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Alteration in Plant-Based Subsistence and Its Influencing Factors from Late Neolithic to Historical Periods in Hexi Corridor, Northwestern China: Archaeobotanical Evidence

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Abstract: The spatio-temporal evolution of human subsistence strategies and their driving force in prehistoric Eurasia has received increasing attention with the rapid development of archaeobotanical, zooarchaeological, and isotopic research in recent decades, while studies focusing on the historical periods are relatively absent. In the Hexi Corridor in northwestern China, which has served as a hub for trans-Eurasian exchange since the late prehistoric period, archaeobotanical data have been reported from numerous Neolithic and Bronze Age sites, as well as sites from the Wei and Jin Dynasties (220–420 BCE) to the Yuan Dynasty (1271–1368 BCE). However, no archaeobotanical study has been conducted at sites of the Han Dynasty (202 BCE–220 CE), a crucial period connecting prehistoric and historical eras. In this study, we identified 32475 plant remains, including 31,463 broomcorn millets, 233 foxtail millets, and 780 weeds, from the Shuangdun North Beacon Tower (SDNBT) site of the Han Dynasty at the western end of the Hexi Corridor, suggesting that millets played a prominent part in human subsistence strategies in the area during this period. In addition, sheep, chicken, dog, horse, and rodent remains were also collected at the site. By applying a multi-disciplinary approach, we detected a remarkable change in plant-based subsistence in the ancient Hexi Corridor. Specifically, the importance of millet crops, compared with other crops (especially barley and wheat), in plant-based subsistence declined from the Late Neolithic to the Bronze Age; it apparently improved during the Han and Sui-Tang Dynasties (581–907 CE), when agricultural empires controlled the area, and then declined again during the Wei, Jin, Northern, and Southern Dynasties (220–581 CE) and the Song-Yuan Dynasty (960–1368 CE), when nomadic regimes controlled the area. Climate change, trans-Eurasian exchanges, and geopolitical shifts influenced the diachronic change in plant-based subsistence from the Late Neolithic to the historical periods in the Hexi Corridor.

Keywords: archaeobotany; zooarchaeology; plant-based subsistence; Hexi Corridor; Han Dynasty; late prehistoric; historical period

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1. Introduction

The variation in the spatio-temporal patterns of human subsistence strategies across Eurasia during the Neolithic and Bronze periods in the Old World [1–5] and their relation to agricultural development, transcontinental exchange, and climate fluctuation have been intensively discussed [6–8], which has been promoted by the universal application of archaeobotanical, zooarchaeological, and isotopic analyses at archaeological studies in recent decades [9–11]. On the other hand, bioarchaeological research in the historical era is relatively weaker than that in the late prehistoric periods, as historical documents are used as the primary dataset to reconstruct ancient human livelihoods. This may impede our understanding of the variation in subsistence strategies throughout prehistoric and historical periods, especially in the remote areas of ancient civilisations where only fragmented historical records have been preserved, such as the Hexi Corridor in northwestern China.

The Hexi Corridor was the throat of the ancient Silk Road and has played a prominent part in the trans-Eurasian exchange since the late prehistoric time [12–14]. Archaeobotanical investigations have been performed in dozens of Late Neolithic and Bronze Age sites in the Hexi Corridor (Figure 1), suggesting that humans might have cultivated foxtail and broomcorn millet in ~2800–2000 BCE, mixed millets and wheat/barley in ~2000–1300 BCE, and primarily barley and secondarily wheat and millets in ~900–200 BCE [15–17]. Recent archaeobotanical studies at seven investigated sites of the Wei, Jin, Northern, and Southern Dynasties (WJNB Dynasties, 220–589 CE) and Song-Yuan Dynasties (960–1368 CE) [18] and the excavation of the Chashancun cemetery of the Tang Dynasty (618–907 CE) [19] indicate that plant-based human subsistence changed substantially across historical periods. However, archaeobotanical data from the Hexi Corridor during the Han Dynasty, the key period linking prehistoric and historical periods, and at the beginning of the ancient Silk Road are absent. Though numerous crops, including foxtail and broomcorn millet, barley, wheat, and beans, have been utilised in the Hexi Corridor during the Han Dynasty [20], according to the records in historical documents, the significance of these crops in plant-based human subsistence remains unclear.

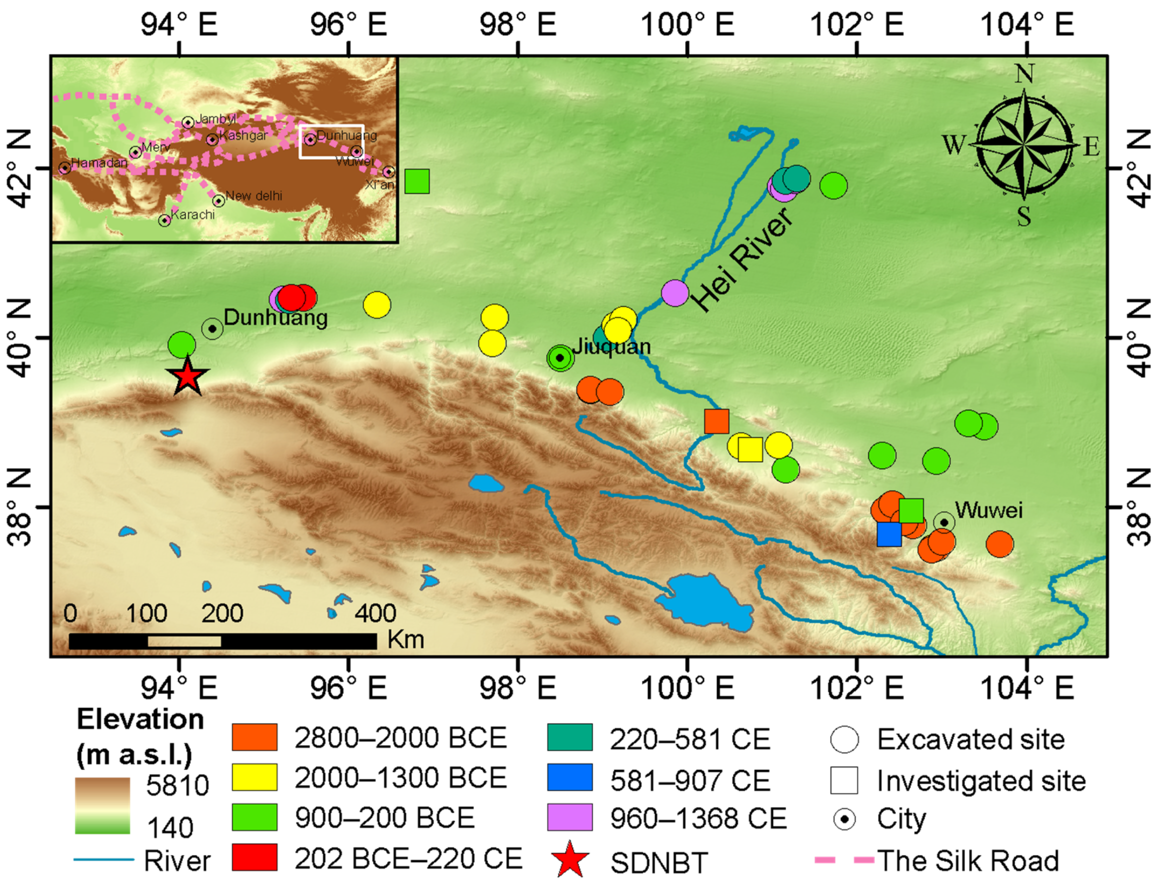

Figure 1. Distribution of excavated and investigated sites in the Hexi Corridor from the Late Neolithic to the historical periods.

Abundant plant remains and few animal remains have been collected from the excavation of the Shuangdun North Beacon Tower (SDNBT) site of the Han Dynasty at the western end of the Hexi Corridor, providing a rare opportunity to explore the human subsistence strategy in the area during this period. In this paper, we aim to study the human strategies of plant utilisation during the Han Dynasty based on archaeobotanical analysis at the SDNBT site and a comparison with historical documents and archaeological data.

Moreover, we reviewed and analysed multi-disciplinary data from the Hexi Corridor and surrounding areas to explore the evolution of plant-based subsistence change in the area, as well as the factors influencing it, throughout prehistoric and historical periods.

2. Study Areas

2.1. Geographical Context

The Hexi Corridor (37°17′–42°48′ N, 92°23′–104°12′ E) is located west of the Yellow River in northwestern China (Figure 1), with a total area of about 400,000 square kilometres. It is bounded by the Loess Plateau to the east, the Tarim Basin to the west, the Tibetan Plateau to the south, the Mongolian Plateau to the north–northwest, and a long and narrow strip to the southeast. Because it lies west of the Yellow River and is shaped like a corridor, it is called the Hexi Corridor. The Corridor is far from the sea, deep in the northwestern hinterland, and has a typical semi-arid and arid climate, with annual average precipitation and temperature of 178 mm and 4~9 °C, respectively (see http://data.cma.cn (accessed on 3 October 2022)). Precipitation gradually decreases from east to west, and the region is crossed by three major inland rivers, the Shiyang, the Hei, and the Shule. The natural vegetation in this area is dominated by C_3 vegetation [21], and the sedimentary $\delta^{13}C$ values demonstrate the predominance of C_3 plants during the Holocene [22]. The main habitat types are temperate desert steppe, and temperate and warm–temperate desert. The main vegetation types are *Stipa capillata* L., *Haloxylon ammodendron*, *Gymnocarpos przewalskii* Maxim., *Calligonum mongolicm Turcz.*, *Reaumuria songarica* (Pall.) Maxim., *Nitraria roborowskii Kom.*, etc. The main types of forest vegetation are *Populus euphratica Oliv.*, *Elaeagnus angustifolia* L., and *Picea crassifolia Kom* [23]. Since the Late Neolithic period, the plant resources consumed by humans in this area have mainly been derived from agricultural production, and millet cultivation was the main subsistence strategy during the Late Neolithic–Middle Bronze Age [17]. Additionally, the Hexi Corridor is a junction of the ancient Silk Road and has been an important channel for the trans-Eurasian exchanges from prehistoric to historical times, especially since the Han Dynasty (202 BCE–220 CE).

The SDNBT (39°34′39.8″ N, 94°05′48.5″ E) site is located in the Akesai area of Jiuquan city, in the west of the Hexi Corridor and to the north of the Tibet Plateau (Figure 1). The Gansu Provincial Institute of Cultural Relics and Archaeology conducted an excavation at the SDNBT site in 2019. The excavation, which covered an area of 16 m^2, unearthed a wealth of artifacts and remains, including pottery sherds, documents, arrow shafts, stone grinders, animal bones and dung, straw rope, black wool felt, linen, and iron blocks. These discoveries offer valuable insights into the history and culture of the region, shedding light on the daily life and activities of the people who once inhabited this area. The discovery of Han bamboo slips and pottery at this site indicates that SDNBT was primarily utilised during the Eastern Han Dynasty.

2.2. Archaeological Context

A cultural sequence of prehistoric and historical periods has been established in the Hexi Corridor [24–26]. Prehistoric and historical cultures in this area included the Majiayao type (2800–2500 BCE), Banshan types (2500–2300 BCE), and Machang types of Majiayao culture (2300–2000 BCE); the Qijia/Xichengyi culture (2000–1600 BCE); the Siba culture (1600–1300 BCE); the Shanma culture (900–200 BCE); the Shajing culture (800–200 BCE); the Han Dynasty (202 BCE–220 CE); the Wei, Jin, Northern, and Southern Dynasties (220–581 CE); the Sui-Tang Dynasties (581–907 CE); and the Song-Yuan Dynasties (960–1368 CE).

According to the cultural periods above, we divided the archaeological data in this study into seven periods: 2800–2000 BCE, 2000–1300 BCE, 900–200 BCE, the Han Dynasty (202 BCE–220 CE); the Wei, Jin, Northern, and Southern Dynasties (220–581CE); the Sui-Tang Dynasties (581–907 CE); and the Song-Yuan Dynasties (960–1368 CE).

3. Materials and Methods

During the excavation of the SDNBT site, a significant quantity of plant and animal remains were sampled from dwelling remains through direct collection or flotation (Figure 2). These samples were then transported to the Environment Archaeology Laboratory, Lanzhou University, for further research.

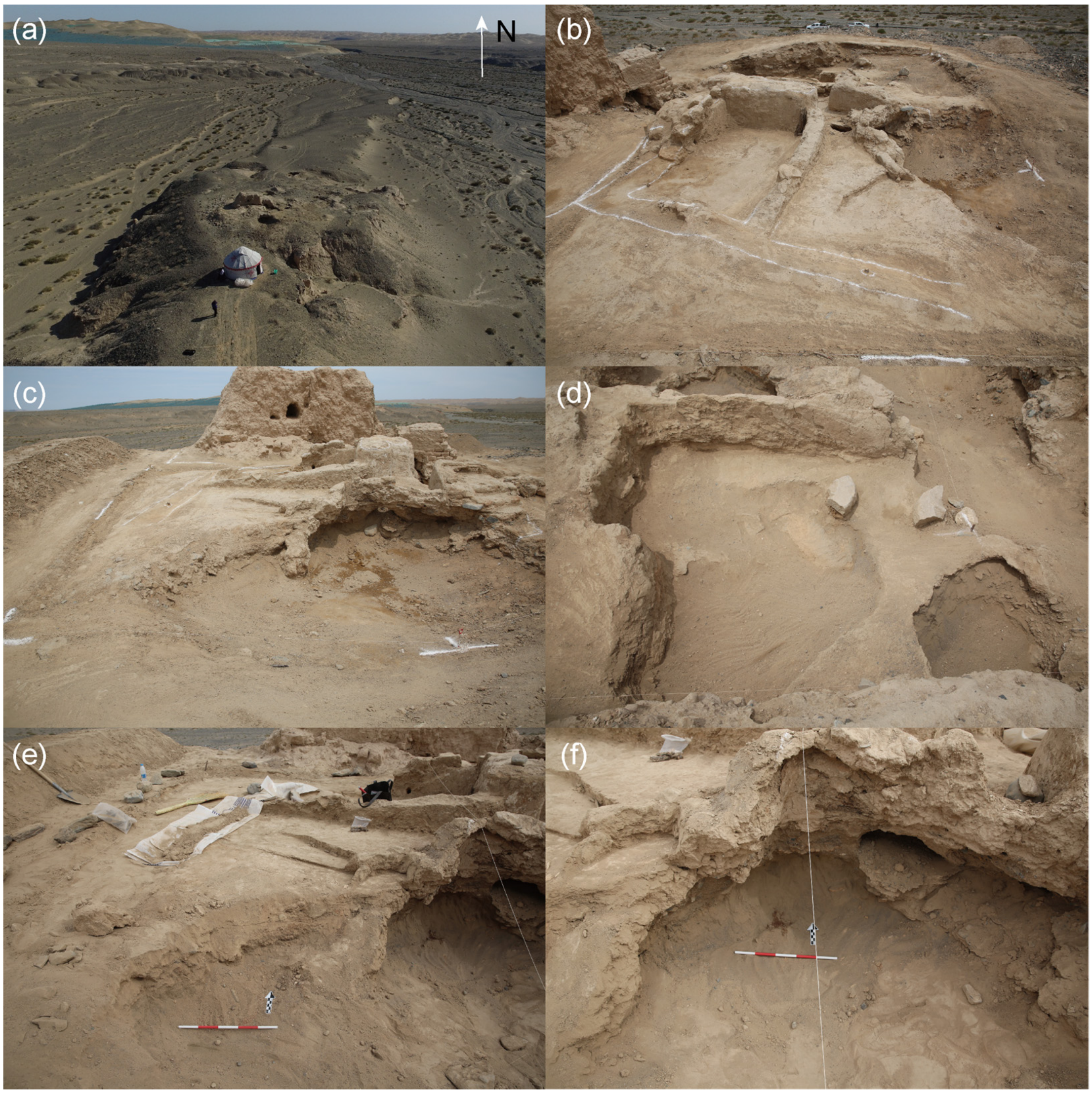

Figure 2. Details of SDNBT site: (**a**) SDNBT site before excavation. (**b**) SDNBT site after excavation. (**c**,**d**) Dwelling remains at SDNBT site. (**e**,**f**) Archaeological remains from dwelling remains.

3.1. Radiocarbon Dating

A tree branch sample unearthed from the SDNBT site was prepared according to the standard acid–alkali–acid pre-treatment method similar to that described by Cao et al. [27]. The sample was then graphitised and analysed in an accelerator mass spectrometer (AMS) at the Key Laboratory of Western China's Environmental Systems, Lanzhou University. The result was calibrated in OxCal v.4.4.4 [28] with an IntCal 20 calibration curve [29]. All ages are reported as "cal. BCE".

3.2. Analysis of Plant Remains

The identification of plant remains was completed by comparing the morphological characteristics of plant remains with various illustrated identification keys [30–32]. In addition, a representative sample identified at the species level with respect to the preserved morphological features was carefully selected for high-precision identification, and detailed photographs were taken with a stereomicroscope.

The relative percentage or proportion of plant remains in archaeological sites serves as a primary method for determining the importance of crops in human subsistence strategies. However, it is important to note that there are substantial differences in the weight of individual grains from different crops [15,33]. As a result, the percentage of crop quantity may not accurately reflect the actual proportion of different species in human life during the prehistoric and historical periods. To address this issue, we calculated the relative weight percentages of crops following the methods described by Zhou et al. [15] and Sheng et al. [34] as follows:

$$P(s) = \frac{Ns \times Fs}{N_1 \times F_1 + N_2 \times F_2} \quad (1)$$

where N_1 = number of foxtail millet grains; F_1 = 2.6 g; N_2 = number of broomcorn millet grains; F_2 = 7.5 g; Ns = number of specimens of a crop; Fs = the average weight measured from 1000 grains of a crop; and P(s) = weight percentage of a crop.

3.3. Analysis of Animal Remains

Before identification, any debris on the surface of the bone were washed away with a brush. All animal remains were then subjected to a thorough identification process, which involved comparing them with comparative collections and atlases of animal skeletons [35,36]. Meanwhile, the minimum number of individuals (MNI) was calculated based on the part of the sample with the highest frequency, considering the left and right sides. This work was carried out at the Key Laboratory of Western China's Environmental Systems (Ministry of Education) at Lanzhou University.

4. Results

The AMS ^{14}C dating result of the tree branch sample indicates that SDNBT was formed in 27–206 cal BCE, in the Eastern Han Dynasty (9–220 CE) (Table 1).

Table 1. Radiocarbon dating of the SDNBT site, where the calibrated range is given at 95.4% probability.

Lab Number	Dated Material	Dating Method	^{14}C Age (BP)	Calibrated Age (cal BCE) 2 σ	Period
LZU19084	Tree branch	AMS	1925 ± 25	27–206	Eastern Han Dynasty

A total of 32,476 plant seeds were collected from three locations within the dwelling remains at the SDNBT site (Table 2), and were identified by Wenyu Wei, including 233 foxtail millet seeds (*Setaria italica*; Figure 3a), 31,463 broomcorn millet seeds (*Panicum miliaceum*; Figure 3b), and 780 weed remains (such as *Cannabis sativa* L., *Setaria viridis*, *Setaria pumila*, *Echinochloa crusgalli*, *Atriplex patens*, and *Erodium stephanianum Willd.*; Figure 3c–h). Millet was the most abundant crop, accounting for 96.88% of the total number of plant remains identified and 99.74% of the total weight of plant remains. In comparison, foxtail millet played a much smaller role in the total seeds, accounting for only 0.72% of the total number of plant remains identified and 0.26% of the total weight of plant remains. Therefore, it is worth noting that broomcorn millet was the predominant cultivated crop, indicating that it played a vital role in human livelihood in the Eastern Han Dynasty.

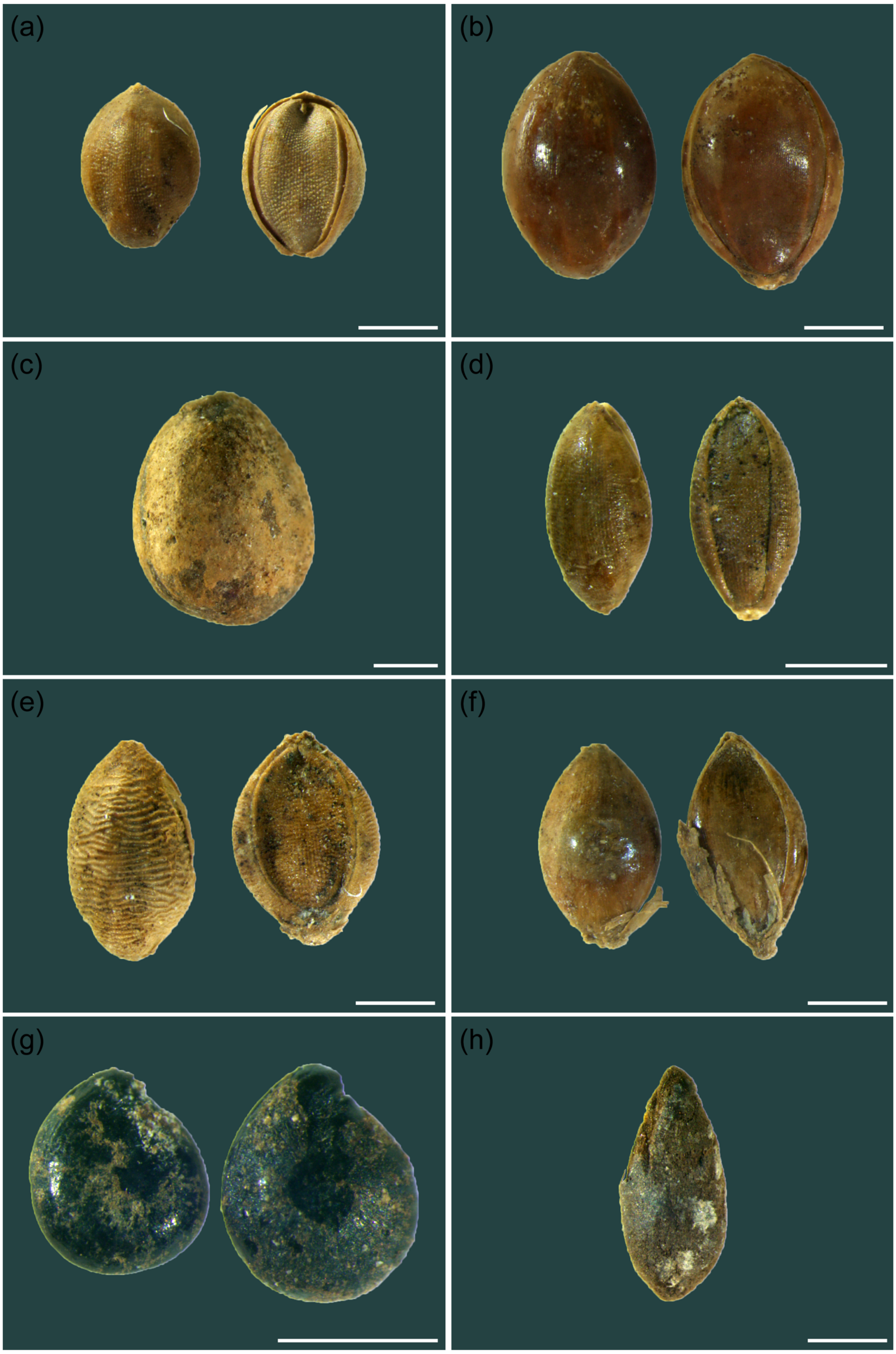

Figure 3. Identified plant seeds from the SDNBT site (scale bar: 1 mm): (**a**) *Setaria italica*; (**b**) *Panicum miliaceum*; (**c**) *Cannabis sativa* L.; (**d**) *Setaria viridis*; (**e**) *Setaria pumila*; (**f**) *Echinochloa crusgalli*; (**g**) *Atriplex patens*; (**h**) *Erodium stephanianum* Willd.

Table 2. Identification results of plant remains from SDNBT site.

Sample Number	Crop				Weed				Total
	Setaria italica	*Panicum miliaceum*	*Cannabis sativa* L.	*Setaria viridis*	*Setaria pumila*	*Echinochloa crusgalli*	*Atriplex patens*	*Erodium stephanianum Willd.*	
F2 aisle	21	126		89				1	237
F3 southwest corner of the probe	64	235		192					491
F3 middle of the probe	148	31,102	1	404	4	84	5		31,748
Total	233	31,463	1	685	4	84	5	1	32,476

A total of 37 animal bones were unearthed from various cultural layers at the SDNBT site. Of these, 29 animal bones could be identified to the species/genus/family level, and 8 animal bones could only be identified as having belonged to medium-sized mammals (Table 3). The number of identified specimens (NISP) of sheep/goat (*Ovis aries/Capra hircus*), horses (*Equus* sp.), dogs (*Canis lupus familiaris*), chickens (*Gallus gallus domestica*), and rodents (Muridae) were 17, 2, 2, 1, and 7, respectively (Table 3). In this assemblage, sheep/goat accounted for the highest proportion, 58.62% of the total animal remains. In addition, dogs, horses, chickens, and rodents accounted for 6.90%, 6.90%, 3.45%, and 24.14% of the total animal remains, respectively. The MNI indicates that sheep/goat, chickens, and dogs accounted for the same percentage of total animal remains, 11.11%, while horses accounted for 22.22% and rodents for 44.44%.

Table 3. NISP and MNI of identified animal remains from SDNBT site.

Species	NISP	NISP%	MNI	MNI%
Ovis aries/Capra hircus	17	58.62	1	11.11
Equus sp.	2	6.90	2	22.22
Canis lupus familiaris	2	6.90	1	11.11
Gallus gallus domestica	1	3.45	1	11.11
Muridae	7	24.14	2	44.44
Total	29	100.00	9	100.00

NISP: number of identified specimens; MNI: minimum number of individuals.

5. Discussion

5.1. Han Dynasty Human Strategy of Plant Utilisation in Hexi Corridor

Archaeobotanical data and the radiocarbon dates from the SDNBT site (Tables 1 and 2) indicate that broomcorn millet was the dominant crop and foxtail millet was the subsidiary crop in plant-based human subsistence during the Eastern Han Dynasty (9–220 CE). Archaeobotanical studies at Han Dynasty sites in the Xi'an area suggest that millet was the dominant crop in human subsistence in the core areas of the Han Empire [37–40]. Moreover, carbon isotopic evidence from most Han Dynasty sites in northern China shows C_4 or mixed C_4 and C_3 signals [38,41], further indicating that millet crops were used as the primary staple food during the Han Dynasty.

The dominance of millet in plant-based human subsistence is also supported by historical records. For example, millets appear 76 times in the "*Shijing*" (《诗经》), more than any other crop. The main grain crops are millets as recorded in the "*Shiji*" (《史记》), "*Lunyu*" (《论语》), "*Shangshu*" (《尚书》), and "*Lüshichunqiu·Shenshi*" (《吕氏春秋·审时》). However, archaeobotanical evidence indicates that foxtail millet was probably more important than broomcorn millet in the Yellow River valley in the period of the Han Dynasty [42–45], which is also confirmed by written records of historical documents, such as "*Shiji*" (《史记》),

"*Hanshu·Shihuozhi*" (《汉书·食货志》), and "*Fanzijiran*" (《范子计然》). The abnormally high proportion of broomcorn millet in the plant remains from the SDNBT site (>96%) may have been caused by the cold environment in the surrounding areas, which could be more unfavourable for the growth of foxtail millet than for broomcorn millet [46]. The harsh environment may have resulted in a shortage of resources for human settlement, which is further supported by the animal assemblage identified at the SDNBT site, as many small rodents (field mouse, gerbil jird, etc.) were utilised.

The archaeobotanical data from the SDNBT site may reflect the characteristics of special groups, likely border guards, considering the defensive attribute of the beacon tower, instead of general groups in the Hexi Corridor in the period of the Han Dynasty. Other crops, including wheat, barley, and beans, were also cultivated in the area, as also recorded in historical documents [20]. Additionally, carbon isotopes of human bone collagen from the Heishuiguo Han cemetery in Zhangye County of the Hexi Corridor suggest that humans consumed mixed C_4 and C_3 foods [47]. While millet was the primary food source, other C_3 crops such as wheat and barley may have also been utilised for subsistence. According to the historical document "*Juyan Han bamboo slips*" (居延汉简), the main crops during the Han Dynasty were foxtail millet, broomcorn millet, wheat, barley, sorghum, and beans. The available data suggest that millet was the most important crop for subsistence in the Hexi Corridor during the Han Dynasty. However, further research is needed to determine its exact significance in human livelihoods.

5.2. The Trajectory of and Influencing Factors for the Change in Plant Subsistence in the Hexi Corridor from the Late Neolithic to Historical Periods

Previous studies have revealed that broomcorn millet and foxtail millet were domesticated and became the main food resources in northern China around 8000 BCE [45,48,49]. In contrast, wheat and barley were domesticated and became stable food in the Fertile Crescent in West Asia around 8500 BCE [50,51]. These important crops have been found alongside evidence of trans-Eurasian exchange in 4000–2000 BCE [4,5]. As a key area for cultural exchange between eastern and western Eurasia, the trajectory of plant-based subsistence and its influence in the Hexi Corridor from the Late Neolithic to historical periods played a crucial role in shaping human livelihoods.

In 2800–2000 BCE, the ancestors who settled in the Hexi Corridor began to use millet crops, as evidenced by the direct dating of millet remains from the Gaomuxudi and Xihetan sites [15,52]. The archaeobotanical results suggest that foxtail millet was the main food for prehistoric humans (Figure 4d) [17,53]. Additionally, carbon isotopic evidence from human bone, pig bone, and dog bones also showed C_4 signals (Figure 4c) [17,54,55], further indicating that millet crops were utilised as the primary staple in the Hexi Corridor during this period. This may be due to the westward spread of agricultural populations in the Loess Plateau region [56–58]. Furthermore, by considering the high-resolution paleoclimate records for this area (Figure 4a,b) [59,60], it can be inferred that favourable precipitation and temperature conditions in 2800–2000 BCE may have provided a conducive environment for millet cultivation.

Archaeobotanical results showed that in ~2000–1300 BCE, the weight proportions of wheat/barley and foxtail/broomcorn millet were very similar (Figure 4d) [17,53,61]. Carbon isotopic evidence also shows mixed C_3 and C_4 signals (Figure 4c) [55,62–64]. The data indicate that millet crops remained dominant in agriculture, and wheat/barley began to make a significant contribution in the Hexi Corridor area during this period. This transformation is likely related to the emergence of China–trans-Eurasian exchange, which introduced new subsistence options, including barley, wheat, sheep, and cattle [5,52,65,66]. Furthermore, the bronze mining and smelting industry began to develop during this period [67,68], and temperatures and precipitation tended to be lower than the previous period (Figure 4a,b) [59,60]. These conditions increased the survival pressure on prehistoric humans, leading to the rapid adoption of high-yield and cold-resistant wheat/barley crops after their introduction.

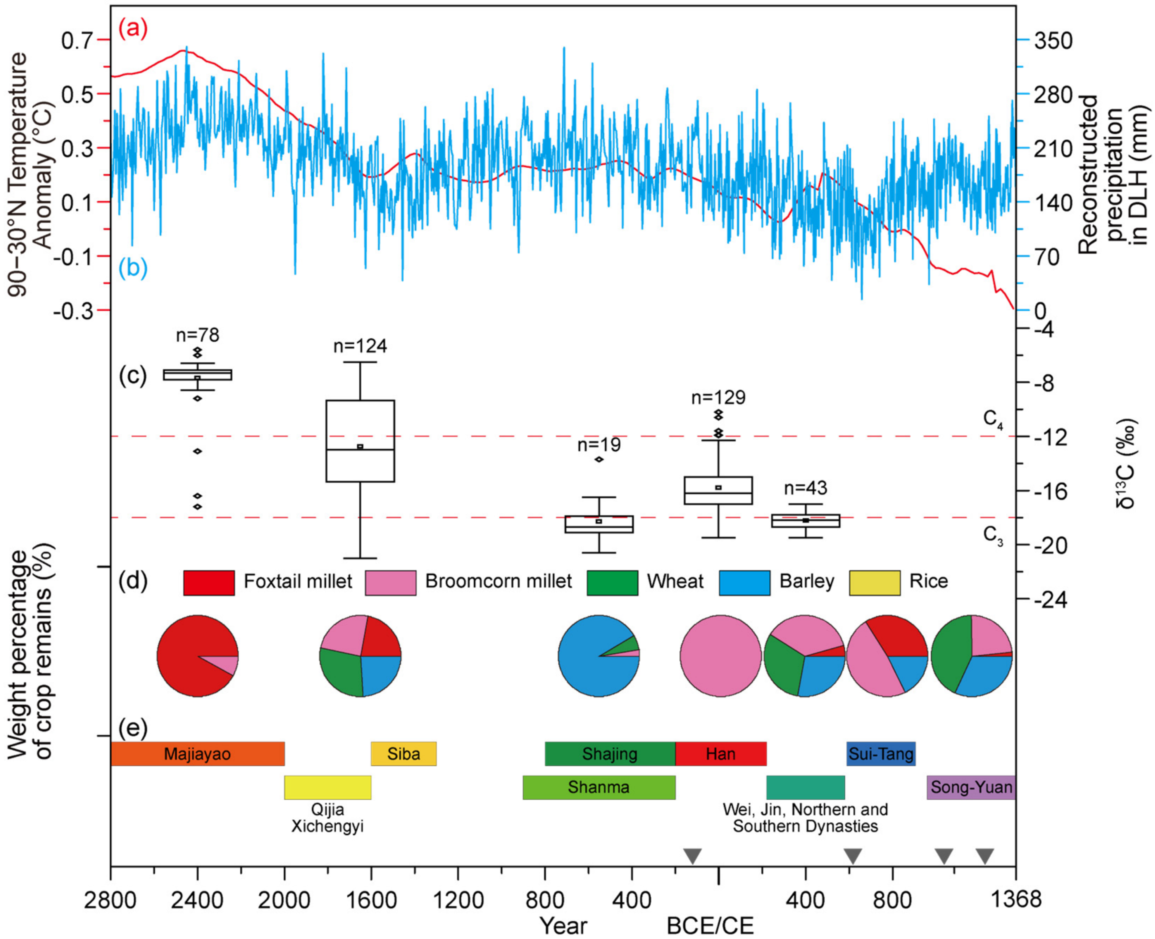

Figure 4. The alteration in plant-based subsistence in the Hexi Corridor from the Late Neolithic to historical periods was compared with climate records and $\delta^{13}C$ values of human, pig, dog, and crop remains from sites in the study area: (**a**) Northern Hemisphere (30° to 90° N) temperature records compared with 1961–1990 instrumental mean temperatures [59]. (**b**) Reconstructed precipitation from DLH (Delingha) [60]. (**c**) $\delta^{13}C$ values of the human, pig, and dog remains from sites in the Hexi Corridor. *n*: the number of isotopic data. (**d**) Weight percentages of the crop remains from sites in the Hexi Corridor [15,34]. (**e**) The archaeological framework of cultural evolution in the Hexi Corridor. Gray inverted triangles from left to right: Han government regained Hexi, Tang government regained Hexi, Xixia government occupied Hexi, and Mongolia government occupied Hexi.

Archaeobotanical findings suggest that in ~900–200 BCE, the weight proportions of barley exceeded ~90%, and carbon isotopic evidence shows more C_3 signals (Figure 4c) [17,53,62]. This indicates that barley was the staple food in the Hexi Corridor during this period. Archaeological evidence indicates that the ancestors of the Shanma culture (900–200 BCE) and the Shajing culture (800–200 BCE) mainly raised livestock, including sheep/goat, camels, and horses, indicating a shift in their subsistence strategy from one dominated by agriculture to one with prevalent pastoralism [16,25,69]. Therefore, we infer that the transformation from a multi-crop structure to a barley-dominant structure was likely related to the occupation by nomadic people during this period.

During the Han Dynasty, the agriculture structure in the Hexi Corridor transformed from being barley-dominated to being millet-dominated (especially broomcorn millet), as evidenced by the archaeobotanical results from the SDNBT site (Figure 4d). The transformation might be related to geopolitical change. The Han Empire governed the Hexi Corridor from ~121 BCE and utilised it as a primary area for consolidating the border area [70]. To defeat the Huns, the government implemented the reclamation of wasteland with an army unit, and a large number of male individuals from the Central Plains migrated to the Hexi Corridor [70,71]. These migrants may have brought with them their previous customs, such as millet-based dietary tradition, and the raising and burial of chickens, into the Hexi Corridor [72,73]. According to the "*Han Shu*" (《汉书》), foxtail/broomcorn millet was the main food crop, despite the Han government's efforts to promote wheat cultivation in northern China. Moreover, carbon isotopic evidence from the Heishuiguo Cemetery showed mixed C_3 and C_4 signals [74]. Therefore, we propose that this pattern may be unique to the SDNBT military site during the Eastern Han Dynasty and may not represent the overall human livelihoods in the Hexi Corridor during the Han Dynasty. It is important to note that humans in this period utilised numerous crops, including millets, wheat, barley, and beans [75,76], with millets being the primary staple food. During the Wei, Jin, Northern, and Southern Dynasties, the weight proportion of wheat and barley exceeded that of millet (Figure 4d), and carbon isotopic evidence also showed C_3 and mixed C_3 and C_4 signals, which may be related to the relatively stable residential environment of the Hexi Corridor during the frequent wars between farming dynasties and nomadic kingdoms in that period [18,77]. Large-scale migration into the Hexi Corridor likely introduced advanced wheat-processing technology [18,78]. During the Tang Dynasty, millet crops once again became the main staple food, possibly due to the Tang Empire's westward expansion and control of the area [19]. During the Song-Yuan periods, wheat/barley gradually became the main taxable crop (Figure 4d) [79–81], which might be related to the introduction of the advanced wheat deep processing technology and the popularisation of rotary wheel (water wheel) in the irrigation system [78,82]. However, in addition to the geopolitical changes mentioned above, other factors, such as transcontinental exchange, local environments, and climate change, also played significant roles in influencing the adoption of various livelihood strategies. It is recommended that future work investigate these effects further.

The trajectory of animal utilisation strategies that changed from the Late Neolithic to the Han Dynasty was preliminarily outlined in a previous study [74]. Similarly, our zooarchaeological results from the SDNBT site also indicate a diversification of the livestock species raised by humans in the Hexi Corridor during the Eastern Han Dynasty. However, a comprehensive understanding of these changes requires further studies of cultural remains from historical sites during various periods.

6. Conclusions

Archaeobotanical, zooarchaeological, and radiocarbon data from the SDNBT site of the Han Dynasty reveal that during the Eastern Han Dynasty (9–220 CE), soldiers in the area primarily consumed broomcorn and foxtail millet and utilised sheep, chicken, dogs, and wild animals. Compared with other datasets, it is suggested that this pattern may be unique and not representative of overall human livelihoods in the Hexi Corridor during the Han Dynasty. It is possible that humans utilised numerous crops, including millets, wheat, barley, and beans, with millets being the primary staple food during that period. In the long-term, trans-regional exchange and climate fluctuations had a clear impact on plant-based human subsistence in the Hexi Corridor during the late Neolithic and Bronze Age. The cropping pattern changed from the cultivation of millets, mixed millets, and wheat/barley to barley-dominant agriculture in ~2800–2000 BCE, ~2000–1300 BCE, and ~900–200 BCE, respectively. Geopolitical change was likely the most influential factor in the alteration in plant-based human subsistence in the Hexi Corridor during the historical era. This was further influenced by the notable increase in the weight of millet crops for plant-based subsistence during the Han Dynasty and Sui-Tang Dynasties, and its decrease during the Wei, Jin, Northern, and Southern Dynasties and Song-Yuan Dynasties. Local environments, climate change, and transcontinental exchange may have also affected the proportions of cultivated crops in the Hexi Corridor during those dynasties.

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