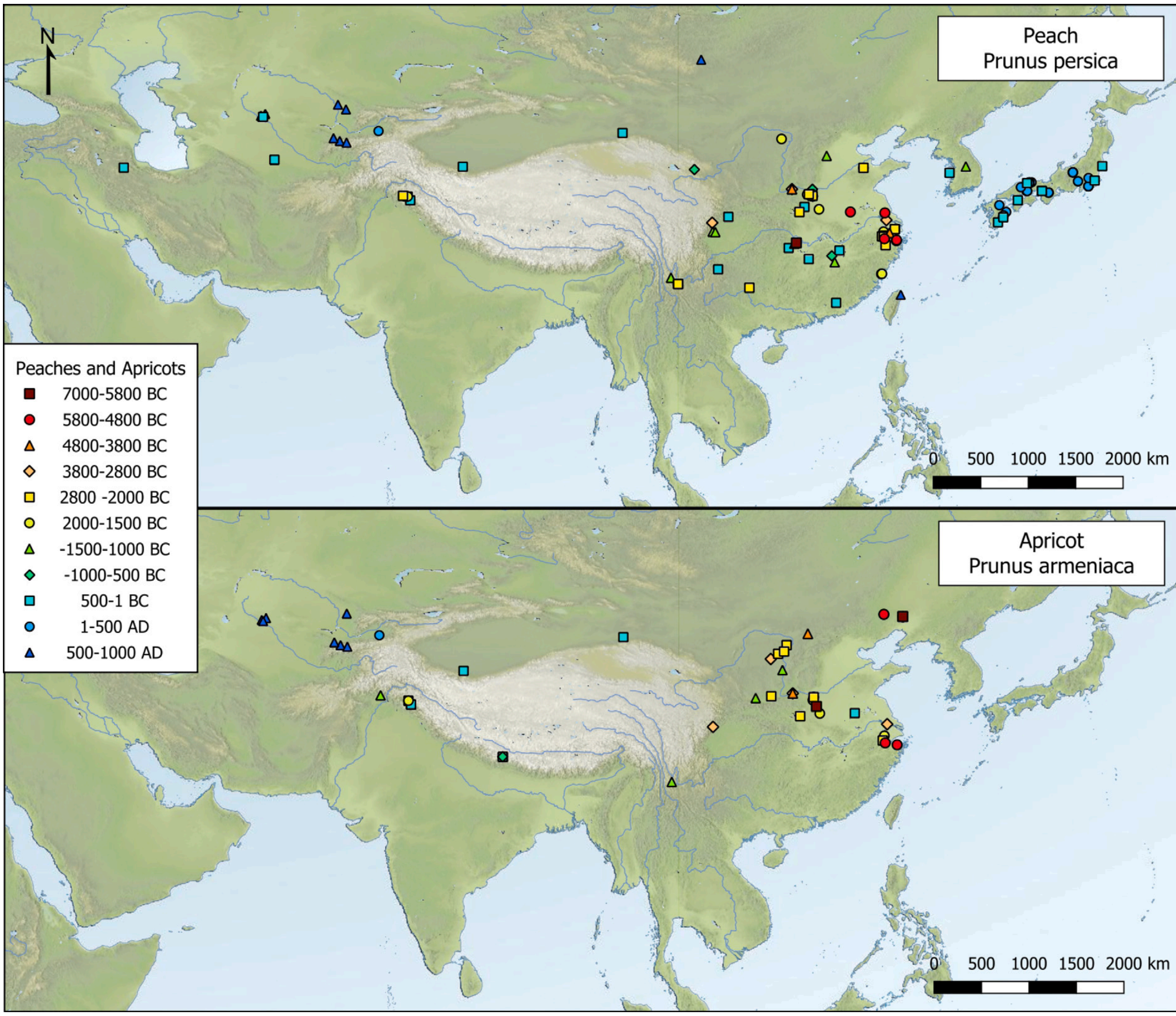


Fig. 5. Remains of peaches and apricots in East and Central Asia (7000 BC–1000 AD). Data is available in Table S3.

3.5. *Prunus*

Both peach (*Prunus persica*) and apricot (*Prunus armeniaca*) are first archaeobotanically attested in the 6th millennium BC in China (Fig. 5). The earliest remains of peach are predominantly in the areas associated with rice domestication in the Lower Yangtze (Fuller and Stevens, 2019). The wild ancestor of domesticated peach is unknown but it seems probable that wild peach came under cultivation following the domestication of rice, after 4000 BC, in this same region (Fuller and Stevens, 2019; Zheng et al., 2014). Early finds from sites outside this region, e.g. Chengtoushan 城头山 (Hunan), and Nanjiaokou 南交口 (Henan) c. 4200-3700 BC, might represent its early spread with domesticated rice, rather than utilization of the wild progenitor. The origin of apricot is also uncertain, as is the wild progenitor, with two possible domestications, one in Northern China where a number of sites with wild apricot are recorded from 6000-5500 BC (Dal Martello et al., 2023) and one in the Lower Yangtze where similar early dates are known (Stevens et al., 2016; Spengler et al., 2018). Genetic work has suggested that in addition to China apricot came under cultivation and domestication in Central Asia, being closer genetically to wild populations in this region (Groppi et al., 2021). However, the absence of early records of apricot for Central Asia make this theory controversial.

The westward spread of both apricot and peach is seen in the pre-second millennium BC, with evidence from Sichuan (Yingpanshan, 3350-2650 BC, Zhao and Chen, 2011) and Yunnan (Baiyangcun, 2500-1750 BC). However, given that it is not always easy to distinguish stones of domesticates from other wild species, such identifications might still be subject to change. Archaeobotanical finds of peach and apricot remain confined to East Asia until the second millennium BC (Dal Martello et al., 2023, 8-10). The site with the earliest record outside of East Asia is Burzahom I in Kashmir, between 2400-1700 BC (Stevens et al., 2016). The date and certainty of identification of these earliest finds, however remains slightly problematic (Dal Martello et al., 2023, 8-10). The chronology of Burzahom has since been refined (Betts et al., 2019), and it is possible that the appearance of peach and apricot is more broadly contemporary with the appearance of harvesting knives between 2000-1700 BC. Early records of peach and apricot from Kanispur (2500-2000 BC) appear less certain, and it should be noted that almond is likely present also at Kanispur (Pokharia et al., 2018). Remains of peach and/or apricot are absent from the earliest southeastern Tibetan sites, although apricot is recorded from Mustang sites in Nepal in the first millennium BC (Knörzer, 2000), with a single record from northwestern Iran (Aali et al., 2012). Outside this region possible apricot stones have been recorded from Barikot, just to the west in Northern Pakistan (Dal Martello et al., 2023). In Europe both textual and archaeological evidence suggest that peach was present in mid to late 1st millennium BC (Dal Martello et al., 2023), while good evidence for apricot outside this region appears less certain.

Evidence from northwest China and Central Asia is later than the Kashmir sites, with the earliest evidence for peach from Xiawatai 下哇台, in Qinghai dating to 1000-800 BC (Jia, 2012). Records of peach and apricot from Central Asia are later still, with a single find from Sampula, Xinjiang, dating to the late 1st millennium BC (Jiang et al., 2008), with further records from Central Asia being no earlier than the late 1st millennium BC to 1st millennium AD. This is significant in terms of the suggested possible domestication of European apricots in Central Asia (Groppi et al., 2021), given the absence of good evidence for the exploitation of wild or domesticated species prior to the 1st millennium AD over much of this region. This would support the argument that modern Central Asian "wild" populations of apricot populations are in fact feral. The estimated date of the split by Groppi et al. (2021) of the lineages that gave rise to cultivated apricots in China and that which gave rise to "wild" Central Asian and European Cultivated apricots is estimated at around 900 BC. This date is later than the 3rd to the 2nd millennium BC evidence for the presence of apricots in Kashmir, Sichuan and Yunnan. As such we might hypothesize that the origin of Central Asian "wild" and cultivated European apricots lies not in Central Asia but with a western, potentially Himalayan, dispersal, that separated this lineage from that of eastern Chinese apricots. The estimated date of the divergence between "wild" southern Central Asian and European apricots at c.250 BC (Groppi et al., 2021), might then suggest that feral apricots emerged in Central Asia at this date.

A similar scenario might exist for peach (Fuller and Stevens, 2019).

3.6. Shouldered hoes/spades

Early work such as Wheeler (1959, 87–89) and Dani (1960, 48–50) have pointed to resemblances between the stone shouldered spades from Northern China, South-East Asia and North-Eastern India, and suggests a Chinese origin for them. Shouldered hoes have more recently been noted as one of the distinctive features of Neolithic North-Eastern India cultures (Dikshit and Hazarika, 2012; Jamir, 2022). Radiocarbon dates are available for some of these sites, for example a date of 2960 ± 30 years BP (1262-1053 cal. BC) for the site of Law Nongthroh in Meghalaya (Mitri and Neog, 2016), and a slightly later luminescence date on pottery of 2700 ± 300 years BP has been provided for Daojali Hading in Assam (Sharma and Singh, 2017), both indicating that this culture dates from the early first millennium BC.

Tada et al. (2012, 51) further provides evidence of 'shouldered adzes' made of jadeite, which they view as "unmistakable evidence of Chinese Neolithic over Arunachal Pradesh" from Yunnan through Northern Myanmar. Bodt (2020, 14) indicates that Duhumbi (Western Kho-Bwa) speakers of the Chug valley also know about these Neolithic stone adzes, which they call *atha nambaq pha* 'axes of grandfather moon' and believe to originate from sky deities.

The origin and evolution of such stone spades/hoes has received little attention, and is difficult to study exhaustively due to confusion with stone axes-adzes in many excavation reports. Stone shouldered spades or hoes are found across a large area of East Asia during the Neolithic, with the earliest examples coming from around 6000-5400 BC, associated with the Peiligang cultures, of Henan (Huang, 1992; An, 1979), and the Xinglongwa cultures of northeast China (Liu and Chen, 2012, 129–131, Shelach and Teng, 2013). As shown in Table 3, similar tools are known from the Yangshao cultures (5000-3000 BC) of the Middle Yellow River Basin, which continue into the Longshan (3500-1800 BC). From the Upper Yellow River, shouldered spades spread westwards to the Tibetan Plateau at Rdzong-ru/Zongri 宗日 (3600-2050 BCE) (Chen et al., 1998).

While bone scapula and wooden spades are known from early rice cultivating sites in the Lower Yangtze from at least Hemudu 河姆渡 culture (5000 BC), shouldered stone spades appear in Liangzhu 良渚 culture (3400-2200 BC) sites (Tang et al., 2020) at a similar time to the appearance of stone harvesting knives, originating in the north. From this point in time stone spades/hoes are evident from a number of later sites, following the westwards spread of agriculture to Xinjiang (Shirenzigou 石人子沟, 1000-700), and on into Central Asia, including the Fergana Valley (Dalverzin) where they associated with the Chust culture (1500-900 BC) (Zadneprovskij, 1962, 76;274, Spengler et al., 2021).

Towards the south and southeast of China, shouldered spades are present on third millennium BC sites from Guangdong and Guangxi, and continue to diffuse with agriculture into Hainan and Vietnam (Rispoli, 2007).

Shouldered spades also spread to the southwest towards Sichuan and Yunnan, and have been recovered from sites located in the Qingyijiang 青衣江 River area, near Leshan in Sichuan (Wu, 1988), and around the Nujiang river such as Chuankouba 船口坝 (the Manghuai type 忙怀类型), near to the border with Burma (Wang, 1991), dated around 1000 BC.

The distribution of shouldered spades thus suggests a spread from Yunnan into North-Eastern India, with a gap of 730 km between Chuankouba in Yunnan and Lawnongthroh in Meghalaya, plausibly due to the paucity of archaeological excavations in Northern Burma.

Further to the west, shouldered spades are also found in the second layer of the Chu-gong culture (Qugong excavation report, 1999; 176–181;217), dated 1530-1210 BC (Gao et al., 2020). It is unclear however whether these spades reflect influence from Northeastern India, or from the eastern part of the Tibetan Plateau.

3.7. Hairpins

In the Yellow River valley, bone hairpins are attested in the Yangshao culture (for instance at Anban 案板, Shaanxi, Liu et al., 2017b), with either no or a very simple top element. Decorative hairpin tops are however quite prominent in Shang dynasty sites, for instance Yinxu 殷墟, where Chen (2022) and other authors have identified eight distinct subtypes.

Among these, the subtype described as 'shaped like the character 羊' (羊字形, 21 items discovered at the Yinxu site), with a flap top having a notch in the centre, with symmetrical grooves on both sides, strongly resemble the style of hairpins found in Loebanr in Swāt, which Stacul (1980, 74) argued were 'shaped like a *t'aot'ieh* mask', a type of a symmetrical zoomorphic pattern with eyes and horns and no lower jaw found on Shang and Zhou period bronzes. While the resemblance of the hairpin heads found at Loebanr with the *tāotiè* 饕餮 pattern is disputable, their commonalities with the Yinxu hairpins is strong enough to support a cultural diffusion from the east rather that than arising by pure chance.

Another subtype with symmetrical triangular saw-like grooves in Yinxu also presents resemblances with hairpins found at Bīr-kōṭ-ghuṇḍai in Swāt (Table 4).

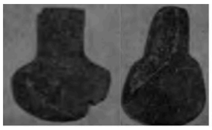
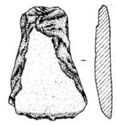
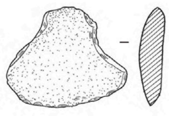
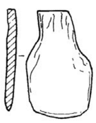
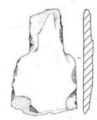
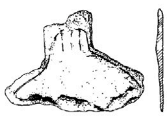
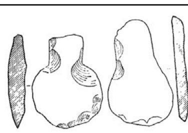
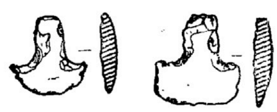
4. Genetic evidence

Within this section we review the genetic evidence for the peopling of firstly Central Asia, followed by that relating to the origins of the people on the Tibetan Plateau.

4.1. Central asia

The current available research on aDNA in Xinjiang does not reveal any evidence of early population movement from the Yellow River to Central Asia. Wang et al. (2021a), Wang et al. (2021b) and Zhang et al. (2021) indicate that the Bronze Age inhabitants of Xinjiang were quite mixed genetically, comprising both Yamnaya/Afanasievo-related and Northern Eurasian ancestry. Zhang et al. (2021) demonstrated that one group of individuals from the Dzungarian Basin, dating to 3000-2800 BC had its origins with agropastoral steppe communities of the Afanasievo culture. However, another group, associated with the Tarim mummies, were agropastoralists with cattle, sheep, goat, wheat, barley, and millet, dating to 2100-1700 BC, but showed no relationship to either Yamnaya nor Yellow River ancient populations, being likely of an as yet unsampled Northern Eurasian people to the northwest, more closely related to the Botai (c. 3500-3000 BC) horse pastoralists.

Table 3
Shouldered spades from China and from North-Eastern India (Hu, 2002; Le, 2010; Li, 2023; Yang et al., 2022; Zhao and Wang, 2012).

 Egou 莪沟, Henan (Peiligang culture), (Li 2023) (5900-5700 BC)	 Gouwan 沟湾, Henan (Yangshao culture), (Le 2010) (4500-4000 BC)
 Fengtou 丰头, Shaanxi (Yangshao culture), (Yang et al. 2022) (3500-2800 BC)	 Wufengbei 五峰北, Jiangsu (Liangzhu culture (Tang et al. 2020) (3400-2200)
 Dingcun qushetou 丁村曲舌头, Shanxi (Taosi culture), (Hu 2002) (2300-1900 BC)	 Xinzhang 辛章, Shanxi (Longshan culture), (Zhao and Wang 2012) (2200-1800 BC)
 Rdzong-ru/Zongri 宗日 (Chen et al. 1998) (3600-2050 BC)	 Qugong II 曲贡, Tibet, (Excavation report 1999: 180 (1530-1210 BC)
 Wanghuacun 王华村, Hongya, Sichuan (Wu 1988) (Shang-Zhou ? 1500-800 BC)	 Chuankouba 船口坝, Longling, Yunnan (Wang 1991)(1000 BC)
 Lawnongthroh, Meghalaya (Mitri and Neog 2016) (1220-770 BC)	 Daojali Hading, Assam (Dikshit and Hazarika 2012) (750 ±300 BC)

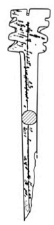
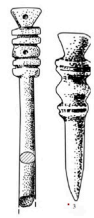
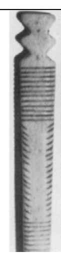
4.2. The Tibetan Plateau

A number of recent studies examining both mitochondrial DNA (Ding et al., 2020; Wang et al., 2023b; Ganyu et al., 2023; Li et al., 2023), non-recombining Y-chromosome (Wang et al., 2021b) and whole genome (Liu et al., 2022b) have supported the origin of Ancient Tibetans (e.g. 5100 BP to 2500 BP, Wang et al., 2023b) as situated within Northern East Asian lineages with admixture from possibly palaeolithic hunter-gatherer populations. A similar conclusion also is reached by studies modelling Y-chromosome sequences (Wang et al., 2018) from modern Tibeto-Burman and East Asian populations, and whole genome data from both ancient and modern populations (He et al., 2021).

Regarding multiple migrations several genetic studies touch on the issue of the movement of agriculturalists onto the higher plateau regions following the introduction of wheat and barley from the 2nd millennium BC (Fahu et al., 2015). An ancient genetic study from Nepal noted that individuals dating from 1500 BC onwards shared a strong related ancestry with Late Neolithic individuals from the Upper Yellow River Valley (Liu et al., 2022b). They hypothesized that while this related ancestry could be correlated with the barley–wheat-driven population expansion onto the Plateau, that it would require a very rapid expansion of such agriculturalists over 1000 km in a period of perhaps just 200 years. A further study also suggested that the mixed ancestry on the Plateau likely predates the dispersal of wheat and barley agriculturalists (Wang et al., 2023b, 3-4). It is interesting to note on this point that an unrelated study of ancient mtDNA, covering much of the Tibetan Plateau, did detect a strong matrilineal input from Northern East Asian populations throughout the 2nd millennium BC (Ganyu et al., 2023). However, this article did not connect this event to the expansion of wheat and barley farmers. This latter study also noted a decline in such influence from 1st millennium BC to the 1st millennium AD which the authors related to climatic deterioration.

A few genetic studies also point to the possibility of multiple migrations onto the Plateau over the last 5000 years, although many also stress periods of genetic continuity. For example, Liu et al. (2022b) points to the existence of two genetic clines in modern and ancient populations of the Tibetan Plateau and neighbouring areas, the Tibetan cline and the non-Tibetan Tibeto-Burman, respectively. These they interpret as corresponding to two distinct routes of population dispersal, one through the Tibetan Plateau and a second through Sichuan, Yunnan and Northern Burma to North-Eastern India. Pertinent to our paper, a

Table 4
Comparison of bone hairpins from The Yellow River basin and Swāt (Stacul, 1978, 1979).

Site	Symmetrical, central notch	Symmetrical triangular patterns
Yinxu, Henan (Chen 2022) 1500-1000 BC		
Loebanr III, Swāt (Stacul 1979) 1700-1400 BC		
Bīr-kōṭ-ghuṇḍai, Swāt (Stacul 1978) 1700-1200 BC		

further study modelling modern populations based on Y-chromosome haplotypes did suggest two ancestral groups relating to two migration routes one via Tibet and the other through Yunnan (Wang et al., 2018).

For southwest China, Tao et al. (2023) show that at Haimenkou in Yunnan on the Sichuan–Assam route, aDNA evidence also points to a millet farmer Yellow River ancestry, with little contribution from rice farmers from the Lower Yangtze, despite the presence of rice on these sites, lending support to the theory that such people did not migrate along the Yangtze River into southwest China (Huan et al., 2022).

5. Synthesis

In this section, we will evaluate to what degree the evidence discussed above supports the spread of Sino-Tibetan languages through demic diffusion as opposed to cultural diffusion, and whether the evidence would support a homeland in the Yellow River Basin rather than in Northeast India. This discussion is framed and explored within the context of three main routes of potential transmission that link Northern China to the Indian subcontinent during the Neolithic: a Sichuan–Tibet–Kashmir route (previously discussed by Han (2012), Lü (2016), a Sichuan–Assam route (which Ma et al., 2023 refer to as 'Shu-Shendu Road' 蜀身毒道) and a Central Asian route through Xinjiang and then south to Kashmir (van Driem, 2002, 243).

Fig. 6 represents these routes, the Sichuan–Tibet–Kashmir route in red the Yunnan–Assam route in orange, and the Central Asian route in green, mapped onto the current distribution of Sino-Tibetan languages (in purple).

5.1. *Sichuan–Tibet–Kashmir route*

The Sichuan–Tibet–Kashmir route, linking Sichuan and Yunnan to Kashmir through the Tibetan Plateau is supported by evidence for the temporal distribution of harvesting knives, millet, peaches, apricot, and hairpins presented above. Other types of data, including a jade pendant and beads in Swāt and semi-subterranean houses (Stacul, 1993b; Lü, 2016), cowrie shells (Ma et al., 2023) and perceived similarities in painted and corded ware pottery (Han, 2012, 2021), as well as black-burnished ceramics (Chen et al., 2024), all contribute to support the plausibility of a migration or cultural diffusion through this path. While some, in particular jade beads and pendants, might plausibly be items of exchange, others such as crops, house-styles, hairpins, cultivation tools and locally made harvesting knives, when combined as a cultural package with linguistic evidence, we would see as more probably the result of the movement of peoples.

The dates of sites displaying such evidence become younger as one moves west, from Sichuan (Liujiazhai), to Chamdo (Mkhar-ro) to Kashmir and finally Swāt, the directionality of this route of dispersal can therefore only be from the east to the west rather than the other way round.

As shown in Fig. 6, this route overlaps with zones where Sino-Tibetan languages are currently spoken, and even the Kashmir/Swāt sites could be interpreted as remains of ancient populations possibly related to the westernmost Sino-Tibetan speaking people, from the West-Himalayish subgroup.

While we lack archaeological evidence for harvesting knives or millet in the second millennium BC between Sikkim and Kashmir, as stated in Section 4.2 above, aDNA demonstrates the presence of individuals whose ancestors originated from the Yellow River, as far west as even Mustang in Nepal, in Suila cal. 1491-1317 BC and Lubrak cal. 1263-1127 BC (Liu et al., 2022b). While radiocarbon dates are available for both individuals unfortunately δC13 values that might provide an indication of millet consumption are not at present available.

This genetic evidence has the potential to shed light on two competing theories for the origin of the earliest presence of agriculture on the Tibetan Plateau, for example at Mkhar-ro/Karuo and Gsho-rngul-mda/Xiaoenda. The first theory is the adoption of millet cultivation, along with many other aspects of millet agricultural cultures, by pre-existing indigenous hunter-gatherer communities inhabiting the Plateau – *cultural diffusion*; the second is the movement or migration of agriculturalists peoples onto the Plateau through population expansion – *demic diffusion*. The first argument for adoption of agriculture has been made for communities on the Northeastern Tibetan Plateau (Ren et al., 2020) and for Eastern Tibet (d'Alpoim Guedes, 2018; d'Alpoim Guedes and Aldenderfer, 2020). The second argument for demic diffusion of agriculturalists, accompanied by language families has been made for East Asia in general (Bellwood, 2005). In this latter framework, the origin of Rdzong-ru/Zongri Culture is seen not as adoption by foragers, but through the spread of Majiayao agriculturalists founding smaller settlements, while that of Mkhar-ro might have also involved some interaction and intermarriage between local hunter-foragers and agriculturalists (Lü, 2022).

Regarding the adoption of agriculture by indigenous peoples a cautionary tale comes from European Neolithic studies. The high amount of wild foods, evidence for hunting, and substantial cultural regional variation between many Neolithic societies in Europe led many to support the cultural diffusion and adoption of crops by pre-existing hunter-gatherers (e.g. Zvelebil, 2001), a position which only more recent aDNA studies conducted in just over the last decade have decisively refuted (Stevens et al., 2022; Rowley-Conwy, 2024).

Current genetic evidence, summarized above, suggests an origin for ancient Tibetan ancestry dating from 5000 years ago largely situated within northern East Asia, with a minor input possibly from indigenous pre-Holocene communities (Wang et al., 2018, 2021b). This pattern would be most in keeping with the expansion of millet farmers

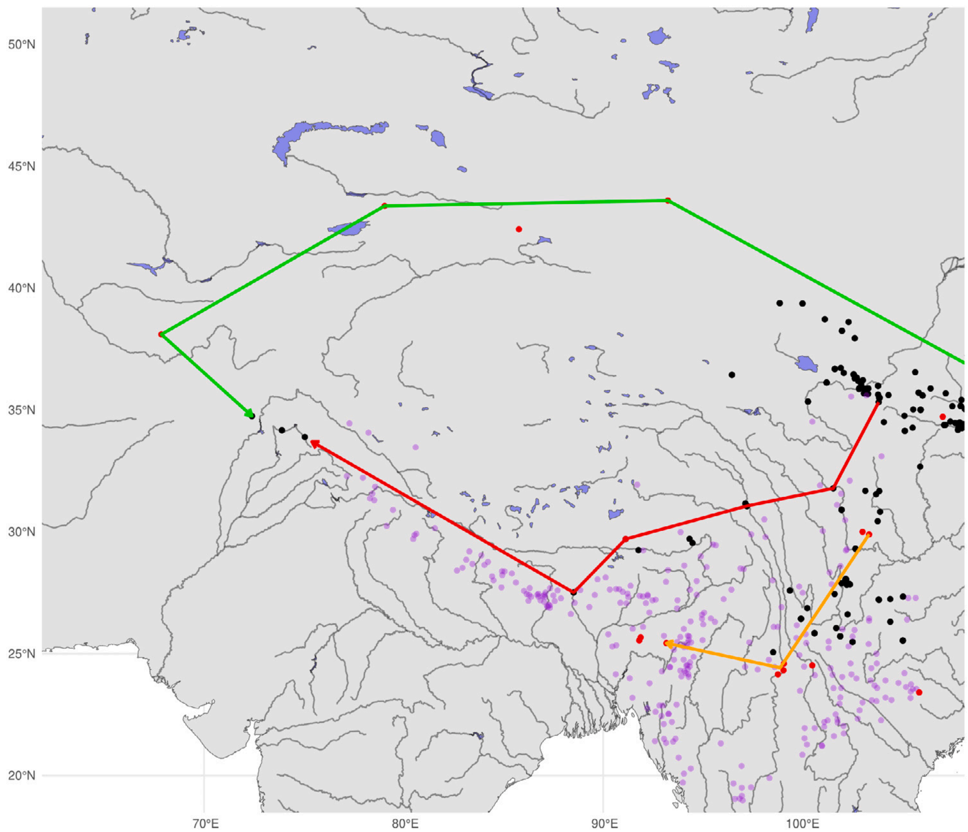


Fig. 6. Hypothetical migrations of Sino-Tibetan speakers: (I) Sichuan–Tibet–Kashmir route in red, (II) Yunnan–Assam route in orange and (III) Central Asia route in green. Purple dots represent the current localization of Sino-Tibetan languages, and the black and red dots correspond to sites where harvesting knives and shouldered spades have been found, respectively.

through demic diffusion as suggested in some papers (Wang et al., 2023b, 2021b). This does not negate the possibility of initially only small founding populations, e.g. subsets of pre-existing populations, their interaction and inter-marriage with hunter-gatherers, and potential increased isolation, all leading to the emergence of distinctive unique Neolithic cultures (Thomas, 2023). However, the adoption of agriculture, not to mention other aspects of farming cultures, by hunter-gatherers without long periods of integration with agriculturalists has been seen as ethnographically and archaeologically unsupported (Bellwood, 2005; Rowley-Conwy, 2024), and argued also to be theoretically unlikely (Stevens et al., 2022).

In addition to the genetic evidence, the very spread of Sino-Tibetan languages themselves would generally support the diffusion of peoples rather than the adoption of agriculture by indigenous groups across the Tibetan Plateau. While it is possible that languages spread much later, replacing earlier non-Sino-Tibetan languages, the existence of broad genetic continuity and the divergence of such languages would lend support to the spread of agriculture alongside languages through the movement of peoples (Sagart, 2008).

Among the subgroups of Sino-Tibetan, those whose speakers are most likely to have reached their current location by migrations through the Sichuan–Tibet–Kashmir route are West Himalayish — the westernmost subgroup, located a mere 100 km from Gufkral and Burzahom, and the Bodish subgroup, comprising Tibetic, East Bodish (in Bhutan) and Tamangic languages (in Nepal), whose common ancestor is evaluated to date back to 3423 BP [4970 BP-2254 BP] according to the results of the Sino-Tibetan phylogeny in Wu et al. (2022). This date is compatible with a migration related to the spread of barley agriculture on the Tibetan Plateau, which also fits the observation that Bodish languages share a cognate for 'barley' (Hyslop and d'Alpoim Guedes, 2020).

Memories of some migrations may be maintained in the oral tradition of some groups of Arunachal Pradesh such as the Apatani, which contends at a northern origin from Tibet rather than from Burma (Blackburn, 2003; Post, 2012).

5.2. Yunnan–Assam route

Archaeological evidence for an alternative migration pathway, the Sichuan–Yunnan–Assam route, is supported by a different range of evidence, in particular stone shouldered spades, ceramics (Hazarika, 2013) and jadeite objects (Tada et al., 2012, 51). Hazarika (2017, 111-112) argues that ceramic tripods found in Neolithic sites of Manipur such as Napachik (dated 1450 BC according to Singh, 1993) resemble the tripods found at Ban Kao in Thailand (dated 2900-2100 BC, Qiao, 2002) as well as the *jia* 斝 or *li* 鬲 tripods that are common in Longshan (3000-1900 BC) and Shijiahe (2500-2000 BC) cultures.

Further, such a route of dispersal from Yunnan into Northeast India has been suggested from modern genetic studies on Y-chromosome haplogroups (Wang et al., 2018, 1298).

However, currently there is little evidence for cereal crops, including millet within this region potentially due to limited archaeobotanical investigation. The nearest definitive evidence for foxtail millet comes from Waina, in Uttar Pradesh some 900 km from Daojali Hading.

On the other hand, there is clear evidence of continuous migrations and contacts between Southwest Yunnan, Northern Burma and Northeastern India, as shown by the current distribution of speakers of the Jinghpo language, who are spread in a patches over a 400 km zone from the Luxi 潞西 and Yingjiang 盈江 counties in Yunnan, Kachin State in Burma up to Titabor in Central Assam and the Burhi Dihing River in Upper Assam (Kurabe, 2014).

This southern route could account for some of the Sino-Tibetan migrations into Northern India, especially those involving groups located south of the Lohit river (Post and Burling, 2017), some of which such as Sal and Kuki-Chin are spread over India and Burma. It could also reflect Austroasiatic-speaking migrations, corresponding to the ancestors of Khasi and Mundas. At the present moment we lack any means of distinguishing between the movements of Sino-Tibetan vs. Austroasiatic speakers, or even groups combining speakers of languages from these two families.

5.3. Central Asian route

A competing westward migration route in the third/second millennia BC, from Majiayao into Kashmir through Xinjiang, and then eastwards from Kashmir into Nepal was proposed by van Driem (2002, 243).

The main evidence for agricultural diffusion from Northern China to Central Asia is evidence for the spread of millets westwards from the Yellow River basin to Xinjiang and Central Asia, and then southwards to Kashmir during the third millennium BC. However, whether this was through cultural or demic diffusion is seldom discussed in depth.

The initial eastward spread of agro-pastoral communities across Central Asia, originating in Western Eurasia, is likely to have been driven by demic diffusion. It has been noted that the dispersal of early millet cultures is more rapid and widespread than that of rice cultivators. This is potentially because the carrying capacity per unit of land is much lower for millet than rice agriculture, meaning millet farmers would have reached population thresholds quicker than rice farmers (Stevens et al., 2024). Extending this argument to the dispersal of wheat, barley across Central Asia, it is probable that only the combination of these elements, which included domesticated livestock (sheep, goat and cattle), allowed sufficient population growth to drive an eastward demic diffusion. Which combined with the lower carrying capacity of the region, drove a relatively rapid dispersal of agro-pastoralists across Central Asia to the edges of the landscape occupied by millet farmers.

In contrast, the absence of suitable animal domesticates within Eastern Eurasia likely initially curtailed the opposite flow of millet farmers west into Central Asia from the Upper Yellow River Basin. Especially given the reduced suitability of soils to millet farming once populations began to extend westwards beyond the Loess Plateau. For example, millet agriculture is seen from archaeobotanical evidence to be restricted in its distribution in Central Asia to "rain-fed locales" (Ventresca-Miller et al., 2023).

To the west, the demic diffusion of agriculturalists out from the Fertile Crescent appears to pause in western Turkmenistan between the 6th and early 4th millennia BC (Stevens et al., 2016). It is likely only after the establishment of agro-pastoral communities in this region, that domesticates and people were able to spread relatively rapidly across this region. This interpretation is reflected in the archaeological record, with only wheat and/or barley along with sheep/goat, appearing initially at key sites across Central Asia, with no millets, e.g. both at Tasbas I (Spengler et al., 2014; Spengler, 2015) and Tongtian Cave, in the millennia between 3500-2500 BC (Zhou et al., 2020).

The conclusive dating of millets in Kashmir at 2500 BC (Spate et al., 2017), and the current absence of evidence for an early 3rd millennium dispersal route along the Himalayas, would support the theory that millets were adopted by Central Asian agro-pastoral groups (cf. Ventresca-Miller et al., 2023), at this time of largely Western Eurasian lineage, and they subsequently rapidly spread west across Central Asian.

This westwards diffusion of millets across Central Asia is then argued to be largely through cultural and not demic diffusion, a theory supported by both genetic evidence (Zhang et al., 2021) and linguistic evidence. With regard to the latter there is no trace of languages from East Asian families, such as Sino-Tibetan, either in ancient written documents, attested languages or toponymy in Xinjiang and Central Asia: the most ancient attested languages of this area, Tocharian, Khotanese and Tumshuqese, have loanwords from Old Chinese or Turkic languages dating from the historical period (Lubotsky and Starostin, 2003), but no trace of prehistorical borrowing from Sino-Tibetan languages, as would have been expected if Yellow River millet farmers had migrated through this area. Moreover, cuisine, associated ceramics and sticky millets did not spread to Xinjiang and Central Asia (Fuller and Rowlands, 2009; Hunt et al., 2024).

Given the spread of millets through Central Asia is thought to be largely through cultural diffusion, it is notable that harvesting knives are largely absent from Central Asia. Although Chen and Zhang (1991) do report stone knives from three sites in Kashgar prefecture, Xinjiang at c.1000 BC, they lack perforations or notches, and were not cord-attached harvesting knives of the type discussed above. This in itself would imply that such items did not generally culturally diffuse with millets west with agro-pastoralists. Notably there is also no evidence to date for peach or apricot within this region for at least this earlier period dispersing with agro-pastoralists (Dal Martello et al., 2023).

5.4. Can farmers revert to foraging?

Blench and Post's (2014) hypothesis, according to which proto-Sino-Tibetan speakers were foragers practising sago arboriculture in the Eastern slopes of the Himalayas 9000 years ago is supported by two main pieces of evidence: the extreme diversity of Sino-Tibetan languages in North-Eastern India, confirmed by the phylogenetic analysis in Section 2.2, and the interpretation that some groups of Arunachal Pradesh, such as the Puroik, are thought to have acquired agriculture only very recently (Stonor, 1952).

Blench and Post (2014) further propose that Sino-Tibetan speakers spread to China through the Sichuan–Tibet route by 5000 BP, but in the opposite direction, and obtained domestic pigs and millet cultivation only once they reached China.

The status of the Puroik as hunter-gatherers who have adopted agriculture, as opposed to agriculturalists who have increased their reliance on the exploitation of sago, is however, problematic. Archaeological evidence has demonstrated that early agricultural societies often relied heavily on wild foods, indeed to the point that in some cases agriculture was abandoned entirely (Stevens et al., 2022). Further, historical examples include the Polynesian people, whose Austronesian ancestors were millet and rice farmers, but abandoned cereal cultivation (Bellwood, 1987), as well as the case of the Mlabri, Austro-asiatic speaking hunter-gatherers who are both genetically (Oota et al., 2005; Xu et al., 2010) and linguistically (Rischel, 1995) closely related to the rice farming Tin people, demonstrating a cultural reversion and abandonment of agriculture.

In keeping with this, it can be argued that the peoples of Mkhar-ro may have diversified their subsistence to minimize risks of crop failures (Song et al., 2021), hence resembling more foragers than farmers.

The presence of terms for pigs and millet in Puroik etymologically related to those of Sino-Tibetan languages located in China (Section 2.3) is difficult to reconcile with the hypothesis that they have never known agriculture. To salvage it, one would need to posit that some unspecified Sino-Tibetan group went back through the same route from China to North-Eastern India, and transmitted the words for pig and millets to the ancestors of Kho-Bwa speakers, early enough for these loanwords to remain undetectable.

6. Conclusion

The linguistic, genetic and archaeological evidence reviewed in this work, comprising cultivated plants, agricultural tools and other cultural implements, is compatible with theories proposing a series of migrations of millet farmers originating from the Yellow River basin along two routes. A proposed likely earlier established route, dating to the third millennium BC, we see as being from Sichuan through Eastern Tibet to Kashmir. The second one, dating to the second millennium BC, involves in our hypothesis demic diffusion through Yunnan to North-East India. Linguistic evidence examined in this work is consistent with multiple distinct episodes of migration across both routes, and a two-pronged westward migration of Sino-Tibetan is supported by the results of Yang et al. (2024), which use a different dataset and method. Conversely, demic diffusion from the Yellow River basin through Xinjiang and Central Asia to Kashmir appears to be unsupported by the present evidence, and the earliest spread of the millets through Central Asia can be associated with their adoption by existing agro-pastoral groups who spread them back into Western Eurasia and the northwest part of South Asia.

While the authors of this paper consider that the presented evidence supports the hypothesis of agriculture spreading together with languages from the Yellow River Basin into Tibet and Northeast India, further work is still required. Regarding the mode of agricultural and cultural dispersal through adoption or the movement of peoples, and the direction of linguistic spread, future genetic work could provide crucial evidence, if it were more directed towards these questions. Future archaeological work in Northeast India also has the potential to shed more light on the issue on whether population expansions from this region might have spread Sino-Tibetan languages into the Tibetan Plateau.

CRediT authorship contribution statement

Guillaume Jacques: Writing – review & editing, Writing – original draft, Visualization, Resources, Methodology, Investigation, Data curation, Conceptualization. **Chris Stevens:** Writing – review & editing, Writing – original draft, Visualization, Resources, Methodology, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The supplementary material contain the millets and *Prunus* database as a spreadsheet and a series of maps (S1-S3, S6-S9), the harvesting knives database as a spreadsheet (S5), and the linguistic dates and additional etymological notes as an additional document (S4).

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Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.quaint.2024.09.001.

References

Aali, Abolfazl, Stöllner, Thomas, Abar, A., Rühli, Frank J., 2012. The salt men of Iran: The salt mine of Douzlakh, Chehrabad. Archaologisches Korrespondenzblatt 42, 61–81.

Allaby, Robin G., Stevens, Chris J., Kistler, Logan, Fuller, Dorian Q., 2022. Emerging evidence of plant domestication as a landscape-level process. Trends Ecol. Evol. 37 (3), 268–279. http://dx.doi.org/10.1016/j.tree.2021.11.002.

Allen, Nicholas J., 1975. Sketch of Thulung Grammar, with Three Texts and a Glossary. China-Japan Program, Ithaca.

An, Zhimin, 1955. Zhōngguó gǔdài de shídāo [the stone knives of Ancient China]. Kǎogǔ xuébào 10, 27–51.

An, Zhimin, 1979. Péilǐgǎng, Císhān hé Yǎngsháo – shìlùn zhōngyuán xīnshíqì wénhuà de yuānyuán jí fāzhǎn. [Peiligang, Cishan and Yangshao, an essay on the origin and development of Neolithic cultures in the Central Plains]. Kǎogǔ (4), 335–346.

Andersson, Johan Gunnar, 1923. An Early Chinese Culture. The Geological Survey of China.

Bellwood, Peter, 1987. The Polynesians. Thames and Hudson, London.

Bellwood, Peter, 2002. Farmers, foragers, languages, genes: The genesis of agricultural societies. In: Bellwood, Peter, Renfrew, Colin (Eds.), Examining the Farming/Language Dispersal Hypothesis. McDonald Institute for Archaeological Research, Cambridge, pp. 17–28.

Bellwood, Peter, 2005. First Farmers, the Origins of Agricultural Societies. Blackwell Publishing, Oxford.

Bellwood, Peter, 2024. Archaeogenetics: Tracing ancient migrations from the Yellow River. Curr. Biol. (34), 16–35.

Bellwood, Peter, Renfrew, Colin, 2002. Farmers, Foragers, Languages, Genes: The Genesis of Agricultural Societies. McDonald Institute for Archaeological Research, Cambridge.

Betts, Alison, Yatoo, Mumtaz, Spate, Michael, Fraser, James, Kaloo, Zahoor, Rashid, Younus, Pokharia, Anil, Zhang, Guilin, 2019. The Northern Neolithic of the Western Himalayas: New research in the Kashmir valley. Archaeol. Res. Asia 18, 17–39. http://dx.doi.org/10.1016/j.ara.2019.02.001.

Billings, Traci N., Cerasetti, Barbara, Forni, Luca, Arciero, Roberto, Martello, Rita Dal, Carra, Marialetizia, Rouse, Lynne M., Boivin, Nicole, Spengler, Robert N., 2022. Agriculture in the Karakum: An archaeobotanical analysis from Togolok 1, southern Turkmenistan (ca. 2300–1700 B.C.). Front. Ecol. Evol. 10, http://dx.doi.org/10.3389/fevo.2022.995490.

Blackburn, Stuart, 2003. Memories of migration: Notes on legends and beads in Arunachal Pradesh, India. Eur. Bull. Himal. Res. 25/26, 15–60.

Blench, Roger, Post, Mark W., 2014. Rethinking Sino-Tibetan phylogeny from the perspective of North East Indian languages. In: Hill, Nathan W., Owen-Smith, Thomas (Eds.), Trans-HImalayan Linguistics. Mouton de Gruyter, Berlin, pp. 71–104.

Bodt, Timotheus Adrianus, 2020. Grammar of Duhumbi (Chugpa). Brill, Leiden.

Bodt, Timotheus Adrianus, 2021. The Duhumbi perspective on proto-Western Kho-Bwa onsets. J. Hist. Linguist. 11 (1), 1–59.

Bodt, Timotheus Adrianus, 2024. Proto-Western Kho-Bwa: Reconstructing a Community's Past Through Language. Institute of Linguistics, Academia Sinica, https://www.ling.sinica.edu.tw/item/en?act=publish_book&code=view&bookID=146.

Bodt, Tim, List, Johann-Mattis, 2019. Testing the predictive strength of the comparative method: an ongoing experiment on unattested words in Western Kho-Bwa languages. Papers Hist. Phonol. 4, 22–44.

Bouchery, Pascal, 2009. Dictionary of the Apatani Language. Apatani Language Project.

Bradley, David, 2022. Phylogeny of Tibeto-Burman from plants and animals. In: Post, Mark W., Morey, Stephen, Huber, Toni (Eds.), Ethnolinguistic Prehistory of the Eastern Himalaya. Brill, Leiden, pp. 173–210.

Bradley, David, Liu, Li, Ning, Chao, Martello, Rita Dal, 2024. Sino-tibetan archaeolinguistics. In: Robbeets, Martine, Hudson, Mark (Eds.), Oxford Handbook of Archaeology and Language. Oxford University Press, (forthcoming).

Brunson, Katherine, 2015. Craft Specialization and Animal Products at the Longshan Period Sites of Taosi and Zhoujiazhuang (Ph.D. dissertation). University of California, Los Angeles, Shanxi province, China.

Brunson, Katherine, He, Nu, Dai, X., 2016. Sheep, cattle, and specialization: New zooarchaeological perspectives on the taosi longshan. Int. J. Osteoarchaeol. 26 (3), 460–475. http://dx.doi.org/10.1002/oa.2436.

Chen, Honghai, 2013. The Qijia Culture of the Upper Yellow River valley. In: Underhill, Anne P. (Ed.), A Companion to Chinese Archaeology. Wiley-Blackwell, Oxford, pp. 105–124.

Chen, Xiang, 2022. Yīnxū gǔjī de zhǒnglèi, yuánliú yǔ gōngnéng. [The types, origin and functions of the bone hairpins at Yinxu]. Kǎogǔ (1), 98–108.

Chen, Tingting, Jia, Xin, Li, Haiming, Dong, Haiming, 2019. Gānqīng dìqū qíjiā wénhuà shíqī nóngyè jiégòu de shíkōng biànhuà jíqí yǐngxiǎng yīnsù fēnxī. [The analysis of spatiotemporal transformations of agriculture and its influencing factors during the Qijia culture period in Gansu and Qinghai. Quater. Sci. 39 (1), 132–144.

Chen, Xinzhou, Lü, Hongliang, Liu, Xinyi, Frachetti, Michael D., 2024. Geospatial modelling of farmer-herder interactions maps cultural geography of Bronze and Iron age Tibet, 3600-2200 BP. Sci. Rep. 14 (1), 2010. http://dx.doi.org/10.1038/s41598-023-50556-9.

Chen, Hong, Shen, Yiming, Xu, Zheng, Si, Hongwei, 2023. Jiāngsū Dānyáng Fènghuángshān yízhǐ mózhì shíqì gōngnéng chūbù yánjiū: jǐyú wēihén fēnxī de zhèngjù. [A preliminary study on the functions of polished stone tools at the Fenghuangshan site in Danyang, Jiangsu, on the basis of evidence from the analysis of microwear]. Jiānghàn kǎogǔ 184 (1), 115–123.
Chen, Honghai, Wang, Duanzhi, ang Mei, Guoshun, Suonan, 1998. Qīnghǎi tóngdé xiàn zōngrì yízhǐ fājué jiǎnbào [Excavation report of Zongri in Tongde, Qinghai]. Kǎogǔ (5).
Chen, Ge, Zhang, Ping, 1991. Xīnjiāng fāxiàn de shídāo, shílián hé tónglián [The stones knives, stone sickles and bronze sickles discovered in Xinjiang]. Kǎogǔ yǔ wénwù (1), 23–29.
Coningham, Robin, Young, Ruth, 2015. The Archaeology of South Asia: From the Indus to Asoka, C. 6500 BCE–200 CE. Cambridge University Press, Cambridge.
Dal Martello, Rita, 2020. Agricultural Trajectories in Yunnan, Southwest China: A Comparative Analysis of Archaeobotanical Remains from the Neolithic to the Bronze Age (Ph.D. dissertation). University College London.
Dal Martello, Rita, von Baeyer, Madelynn, Hudson, Mark, Bjorn, Rasmus G., Leipe, Christian, Zach, Basira, Mir-Makhamad, Barbara, Billings, Traci N., Muñoz Fernández, Irene M., Huber, Barbara, Boxleitner, Kseniia, Lu, Jou-Chun, Chi, Ko-An, Liu, Hsiao-Lei, Kistler, Logan, Spengler, Robert N., 2023. The domestication and dispersal of large-fruiting *Prunus* spp.: A metadata analysis of archaeobotanical material. Agronomy 13 (1027), 1–23.
Dal Martello, Rita, Min, Rui, Stevens, Chris, Higham, Charles, Higham, Thomas, Qin, Ling, Fuller, Dorian Q., 2018. Early agriculture at the crossroads of China and Southeast Asia: Archaeobotanical evidence and radiocarbon dates from Baiyangcun, Yunnan. J. Archaeol. Sci.: Rep. 20, 711–721. http://dx.doi.org/10.1016/j.jasrep.2018.06.005.
d'Alpoim Guedes, Jade, 2018. Did foragers adopt farming? A perspective from the margins of the Tibetan Plateau. Quat. Int. 489, 91–100. http://dx.doi.org/10.1016/j.quaint.2016.12.010.
d'Alpoim Guedes, Jade, Aldenderfer, Mark, 2020. The archaeology of the early Tibetan plateau: New research on the initial peopling through the early bronze age. J. Archaeol. Res. 28, 339–392. http://dx.doi.org/10.1007/s10814-019-09137-6.
d'Alpoim Guedes, Jade, Jiang, Ming, He, Kunyu, Wu, Xiaohong, Jiang, Zhanghua, 2015. Site of Baodun yields earliest evidence for the spread of rice and foxtail millet agriculture to south-west China. Antiquity 87 (337), 758–771. http://dx.doi.org/10.1017/S0003598X00049449.
d'Alpoim Guedes, Jade, Lu, Hongliang, Hein, Anke M., Schmidt, Amanda H., 2015. Early evidence for the use of wheat and barley as staple crops on the margins of the Tibetan plateau. Proc. Natl. Acad. Sci. 112 (18), 5625–5630. http://dx.doi.org/10.1073/pnas.1423708112.
d'Alpoim Guedes, Jade, Lu, Hongliang, Li, Yongxian, Spengler, Robert N., Wu, Xiaohong, Aldenderfer, Mark S., 2014. Moving agriculture onto the Tibetan plateau: the archaeobotanical evidence. Archaeol. Anthropol. Sci. 6, 255–269. http://dx.doi.org/10.1007/s12520-013-0153-4.
Dani, Ahmad Hasan, 1960. Prehistory and Protohistory of Eastern India, with a Detailed Account of the Neolithic Cultures in Mainland South East Asia. K. L. Mukhopadhyay, Calcutta.
Deng, Zhenhua, Fuller, Dorian Q., Chu, Xiaolong, Cao, Yanpeng, Jiang, Yuchao, Wang, Lizhi, Lu, Houyuan, 2020. Assessing the occurrence and status of wheat in late Neolithic central China: the importance of direct AMS radiocarbon dates from Xiazhai. Veg. Hist. Archaeobot. 29, 61–73. http://dx.doi.org/10.1007/s00334-019-00732-7.
Deuri, Ram Kumar (Ed.), 1982. The Sulungs. Government of Arunachal Pradesh, Shillong.
Diamond, Jared, Bellwood, Peter, 2003. Farmers and their languages: The first expansions. Science 300, 597–603. http://dx.doi.org/10.1126/science.1078208.
Dikshit, K.N, Hazarika, Manjil, 2012. The Neolithic cultures of Northeast India and adjoining regions: A comparative study. J. Indian Ocean Archaeol. 7/8, 98–148.
Ding, Manyu, Wang, Tianyi, Ko, Albert Min-Shan, Chen, Honghai, Wang, Hui, Dong, Guanghui, Lu, Hongliang, He, Wei, Wangdue, Shargan, Yuan, Haibing, He, Yuanhong, Cai, Linhai, Chen, Zujun, Hou, Guangliang, Zhang, Dongju, Zhang, Zhaoxia, Cao, Peng, Dai, Qingyan, Feng, Xiaotian, Zhang, Ming, Wang, Hongru, Yang, Melinda A., Fu, Qiaomei, 2020. Ancient mitogenomes show plateau populations from last 5200 years partially contributed to present-day Tibetans. Proc. R. Soc. Lond. [Biol.] 287 (1923), 20192968. http://dx.doi.org/10.1098/rspb.2019.2968, https://royalsocietypublishing.org/doi/abs/10.1098/rspb.2019.2968.
Dodson, John, Dodson, Eoin, Banati, Richard, Li, Xiaoqiang, Atahan, Pia, Hu, Songmei, Middleton, Ryan J., Zhou, Xinying, Nan, Sun, 2014. Oldest directly dated remains of sheep in China. Sci. Rep. 4, 7170.
Dong, Guanghui, Jia, Xin, Elston, Robert, Chen, Fahu, Li, Shuicheng, Wang, Lin, Cai, Linhai, An, Chengbang, 2013. Spatial and temporal variety of prehistoric human settlement and its influencing factors in the upper Yellow River valley, Qinghai province, China. J. Archaeol. Sci. 40 (5), 2538–2546. http://dx.doi.org/10.1016/j.jas.2012.10.002.
Fahu, Chen, Dong, G.H., Zhang, D.J., Liu, X.Y., Jia, X., An, C.B., Ma, M.M., Xie, Y.W., Barton, L., Ren, X.Y., Zhao, Z.J., Wu, X.H., Jones, Martin K., 2015. Agriculture facilitated permanent human occupation of the Tibetan Plateau after 3600 B.P. Science 347 (6219), 248–250. http://dx.doi.org/10.1126/science.1259172.
Fellner, Hannes A, Hill, Nathan W., 2019. The differing status of reconstruction in Trans-Himalayan and Indo-European. Cahiers de Linguistique Asie Orientale 48 (2), 159–172.
Flad, Rowan K, Yuan, Jing, Li, Shuicheng, 2007. Zooarchaeological evidence for animal domestication in Northwest China. In: Madsen, D.B., Chen, F.H., Xing, G. (Eds.), Late Quaternary Climate Change and Human Adaptation in Arid China. Elsevier, Amsterdam, pp. 167–204.
Fonia, Ramnath Singh, 2022. Excavations at Burzahom (1960–1971). Archaeological Survey of India.
Fuller, Dorian Q, Rowlands, Mike, 2009. Towards along-term macro-geography of cultural substances: food and sacrifice traditions in East, West and South Asia. Chinese Rev. Anthropol. 12, 1–37.
Fuller, Dorian Q, Stevens, Chris J., 2017. The spread of agriculture in eastern Asia, archaeological bases for hypothetical farmer/language dispersals. Lang. Dyn. Change 7, 152–186.
Fuller, Dorian Q, Stevens, Chris J., 2019. Between domestication and civilization: the role of agriculture and arboriculture in the emergence of the first urban societies. Veg. Hist. Archaeobot. 28 (3), 263–282. http://dx.doi.org/10.1007/s00334-019-00727-4.
Ganyu, Zhang, Cui, Can, Wangdue, Shargan, Lu, Hongliang, Chen, Honghai, Xi, Lin, He, Wei, Yuan, Haibing, Tsring, Tinley, Chen, Zujun, Yang, Feng, Tsering, Tashi, Li, Shuai, Tashi, Norbu, Yang, Tsho, Tong, Yan, Wu, Xiaohong, Li, Linhui, He, Yuanhong, Cao, Peng, Dai, Qingyan, Liu, Feng, Feng, Xiaotian, Wang, Tianyi, Yang, Ruowei, Ping, Wanjing, Zhang, Ming, Gao, Xing, Liu, Yichen, Wang, Wenjun, Fu, Qiaomei, 2023. Maternal genetic history of ancient Tibetans over the past 4000 years. J. Genet. Genom. 50 (10), 765–775. http://dx.doi.org/10.1016/j.jgg.2023.03.007.
Gao, Yu, Yang, Jishuai, Ma, Zhikun, Tong, Yan, Yang, Xiaoyan, 2020. New evidence from the Qugong site in the central Tibetan Plateau for the prehistoric highland Silk Road. Holocene 31 (2), 230–239.
García-Granero, Juan José, Gadekar, Charusmita, Esteban, Irene, Lancelotti, Carla, Madella, Marco, Ajithprasad, P., 2015. What is on the craftsmen's menu? plant consumption at Datrana, a 5000-year-old lithic blade workshop in North Gujarat, India. Archaeol. Anthropol. Sci.
Groppi, Alexis, Liu, Shuo, Cornille, Amandine, Decroocq, Stéphane, Bui, Quynh Trang, Tricon, David, Cruaud, Corinne, Arribat, Sandrine, Belser, Caroline, Marande, William, Salse, Jérôme, Huneau, Cécile, Rodde, Nathalie, Rhalloussi, Wassim, Cauet, Stéphane, Istace, Benjamin, Denis, Erwan, Carrère, Sébastien, Audergon, Jean-Marc, Roch, Guillaume, Lambert, Patrick, Zhebentyayeva, Tetyana, Liu, Wei-Sheng, Bouchez, Olivier, Lopez-Roques, Céline, Serre, Rémy-Félix, Debuchy, Robert, Tran, Joseph, Wincker, Patrick, Chen, Xilong, Pétriacq, Pierre, Barre, Aurélien, Nikolski, Macha, Aury, Jean-Marc, Abbott, Albert Glenn, 2021. Population genomics of apricots unravels domestication history and adaptive events. Nature Commun. 12 (1), 3956. http://dx.doi.org/10.1038/s41467-021-24283-6.
Han, Jianye, 2012. The painted pottery road and early sino-western cultural exchanges. Anabasis, Studia classica et orientalia 3, 25–42.
Han, Jianye, 2021. Zǎoqī dōngxī wénhuà jiāoliú de sāngè jiēduàn. [Three stages of early east–west cultural exchange]. Kǎogǔ xuébào (3), 317–338.
Handel, Zev, 2008. What is Sino-Tibetan? Snapshot of a field and a language family in flux. Lang. Linguist. Compass 2/3, 422–441.
Harada, Motoki, 2015. Sekki shiyō-kon kara mita higashi ajia no shoki nōkō (Ph.D. dissertation). Kanazawa university.
Harris, D.R, Masson, V.M., Berezkin, Y.E., Charles, M.P., Gosden, C., Hillman, G.C., Kasparov, A.K., Korobkova, G.F., Kurbansakhatov, K., Legge, A.J., et al., 1993. Investigating early agriculture in Central Asia: new research at Jeitun, Turkmenistan. Antiquity 67 (255), 324–338. http://dx.doi.org/10.1017/S0003598X00045385.
Hazarika, Manjil, 2013. Prehistoric cultural affinities between Southeast Asia, East Asia and Northeast India: An exploration. In: Klokke, Marijke J., Degroot, Véronique (Eds.), Unearthing Southeast Asia's Past, Selected Papers from the 12th International Conference of the European Association of South East Asian Archaeologists. vol. 1, NUS Press, Singapore, pp. 16–25.
Hazarika, Manjil, 2017. Prehistory and Archaeology of Northeast India: Multidisciplinary Investigation in an Archaeological Terra Incognita. Oxford University Press, Oxford.
He, Keyang, Lu, Houyang, Zhang, Jianping, Wang, Can, 2022. Holocene spatiotemporal millet agricultural patterns in northern China: A dataset of archaeobotanical macroremains. Earth Syst. Sci. Data 14 (10), 4777–4791. http://dx.doi.org/10.5194/essd-14-4777-2022.
He, Guanglin, Wang, Mengge, Zou, Xing, Chen, Pengyu, Wang, Zheng, Liu, Yan, Yao, Hongbin, Wei, Lan-Hai, Tang, Renkuan, Wang, Chuan-Chao, Yeh, Hui-Yuan, 2021. Peopling history of the Tibetan Plateau and multiple waves of admixture of Tibetans inferred from both ancient and modern genome-wide data. Front. Genet. 12 (725243), http://dx.doi.org/10.3389/fgene.2021.725243.
Heggarty, Paul, 2014. Prehistory by Bayesian phylogenetics? the state of the art on Indo-European origins. Antiquity 88 (340), 566–577.
Hu, Jian, 2002. Shānxī Xiāngfénxiàn Dīngcūn Qūshétóu xīnshíqì shídài yízhǐ fājué jiǎnbào. [A brief report on the Qushetou Neolithic site at Dingcun, Xiangfen prefecture, Shanxi]. Kǎogǔ (2), 29–40.

Hu, Songmei, Zhang, Pengcheng, Yuan, Ming, 2008. Yúlín Huǒshíliáng yízhǐ dòngwù yícún yánjiū. [Research on animal remains at the Huoshiliang site in Yulin]. Rénlèixué xuébào 27 (3), 232–248.

Huan, Xiujia, Deng, Zhenhua, Zhou, Zhiqing, Yan, Xue, Hao, Xiaoxiao, Bu, Qi, Lu, Houyuan, 2022. The emergence of rice and millet farming in the Zang-Yi corridor of Southwest China dates back to 5000 years ago. Front. Earth Sci. 10, http://dx.doi.org/10.3389/feart.2022.874649.

Huang, Keying, 1992. Péilǐgǎng, Císhān wénhuà chángtiáoxíng shíchǎn biàn – shìlùn qí wénhuà de nóngyè jiēduàn jí jīngjì zhuàngkuàng. [on criterias for distinguishing the long stone spades in Peiligang and Cishan culture, an essay into the agronomical stage and economic situation of its culture]. Huáxià kǎogǔ (4), 39–46.

Hunt, Harriet V., Jiang, Hongen, Liu, Xinyi, Lister, Diane L., Abuduresule, Yidilisi, Li, Wenying, Wang, Changsui, Jones, Martin K., 2024. Did crops expand in tandem with culinary practices from their region of origin? evidence from ancient DNA and material culture. Antiquity 1–18. http://dx.doi.org/10.15184/aqy.2023.197.

Hyslop, Gwendolyn, d'Alpoim Guedes, Jade, 2020. Linguistic evidence supports a long antiquity of cultivation of barley and buckwheat over that of millet and rice in eastern Bhutan. Veg. Hist. Archaeobot. 30 (4), 571–579.

Jacques, Guillaume, 2004. Phonologie et morphologie du japhug (Rgyalrong) (Ph.D. dissertation). Université Paris VII - Denis Diderot, Paris.

Jacques, Guillaume, d'Alpoim Guedes, Jade, Zhang, Shuya, 2021. Yak domestication: A review of linguistic, archaeological, and genetic evidence. Ethnobiol. Lett. 12 (1), 103–114. http://dx.doi.org/10.14237/ebl.12.1.2021.1755.

Jamir, Tiatoshi, 2022. Archaeology of northeast India. In: Oxford Research Encyclopedia of Asian History. Oxford University Press, http://dx.doi.org/10.1093/acrefore/9780190277727.013.646.

Jia, Xin, 2012. Qīnghǎishěng dōngběibù dìqū xīnshíqì - qīngtóng shídài wénhuà yǎnhuà guòchéng yǔ zhíwù yícún yánjiū. [STudy of the Cultural Evolution and Plant Remains of Neolithic-BRonze Age in Northeast Qinghai Province] (Ph.D. dissertation). Lanzhou university.

Jiang, Hong-En, Wang, Bo, Li, Xiao, Lü, En-Guo, Li, Cheng-Sen, 2008. A consideration of the involucre remains of *Coix lacryma-jobi* L. (poaceae) in the sampula cemetery (2000 years BP), xinjiang, China. J. Archaeol. Sci. 35 (5), 1311–1316. http://dx.doi.org/10.1016/j.jas.2007.09.006.

Jin, Hetian, Liu, Xu, Min, Rui, Li, Xiaorui, Xiaohong, Wu, Early subsistence practices at prehistoric dadunzi in yuanmou, yunnan: New evidence for the origins of early agriculture in southwest china. In: Hein, Anke (Ed.), The 'Crescent-Shaped Cultural-Communicaion Belt' : Tong Enzheng's Model in Retrospect. an Examinaion of Methodological, Theoreical and Material Concerns of Long-Distance Interacions in East Asia. Archaeopress, Oxford, pp. 133–140.

Khan, Farid, Knox, J.R., Thomas, K.D., Petrie, Cameron A., Morris, J.C, Cartwright, Caroline R., Joyner, Louise, 2010. Sheri Khan Tarakai and Early Village Life in the Borderlands of North-West Pakistan: Bannu Archaeological Project Surveys and Excavations 1985-2001. Oxbow Books, Oxford.

Kingwell-Banham, Eleanor, Fuller, Dorian Q., 2012. Shifting cultivators in south Asia: Expansion, marginalisation and specialisation over the long term. Quat. Int. 249, 84–95. http://dx.doi.org/10.1016/j.quaint.2011.05.025.

Kingwell-Banham, Eleanor, Petrie, Cameron A., Fuller, Dorian Q., 2015. Early agriculture in south Asia. In: Barker, Graeme, Goucher, Candice (Eds.), The Cambridge World History. Cambridge University Press, Cambridge, pp. 261–288.

Knörzer, Karl-Heinz, 2000. 3000 years of agriculture in a valley of the High Himalayas. Veg. Hist. Archaeobot. 9, 219–222.

Kurabe, Keita, 2014. Phonological inventories of seven Jingphoish languages and dialect. Kyoto Univ. Linguist. Res. 33, 57–88, https://repository.kulib.kyoto-u.ac.jp/dspace/bitstream/2433/196278/1/kulr33_057.pdf.

Le, Song'an, 2010. Hénán Xīchuānxiàn Gōuwān yízhǐ Yǎngsháo wénhuà yícún fājué jiǎnbào. [A brief report on the Yangshao Gouwan site in Xichuan prefecture, Henan]. Kǎogǔ (6), 487–501.

Lee, C.Y, Lin, K.C, Zhou, Z, Chen, J, Liu, X, Yuan, H, Wang, P.L., 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), 762–776.

Li, Binsen, 2023. Péilǐgǎng wénhuà Xīnmì Egōu yízhǐ shēngjì fāngshì tànxī. [An analysis of the mode of food production in the Peiligang Egou site in Xinmi]. Nóngyè kǎogǔ (4), 5–11.

Li, Xin, Zhang, Xianpeng, Yu, Ting, Ye, Liping, Huang, Ting, Chen, Ying, Liu, Shuhan, Wen, Youfeng, 2023. Whole mitochondrial genome analysis in highland Tibetans: further matrilineal genetic structure exploration. Front. Genet. 14, http://dx.doi.org/10.3389/fgene.2023.1221388.

Li, Wei, Zhou, Ligang, Lin, YiHsien, Zhang, Hai, Zhang, Ying, Wu, Xiaohong, Stevens, Chris, Yang, Yingliang, Wang, Hui, Fang, Yanming, Liang, Fawei, 2021. Interdisciplinary study on dietary complexity in Central China during the Longshan period (4.–3.8 kaBP): New isotopic evidence from Wadian and Haojiatai, Henan province. Holocene 31 (2), 258–270. http://dx.doi.org/10.1177/0959683620970252.

Li, Xiaoqiang, Zhou, Xinying, Zhou, Jie, Dodson, J, Zhang, Hongbin, Shang, Xue, 2007. The earliest archaeobiological evidence of the broadening agriculture in China recorded at Xishanping site in Gansu province. Sci. China Ser. D: Earth Sci. 50 (11), 1707–1714. http://dx.doi.org/10.1007/s11430-007-0066-0.

Lieberherr, Ismael, 2017. A Grammar of Bulu Puroik (Ph.D. dissertation). Universität Bern.

Lieberherr, Ismael, Bodt, Timotheus Adrianus, 2017. Sub-grouping kho-bwa based on shared core vocabulary. Himal. Linguist. 16 (2), 26–63.

Liu, Li, Chen, Xingcan, 2012. The Archaeology of China, from the Late Paleolithic to the Early Bronze Age. Cambridge University Press, Cambridge.

Liu, Li, Chen, Jian, Wang, Jiajing, Zhao, Yanan, Chen, Xingcan., 2022a. Archaeological evidence for initial migration of Neolithic Proto Sino-Tibetan speakers from Yellow River valley to Tibetan Plateau. Proc. Natl. Acad. Sci. 119 (51), http://dx.doi.org/10.1073/pnas.2212006119.

Liu, Xinyi, Lister, Diane L., Zhao, Zhijun, Petrie, Cameron A., Zeng, Xiongsheng, Jones, Penelope J., Staff, Richard A., Pokharia, Anil K., Bates, Jennifer, Singh, Ravindra N., Weber, Steven A., 2017a. Journey to the east: Diverse routes and variable flowering times for wheat and barley en route to prehistoric China. PLoS One 12 (11), 1–16. http://dx.doi.org/10.1371/journal.pone.0187405.

Liu, Chi-Chun, Witonsky, David, Gosling, Anna, Lee, Ju Hyeon, Ringbauer, Harald, Hagan, Richard, Patel, Nisha, Stahl, Raphaela, Novembre, John, Aldenderfer, Mark, Warinner, Christina, Rienzo, Anna Di, Jeong, Choongwon, 2022b. Ancient genomes from the himalayas illuminate the genetic history of Tibetans and their Tibeto-Burman speaking neighbors. Nature Commun. 13 (1203), http://dx.doi.org/10.1038/s41467-022-28827-2.

Liu, Bin, Yang, Jing, Qian, Yaopeng, 2017b. Shǎnxī Fúfēng Anbǎn yízhǐ 2012 nián fājué jiǎnbào. [A brief report on the 2012 excavation of the Anban site in Fufeng, Shanxi]. Kǎogǔ yǔ wénwù (5), 3–16.

Lone, F.A, Khan, M, Buth, G.M., 1993. Palaeoethnobotany Plants and Ancient Man in Kashmir. AA Balkema, Rotterdam.

Long, Tengwen, Leipe, Christian, Jin, Guiyun, Wagner, Mayke, Guo, Rongzhen, Schröder, Oskar, Tarasov, Pavel E., 2018. The early history of wheat in China from 14C dating and Bayesian chronological modelling. Nature Plants 4, 272–279. http://dx.doi.org/10.1038/s41477-018-0141-x.

Lü, Hongliang, 2016. Neolithic age of western Tibet: a trans-Himalayan perspective. Chinese Archaeol. 16, 79–84.

Lü, Hongliang, 2022. Local millet farming and permanent occupation on the Tibetan Plateau. Sci. China Earth Sci. 66 (2), 430–434. http://dx.doi.org/10.1007/s11430-022-1018-7.

Lu, Peng, Brunson, Katherine, Yuan, Jing, Li, Zhipeng, 2017. Zooarchaeological and genetic evidence for the origins of domestic cattle in Ancient China. Asian Perspect. 56 (1), 92–120.

Lü, Hongliang, Chen, Xinzhou, Zhang, Zhengwei, Tang, Li, Lemoine, Ximena, Wangdue, Shargan, Chen, Zujun, Liu, Xinyi, Frachetti, Michael D., 2021. Early agropastoral settlement and cultural change in central Tibet in the first millennium BC: excavations at Bangga. Antiquity 95 (382), 955. http://dx.doi.org/10.15184/aqy.2020.185.

Lubotsky, Alexander, Starostin, Sergei, 2003. Turkic and Chinese loanwords in tocharian. In: Bauer, Brigitte L.M., Pinault, Georges-Jean (Eds.), Language in Time and Space. De Gruyter Mouton, Berlin, New York, pp. 257–270. http://dx.doi.org/10.1515/9783110897722.257.

Luo, Erhu, 2004. Zhōngguó gǔdài jìshéng shídāo yánjiū. [The cord-attached stone knives in Ancient China]. Kǎogǔxué jíkān 311–391.

Luo, Erhu, 2007. Lùn Zhōngguó gǔdài de jìshéng táodāo. [On the cord-attached ceramic knives in Ancient China]. Kǎogǔ (12), 69–77.

Luo, Erhu, Li, Fei, 2013. Lùn gǔdài jìshéng shídāo de gōngnéng – jiāntán mínzú kǎogǔxué fāngfǎ. [On the function of the ancient cord-attached stone knives, with a discussion on the methodology of ethnoarchaeology]. Kǎogǔxué yánjiū 10, 27–35.

Ma, Minmin, Lu, Yongxiu, Dong, Guanghui, Ren, Lele, Min, Rui, Kang, Lihong, Zhu, Zhonghua, Li, Xiaorui, Li, Bo, Yang, Zhijian, Cili, Nongbu, Liu, Ruiliang, Gao, Yu, Chen, Fahu, 2023. Understanding the transport networks complex between South Asia, Southeast Asia and China during the late Neolithic and Bronze Age. Holocene 33 (2), 147–158.

Meadow, R., 1986. The geographical and paleoenvironmental setting of Tepe Yahya. In: Lamberg-Karlovsky, C.C, Beale, T.W. (Eds.), Excavations at Tepe Yahya, Iran 1967-1975. the Early Periods. Harvard University Press, Cambridge, pp. 21–38.

Michailovsky, Boyd, 2002. Limbu-English Dictionary. Mandala Book Point, Kathmandu.

Miller, Naomi F., 1999. Agricultural development in western Central Asia in the Chalcolithic and Bronze Ages. Veg. Hist. Archaeobot. 8 (1), 13–19. http://dx.doi.org/10.1007/BF02042837.

Mitri, Marco, Neog, Dhiraj, 2016. Preliminary report on the excavations of Neolithic sites from Khasi Hills Meghalaya. Ancient Asia 7 (7), 1–17. http://dx.doi.org/10.5334/aa.119.

Motuzaite Matuzeviciute, Giedre, Abdykanova, Aida, Kume, Shogo, Nishiaki, Yoshihiro, Tabaldiev, Kubatbek, 2018. The effect of geographical margins on cereal grain size variation: Case study for highlands of Kyrgyzstan. J. Archaeol. Sci.: Rep. 20, 400–410. http://dx.doi.org/10.1016/j.jasrep.2018.04.037.

Mutin, Benjamin, Garazhian, Omram., 2020. Iranian-French archaeological mission in bam, kerman: Summary of field-seasons 2016–2017. Archaeology: Quart. J. Iran. Center Archaeol. Res. 3 (4), 93–105.

Nishiaki, Yoshihiro, Aripdjanov, Otabek, Arai, Saiji, Akashi, Chie, Nakata, Hiroto, Sayfullayev, Bakhtiyor, Ergashev, Odil, Suleimanov, Rustam, 2022. Neolithization during the 6th millennium BCE in western Central Asia: New evidence from Kaynar Kamar rockshelter, Hissar Mountains, Southeast Uzbekistan. Archaeol. Res. Asia 30, 100352. http://dx.doi.org/10.1016/j.ara.2022.100352.

Oota, Hiroki, Pakendorf, Brigitte, Weiss, Gunter, von Haeseler, Arndt, Pookajorn, Surin, Settheetham-Ishida, Wannapa, Tiwawech, Danai, Ishida, Takafumi, Stoneking, Mark, 2005. Recent origin and cultural reversion of a hunter–gatherer group. PLoS Biol. 3 (3), e71. http://dx.doi.org/10.1371/journal.pbio.0030071.

Owlett, Tricia E., 2016. Finding greener pastures: The local development of agro-pastoralism in the Ordos region, North China. J. Indo-Pac. Archaeol. 40, 42–53.

Pellard, Thomas, Ryder, Robin J., Jacques, Guillaume, 2024. The family tree model. In: Ledgeway, Adam, Aldridge, Edith, Breitbarth, Anne, Kiss, Katalin E., Salmons, Joseph, Simonenko, Alexandra (Eds.), Wiley Blackwell Companion to Diachronic Linguistics. Wiley Blackwell, Hoboken, (forthcoming).

Peters, Joris, von den Driesch, Angela, Helmer, Daniel, 2005. The upper euphrates-tigris basin: cradle of agro-pastoralism?. In: Vigne, Jean-Denis, Peters, Joris, Helmer, Daniel (Eds.), The First Steps of Animal Domestication. New Archaeological Approaches. Oxbow Books, Oxford, pp. 96–124.

Pokharia, Anil K., 2011. Palaeoethnobotany at lahuradewa: a contribution to the 2nd millennium BC agriculture of the Ganga Plain, India. Current Sci. 101 (12), 1569–1578.

Pokharia, Anil K, Mani, B.R., Spate, Michael, Betts, Alison, Srivastava, Alka, 2018. Early Neolithic agriculture (2700–2000 BC) and Kushan period developments (AD 100–300): macrobotanical evidence from Kanispur in Kashmir, India. Veg. Hist. Archaeobot. 27, 477–491.

Post, Mark W., 2012. The language, culture, environment and origins of proto-Tani speakers: What is knowable, and what is not (yet). In: Huber, Toni, Blackburn, Stuart (Eds.), Origins and Migrations in the Extended Eastern Himalaya. Brill, Leiden, pp. 153–186.

Post, Mark W., 2013. The siyom river valley: An essay on intra-subgroup convergence in tibeto-burman. In: Hyslop, Gwendolyn, Morey, Stephen, Post, Mark W. (Eds.), North East Indian Linguistics Volume. vol. 5, Cambridge University Press India, New Delhi, pp. 60–90.

Post, Mark W., 2022. On reconstructing ethno-linguistic prehistory: The case of tani. In: Lange, D., Ptackova, J., Wettstein, M., Wulff, M. (Eds.), Crossing Boundaries: Tibetan Studies Unlimited. Academia Nakladatelství, Prague, pp. 311–340.

Post, Mark W., Burling, Robbins, 2017. The Tibeto-Burman languages of Northeastern India. In: Thurgood, Graham, LaPolla, Randy (Eds.), The Sino-TIbetan Languages. Routledge, London, pp. 213–424.

Post, Mark W., Lipir, Dugbang, Modi, Yankee, 2017. The Tangam Language, Grammar, Lexicon and Texts. Brill, Leiden.

Post, Mark W, Modi, Yankee, 2011. Language contact and the genetic position of Milang (Eastern Himalaya). Anthropol. Linguist. 53 (3), 215–258. http://dx.doi.org/10.1353/anl.2011.0014.

Qiao, Liang, 2002. Zhōngguó jìngwài fāxiàn de lìxíng táoqì [tripod-shaped ceramics discovered outside of [c]hina]. Wenwu (1), 72–78.

Ren, Lele, Dong, Guanghui, Liu, Fengwen, Guedes, Jade d'Alpoim, Flad, Rowan K., Ma, Minmin, Li, Haiming, Yang, Yishi, Liu, Yujia, Zhang, Dongju, 2020. Foraging and farming: archaeobotanical and zooarchaeological evidence for neolithic exchange on the tibetan plateau. Antiquity 375 (94), 637–652.

Ren, Xiaolin, Xu, Junjie, Wang, Hui, Storozum, Michael, Lu, Peng, Mo, Duowen, Li, Tuoyu, Xiong, Jianguo, Kidder, Tristram R., 2021. Holocene fluctuations in vegetation and humanpopulation demonstrate social resilience in the prehistory of the Central Plains of China. Environ. Res. Lett. 16 (5), 1–12.

Ribaa, Igoo, Post, Mark, Ribaa, Ilii, Nodu, Miilii, Bagra, Kenjum, Ribaa, Bomcak, Ribaa, Toomoo, Aado, Notoo, Keenaa, Dambom, 2009. Galo-English Dictionary. Galo Welfare Society, Itanagar.

Rischel, Jørgen, 1995. Minor Mlabri. A Hunter-Gatherer Language of Northern Indochina. Museum Tusculanum Press, Copenhagen.

Rispoli, Fiorella, 2007. The incised and impressed pottery style of mainland Southeast Asia: Following the paths of neolithization. East and West vol. 57 (1/4), 235–304.

Rowley-Conwy, Peter, 2024. Hunter-gatherers and earliest farmers in western Europe. Proc. Natl. Acad. Sci. 121 (10), e2322683121. http://dx.doi.org/10.1073/pnas.2322683121.

Sagart, Laurent, 2008. The expansion of *Setaria* farmers in East Asia. In: Sanchez-Mazas, Alicia, Blench, Roger, Ross, Malcolm, Peiros, Ilya, Lin, Marie (Eds.), Past Human Migrations in East Asia. Routledge, London, pp. 133–157.

Sagart, Laurent, Hsu, Tze-Fu, Tsai, Yuan-Ching, Hsing, Yue-Ie, 2017. Austronesian and Chinese words for the millets. Lang. Dyn. Change 7 (2), 187–209.

Sagart, Laurent, Jacques, Guillaume, Lai, Yunfan, Ryder, Robin J., Thouzeau, Valentin, Greenhill, Simon J., List, Johann-Mattis, 2019. Dated language phylogenies shed light on the ancestry of Sino-Tibetan. Proc. Natl. Acad. Sci. 116 (21), 10317–10322. http://dx.doi.org/10.1073/pnas.1817972116.

Saraswat, K.S., 2004. Plant economy of early farming communities. In: Singh, B.P. (Ed.), Early Farming Communities of the Kaimur (Excavations at Senuwar). Publication Scheme, Jaipur, pp. 416–535.

Sharif, M., Thapar, B.K., 1992. Food-producing communities in Pakistan and Northern India. In: Dani, A.H., Masson, V.M. (Eds.), History and Civilizations of Central Asia. The Dawn of Civilization, Earliest Times to 700 B.C. 1. UNESCO, Paris, pp. 127–151.

Sharma, Sukanya, Singh, Pankaj, 2017. Luminescence dating of Neolithic pottery in North East India. Current Sci. 113 (3), 492–496.

Shelach, Gideon, Teng, Mingyu, 2013. Earlier neolithic economic and social systems of the Liao river region, northeast China. In: Underhill, Anne (Ed.), A Companion to Chinese Archaeology. Wiley-Blackwell, pp. 37–54.

Shorto, Harry, 2006. A Mon-KHmer Comparative Dictionary. Pacific Linguistics, Canberra.

Singh, Okram Kumar, 1993. Stone Age Culture of Manipur (Ph.D. dissertation). University of Manipur, Imphal.

Song, Jixiang, Gao, Yuanyuan, Tang, Li, Zhang, Zhengwei, Tang, Mana Hayashi, Xu, Hailun, Wangyal, Tashi, Yuan, Haibing, Li, Lan, Li, Yongxian, Wangdue, Shargan, Liu, Xinyi, Lu, Hongliang, 2021. Farming and multi-resource subsistence in the third and second millennium BC: archaeobotanical evidence from Karuo. Archaeol. Anthropol. Sci. 13, 1–16.

Spate, Michael, Zhang, Guilin, Yatoo, Mumtaz, Betts, Alison, 2017. New evidence for early 4th millennium BP agriculture in the Western Himalayas: Qasim Bagh, Kashmir. J. Archaeol. Sci.: Rep. 11, 568–577. http://dx.doi.org/10.1016/j.jasrep.2016.12.038.

Spengler, Robert N., 2015. Agriculture in the Central Asian Bronze Age. J. World Prehistory 28, 215–253.

Spengler, Robert N., Frachetti, Michael D., Doumani, Paula N., 2014. Late Bronze Age agriculture at Tasbas in the Dzhungar mountains of eastern Kazakhstan. Quat. Int. 348, 147–157. http://dx.doi.org/10.1016/j.quaint.2014.03.039.

Spengler, Robert N., Maksudov, Farhod, Bullion, Elissa, Merkle, Ann, Hermes, Taylor, Frachetti, Michael, 2018. Arboreal crops on the medieval silk road: Archaeobotanical studies at tashbulak. PLoS One 13 (8), 1–16. http://dx.doi.org/10.1371/journal.pone.0201409.

Spengler, Robert N., Willcox, George, 2013. Archaeobotanical results from Sarazm, Tajikistan, an Early Bronze Age settlement on the edge: Agriculture and exchange. Environ. Archaeol. 18 (3), 211–221. http://dx.doi.org/10.1179/1749631413Y.0000000008.

Spengler, III, Robert N., Miller, Alicia Ventresca, Schmaus, Tekla, Matuzevičiūtė, Giedrė Motuzaitė, Miller, Bryan K., Wilkin, Shevan, Taylor, William Timothy Treal, Li, Yuqi, Roberts, Patrick, Boivin, Nicole, 2021. An imagined past? Nomadic narratives in central Asian archaeology. Curr. Anthropol. 62 (3), 251–286.

Stacul, Giorgio, 1978. Excavation at Bīr-kōṭ -ghuṇḍai (Swāt, Pakistan). East West 28 (1/4), 137–150.

Stacul, Giorgio, 1979. The black-burnished ware period in the Swāt valley (c. 1700-1500 BC). In: Taddei, M. (Ed.), South Asian Archaeology 1977. Istituto Universitario Orientale di Napoli, Naples, pp. 661–673.

Stacul, Giorgio, 1980. Loebanr III (Swāt, Pakistan) 1979 excavation report. East West 30 (1/4), 67–76.

Stacul, Giorgio, 1993a. Kalako-Deray, Swat: 1989–1991 Excavation Report. East and West 43 (1–4), 69–94.

Stacul, Giorgio, 1993b. Kalako-deray, Swāt: an archaeological complex from the early/mid-2nd millenium B.C.. In: Gail, Adalbert J., Mevissen, Gerd J.R. (Eds.), South Asian Archaeology 1991. Franz Steiner Verlag, Stuttgart, pp. 265–272.

Stevens, Chris, Crema, Enrico, Shoda, Shinya, 2022. The importance of wild resources as a reflection of the resilience and changing nature of early agricultural systems in East Asia and Europe. Front. Ecol. Evol. 10, http://dx.doi.org/10.3389/fevo.2022.1017909.

Stevens, Chris J., Murphy, Charlene, Roberts, Rebecca, Lucas, Leilani, Silva, Fabio, Fuller, Dorian Q., 2016. Between China and South Asia: A Middle Asian corridor of crop dispersal and agricultural innovation in the Bronze Age. Holocene 26 (10), 1541–1555.

Stevens, Chris J., Shelach-Lavi, Gideon, Zhang, Hai, Teng, Mingyu, Fuller, Dorian Q., 2021. A model for the domestication of *Panicum miliaceum* (common, proso or broomcorn millet) in China. Veg. Hist. Archaeobot. 30 (1), 21–33. http://dx.doi.org/10.1007/s00334-020-00804-z.

Stevens, Chris, Zhuang, Yijie, Fuller, Dorian Q., 2024. Millets, dogs, pigs and permanent settlement: productivity transitions in Neolithic northern China. Evol. Hum. Sci. (forthcoming).

Stonor, C.R., 1952. The sulung tribe of the assam himalayas. Anthropos 47, 947–962.

Sun, Jackson T.S., 1993. A Historical-Comparative Study of the Tani (Mirish) Branch in Tibeto-BUrman (Ph.D. dissertation). University of California at Berkeley.

Tada, Tage, Dutta, J.C, Deori, Nabajit, 2012. Archaeological Heritage of Arunachal Pradesh: A Book Exclusively Based on the Findings of Archaeological Investigations of Two Decades (1991-2011). Government of Arunachal Pradesh, Department of Cultural Affairs, Directorate of Research, Itanagar.

Tang, Li, Lu, Hongliang, Song, Jixiang, Wangdue, Shargan, Chen, Xinzhou, Zhang, Zhengwei, Liu, Xinyi, Boivin, Nicole, Robert N. Spengler, 2021. The transition to a barley-dominant cultivation system in Tibet: First millennium BC archaeobotanical evidence from Bangga. J. Anthropol. Archaeol. 61, 101242. http://dx.doi.org/10.1016/j.jaa.2020.101242.

Tang, Yiyi, Marston, John M., Fang, Xiangming, 2022. Early millet cultivation, subsistence diversity, and wild plant use at neolithic anle, lower yangtze, china. Holocene 32 (10), 1003–1014. http://dx.doi.org/10.1177/09596836221109004.

Tang, Jinqiong, Sun, Mingli, Chen, Hong, 2020. Jiāngsū Sūzhōushì Wǔfēngběi yízhǐ 2016 nián fājué jiǎnbào. [A brief report on the 2016 excavation of the Wufengbei site in Suzhou, Jiangsu]. Kǎogǔ (1), 3–19.

Tao, Le, Yuan, Haibing, Zhu, Kongyang, Liu, Xiangyu, Guo, Jianxin, Min, Rui, He, Haifeng, Cao, Doudou, Yang, Xiaomin, Zhou, Zhiqing, Wang, Rui, Zhao, Deyun, Ma, Hao, Chen, Jian, Zhao, Jing, Li, Yingfu, He, Yuanhong, Suo, Dehao, Zhang, Ruojing, Li, Shuai, Li, Lan, Yang, Feng, Li, Haichao, Zhang, Liang, Jin, Li, Wang, Chuan-Chao., 2023. Ancient genomes reveal millet farming-related demic diffusion from the Yellow River into southwest China. Curr. Biol. 33 (22), 4995–5002.e7. http://dx.doi.org/10.1016/j.cub.2023.09.055.

Taylor, William T.T., Pruvost, Mélanie, Posth, Cosimo, Rendu, William, Krajcarz, Maciej T., Abdykanova, Aida, Brancaleoni, Greta, Spengler, Robert, Hermes, Taylor, Schiavinato, Stéphanie, Hodgins, Gregory, Stahl, Raphaela, Min, Jina, Alisher, Saltanat, Fedorowicz, Stanisław, Orlando, Ludovic, Douka, Katerina, Krivoshapkin, Andrey, Jeong, Choongwon, Warinner, Christina, Shnaider, Svetlana, 2021. Evidence for early dispersal of domestic sheep into central asia. Nat. Hum. Behav. (5), 1169–1179.

Tengberg, Margareta, 1999. Crop husbandry at Miri Qalat Makran, S.W. Pakistan (4000-2000 B.C.). Veg. Hist. Archaeobot. 8 (1), 3–12. http://dx.doi.org/10.1007/BF02042836.

Thomas, Julian, 2023. Neolithization and population replacement in britain: An alternative view. Cambridge Archaeol. J. 32 (3), 507–525. http://dx.doi.org/10.1017/S0959774321000639.

Torii, Rinzo, 1915. Etudes archéologiques et ethnologiques, populations préhistoriques de la mandchourie méridionale. J. Coll. Sci. Imp. Univ. Tokyo 36 (8), 1–80.

van Driem, Georges, 2002. Tibeto-Burman phylogeny and prehistory: Languages, material culture and genes. In: Bellwood, Peter, Renfrew, Colin (Eds.), Examining the Farming/Language Dispersal Hypothesis. McDonald Institute for Archaeological Research, Cambridge, pp. 233–249.

Vander Linden, Marc, Silva, Fabio, 2021. Dispersals as demographic processes: testing and describing the spread of the Neolithic in the Balkans. Phil. Trans. R. Soc. B 376 (1816), 20200231. http://dx.doi.org/10.1098/rstb.2020.0231.

Ventresca-Miller, Alicia R., Wilkin, Shevan, Smithers, Rachel, Larson, Kara, Spengler, Robert, Haruda, Ashleigh, Kradin, Nikolay, Bazarov, Bilikto, Miyagashev, Denis, Odbaatar, Tserendorj, Turbat, Tsagaan, Zhambaltarova, Elena, Konovalov, Prokopii, Bayarsaikhan, Jamsranjav, Hein, Anke, Hommel, Peter, Nash, Brendan, Nayak, Ayushi, Vanwezer, Nils, Miller, Bryan, Fernandes, Ricardo, Boivin, Nicole, Roberts, Patrick, 2023. Adaptability of millets and landscapes: Ancient cultivation in North-Central Asia. Agronomy 13 (11), http://dx.doi.org/10.3390/agronomy13112848.

Wang, Jinlin, 1991. Yúnnán Lónglíngxiàn xīnshíqì shídài yízhǐ diàochá. [An investigation on Neolithic sites in Longling prefecture, Yunnan]. Kǎogǔ (4), 289–293.

Wang, Fen, 2013. The Houli and Beixin cultures. In: Underhill, Anne P. (Ed.), A Companion to Chinese Archaeology. Wiley-Blackwell, Oxford, pp. 389–410.

Wang, Yiru, 2017. Identifying the Beginnings of Sheep Husbandry in Western China (Ph.D. dissertation). Darwin College, University of Cambridge, http://dx.doi.org/10.17863/CAM.16868.

Wang, Wenjun, Ding, Manyu, Gardner, Jacob D., Wang, Yongqiang, Miao, Bo, Guo, Wu, Wu, Xinhua, Ruan, Qiurong, Yu, Jianjun, Hu, Xingjun, Wang, Bo, Wu, Xiaohong, Tang, Zihua, Niyazi, Alipujiang, Zhang, Jie, Chang, Xien, Tang, Yunpeng, Ren, Meng, Cao, Peng, Liu, Feng, Dai, Qingyan, Feng, Xiaotian, Yang, Ruowei, Zhang, Ming, Wang, Tianyi, Ping, Wanjing, Hou, Weihong, Li, Wenying, Ma, Jian, Kumar, Vikas, Fu, Qiaomei, 2021a. Ancient xinjiang mitogenomes reveal intense admixture with high genetic diversity. Sci. Adv. 7 (14), eabd6690. http://dx.doi.org/10.1126/sciadv.abd6690.

Wang, Yiru, Gao, Yu, Zhang, Zhengwei, Gu, Zhengquan, Yang, Jishuai, Wang, Yanren, Sun, Qingli, He, Wei, tsho, Yang, Shargan, Wangdue, Ma, Chunmei, Peters, Joris, Yang, Xiaoyan, 2023a. Human–animal–environment dynamics and formation of pastoralism in the southern Tibetan Plateau during the Middle–Late Holocene. Quat. Res. 114, 30–51. http://dx.doi.org/10.1017/qua.2023.6.

Wang, Ling-Xiang, Lu, Yan, Zhang, Chao, Wei, Lan-Hai, Yan, Shi, Huang, Yun-Zhi, Wang, Chuan-Chao, Mallick, Swapan, Wen, Shao-Qing, Jin, Li, Xu, Shu-Hua, Li, Hui, 2018. Reconstruction of Y-chromosome phylogeny reveals two Neolithic expansions of Tibeto-Burman populations. Mol. Genet. Genom. 293, 1293–1300. http://dx.doi.org/10.1007/s00438-018-1461-2.

Wang, Hongru, Yang, Melinda A., Wangdue, Shargan, Lu, Hongliang, Chen, Honghai, Li, Linhui, Dong, Guanghui, Tsring, Tinley, Yuan, Haibing, He, Wei, Ding, Manyu, Wu, Xiaohong, Li, Shuai, Tashi, Norbu, Yang, Tsho, Yang, Feng, Tong, Yan, Chen, Zujun, He, Yuanhong, Cao, Peng, Dai, Qingyan, Liu, Feng, Feng, Xiaotian, Wang, Tianyi, Yang, Ruowei, Ping, Wanjing, Zhang, Zhaoxia, Gao, Yang, Zhang, Ming, Wang, Xiaoji, Zhang, Chao, Yuan, Kai, Ko, Albert Min-Shan, Aldenderfer, Mark, Gao, Xing, Xu, Shuhua, Fu, Qiaomei, 2023b. Human genetic history on the Tibetan Plateau in the past 5100 years. Sci. Adv. 9 (11), eadd5582. http://dx.doi.org/10.1126/sciadv.add5582.

Wang, Chuan-Chao, Yeh, Hui-Yuan, Popov, Alexander N., Zhang, Hu-Qin, Matsumura, Hirofumi, Sirak, Kendra, Cheronet, Olivia, Kovalev, Alexey, Rohland, Nadin, Kim, Alexander M., Mallick, Swapan, Bernardos, Rebecca, Tumen, Dashtseveg, Zhao, Jing, Liu, Yi-Chang, Liu, Jiun-Yu, Mah, Matthew, Wang, Ke, Zhang, Zhao, Adamski, Nicole, Broomandkhoshbacht, Nasreen, Callan, Kimberly, Candilio, Francesca, Carlson, Kellie.Sara.Duffett, Culleton, Brendan J., Eccles, Laurie, Freilich, Suzanne, Keating, Denise, Lawson, Ann.Marie, Mandl, Kirsten, Michel, Megan, Oppenheimer, Jonas, özdoğan, Kadir.Toykan, Stewardson, Kristin, Wen, Shaoqing, Yan, Shi, Zalzala, Fatma, Chuang, Richard, Huang, Ching-Jung, Looh, Hana, Shiung, Chung-Ching, Nikitin, Yuri G., Tabarev, Andrei V., Tishkin, Alexey A., Lin, Song, Sun, Zhou-Yong, Wu, Xiao-Ming, Yang, Tie-Lin, Hu, Xi, Chen, Liang, Du, Hua, Bayarsaikhan, Jamsranjav, Mijiddorj, Enkhbayar, Erdenebaatar, Diimaajav, Iderkhangai, Tumur-Ochir, Myagmar, Erdene, Kanzawa-Kiriyama, Hideaki, Nishino, Masato, Shinoda, Ken.ichi, Shubina, Olga A., Guo, Jianxin, Cai, Wangwei, Deng, Qiongying, Kang, Longli, Li, Dawei, Li, Dongna, Lin, Rong, Nini, Shrestha, Rukesh, Wang, Ling-Xiang, Wei, Lanhai, Xie, Guangmao, Yao, Hongbing, Zhang, Manfei, He, Guanglin, Yang, Xiaomin, Hu, Rong, Robbeets, Martine, Schiffels, Stephan, Kennett, Douglas J., Jin, Li, Li, Hui, Krause, Johannes, Pinhasi, Ron, Reich, David, 2021b. Genomic insights into the formation of human populations in East Asia. Nature 591, 413–419.

wénguǎnhuì, Kāifēng dìqū, wénguǎnhuì, Xīnzhèngxiàn, 1978. Hénán Xīnzhèng Péilǐgǎng xīnshíqì shídài yízhǐ [The Neolithic Peiligang site of Xinzheng in Henan]]. Kǎogǔ (2), 73–79.

Wheeler, Mortimer, 1959. Early India and Pakistan to Ashoka. Thames and Hudson, London.

Wu, Jia’an, 1988. Sìchuān Lèshānshì kǎogǔ diàochá jiǎnbào. [A brief report on archaeological investigations in Leshan, Sichuan]. Kǎogǔ (1), 7–11.

Wu, Mei-Shin, Bodt, Timotheus A., Tresoldi, Tiago, 2022. Bayesian phylogenetics illuminate shallower relationships among Trans-Himalayan languages in the Tibet-Arunachal area. Linguist. Tibeto-Burman Area 45 (2), 171–210.

Xu, Shuhua, Kangwanpong, Daoroong, Seielstad, Mark, Srikummool, Metawee, Kampuansai, Jatupol, Jin, Li, The HUGO Pan-Asian SNP Consortium, 2010. Genetic evidence supports linguistic affinity of Mlabri- a hunter-gatherer group in Thailand. BMC Genet. 11 (1), 18. http://dx.doi.org/10.1186/1471-2156-11-18.

Xue, Yining, Dal Martello, Rita, Qin, Ling, Stevens, Chris J., Min, Rui, Fuller, Dorian Q., 2022. Post-neolithic broadening of agriculture in Yunnan, China: Archaeobotanical evidence from Haimenkou. Archaeolog. Res. Asia 30, 100364. http://dx.doi.org/10.1016/j.ara.2022.100364.

Yang, Sizhe, Sun, Xiaoru, Jin, Li, Zhang, Menghan, 2024. Inferring language dispersal patterns with velocity field estimation. Nature Commun. 15 (1), 190. http://dx.doi.org/10.1038/s41467-023-44430-5.

Yang, Liping, Yin, Yupeng, Ge, Yanze, Sun, Bingjun, 2022. Shǎnxī Qiānyáng Fēngtóu yízhǐ fājué jiǎnbào. [A brief report on the excavation of the Fengtou site in Qianyang, Shaanxi]. Kǎogǔ yǔ wénwù (4), 3–15.

Yatoo, Mumtaz A., Spate, Michael, Betts, Alison, Pokharia, Anil K., Shah, Mohamad Ajmal, 2020. New evidence from the Kashmir valley indicates the adoption of East and West Asian crops in the western Himalayas by 4400 years ago. Quat. Sci. Adv. 2, 100011. http://dx.doi.org/10.1016/j.qsa.2020.100011.

Zadneprovskij, Ju. A., 1962. Drevnezemledel’cheskaja kul’tura fergany. Izdatel’stvo Akademii nauk SSSR, Moskva.

Zhang, Zhengwei, Chen, Zujun, Marshall, Fiona, Lü, Hongliang, Lemoine, Ximena, Wangyal, Tashi, Dorje, Tsepa, Liu, Xinyi, 2019a. The importance of localized hunting of diverse animals to early inhabitants of the Eastern Tibetan Plateau at the Neolithic site of Xiaoenda. Quat. Int. 529, 38–46. http://dx.doi.org/10.1016/j.quaint.2019.09.019.

Zhang, Fan, Ning, Chao, Scott, Ashley, Fu, Qiaomei, Bjørn, Rasmus, Li, Wenying, Wei, Dong, Wang, Wenjun, Fan, Linyuan, Abuduresule, Idilisi, Hu, Xingjun, Ruan, Qiurong, Niyazi, Alipujiang, Dong, Guanghui, Cao, Peng, Liu, Feng, Dai, Qingyan, Feng, Xiaotian, Yang, Ruowei, Tang, Zihua, Ma, Pengcheng, Li, Chunxiang, Gao, Shizhu, Xu, Yang, Wu, Sihao, Wen, Shaoqing, Zhu, Hong, Zhou, Hui, Robbeets, Martine, Kumar, Vikas, Krause, Johannes, Warinner, Christina, Jeong, Choongwon, Cu, Yinqiu, 2021. The genomic origins of the Bronze Age Tarim Basin mummies. Nature 599 (7884), 256–261. http://dx.doi.org/10.1038/s41586-021-04052-7.

Zhang, Menghan, Yan, Shi, Pan, Wuyun, Jin, Li, 2019b. Phylogenetic evidence for Sino-Tibetan origin in northern China in the Late Neolithic. Nature 569, 112–115.

Zhao, Zhijun, Chen, Jian, 2011. Sìchuān màoxiàn yíngpánshān yízhǐ fúxuǎn jiéguǒ jí fēnxī [Result of the flotation of the Yingpanshan site in Maoxian, Sichuan]. Nánfāng wénwù (3) 60–67.

Zhao, Jie, Wang, Wei, 2012. Shānxī Yuánpíngshì Xīnzhāng yízhǐ 2012 nián fājué jiǎnbào. [A brief report on the 2012 excavation of the Xinzhang site in Yuanping, Shanxi]. Kǎogǔ (5), 3–16.

Zheng, Yunfei, Crawford, Gary W., Chen, Xugao, 2014. Archaeological evidence for peach (*Prunus persica*) cultivation and domestication in China. PLoS One 9 (9), 1–9. http://dx.doi.org/10.1371/journal.pone.0106595.

Zhōngguó shèhuì kēxuéyuàn kǎogǔ yánjiūsuǒ, 1999. Lāsà qūgòng. Zhōngguó dàbǎikē quánshū chūbǎnshè.

Zhou, Xinying, Yu, Jianjun, Spengler, Robert Nicholas, Shen, Hui, Zhao, Keliang, Ge, Junyi, Bao, Yige, Liu, Junchi, Yang, Qingjiang, Chen, Guanhan, Jia, Peter Weiming, Li, Xiaoqiang, 2020. 5 200-year-old cereal grains from the eastern Altai Mountains redate the trans-Eurasian crop exchange. Nature Plants 6, 78–87.

Zvelebil, Marek, 2001. The agricultural transition and the origins of Neolithic society in Europe. Documenta Praehistorica 28, 1–26. http://dx.doi.org/10.4312/dp.28.1.