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# Dry Farming in the Areas North and South of the Yanshan Mountains During the Neolithic Age—A Case Study of Foxtail Millet and Broomcorn Millet Cultivation

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**Abstract:** This paper reviews the current situation and progress of farming represented by foxtail millet and broomcorn millet in dry farming. Through the integration of archaeobotanical remains, collection and analysis of paleoenvironmental data, and typological analysis of tools, a comprehensive understanding of millet farming in the Neolithic Age is achieved. Dry farming in the areas north and south of the Yanshan Mountains underwent a dynamic process from origin, development, to maturity. It can serve as an important reference for the study of natural plant remains and reflects the wisdom of primitive ancestors in production and life. It provides an important perspective for studying the diversified development, wave-like advancement, and spiral upward progress of China's agricultural civilization.

**Keywords:** North and south of the Yanshan Mountains; Neolithic Age; Dry farming; Crop farming; Foxtail millet; Broomcorn millet; Subsistence economy

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## 1. Introduction

### 1.1. Research background

The region north and south of the Yanshan Mountains–Great Wall is of special significance in archaeological research. Located in the transitional zone from the Mongolian Plateau to the North China Plain and Northeast China Plain, its southern part includes the northern Haihe River Basin and the lower Luanhe River, while its northern part covers the upper Luanhe River, the Daling and Xiaoling Rivers, and the upper Liaohe River [1]. Covering a vast geographical area, it is a key subject for studying the development of dry farming in northern China. As a boundary of the agro-pastoral ecotone, the Yanshan Mountains feature distinctly different

agricultural types on their northern and southern sides.

The northern side is dominated by the West Liaohe Plain and Inner Mongolia Plateau, mostly covered by grasslands and deserts with a relatively arid climate. The southern side is dominated by the North China Plain and the Taihang Mountains, where farming is the main practice. Archaeological cultures in this region include the Donghulin and Zhuanian cultures in the early Neolithic Age around Beijing; the Xinglongwa, Zhaobaogou, Hongshan, and Xiaoheyan cultures in Inner Mongolia and Liaoning; and the Cishan and Shangzhai cultures in Hebei and Beijing during the middle and late Neolithic Age.

### 1.2. Research methods

The core of this study is dry farming, which inevitably involves the origin and development of agriculture. Research on agricultural origin focuses on agriculture in the narrow sense, whose core is crop farming with plants as the target. Therefore, the most direct physical evidence reflecting the origin of ancient agriculture is plant remains unearthed through archaeological excavations. For archaeobotanical remains, flotation is currently the most important research method [2].

### 1.3. Research significance

Previous studies on foxtail millet and broomcorn millet farming in the areas north and south of the Yanshan Mountains have involved extensive field investigations and experiments, yielding rich and diverse conclusions. However, some issues remain unsolved. Most studies focus on major core sites, with insufficient attention to remains in marginal areas; excavations and research are scattered, lacking a systematic framework. In addition, studies are mostly conducted from a single disciplinary perspective, emphasizing the identification and dating of millet remains, with insufficient integration of animal bones or stable isotope analysis.

## 2. Archaeological cultural sequence and stages in the areas north and south of the Yanshan Mountains during the Neolithic Age

### 2.1. Typical cultures of the early and middle Neolithic Age

Cultures of the early Neolithic Age (about 10,000–7,000 years ago) are diverse, represented by the Nanzhuangtou site in Xushui, Hebei; Donghulin and Zhuanian sites in Beijing; Sitai site in Shangyi, Inner Mongolia; Xiaoxihou culture site cluster; and Chahai site in Fuxin, Liaoning.

### 2.2. Typical cultures of the middle Neolithic Age

Cultures of the middle Neolithic Age are more abundant than early ones, represented by the Cishan site in Wu'an, Shangzhai site in Pinggu, Xinglongwa site in Aohan Banner, and Zhaobaogou site in Chifeng, Inner Mongolia.

### 2.3. Typical cultures of the late Neolithic Age

Cultural remains of the late Neolithic Age are more widely distributed, represented by the Niuheliang site and Dongshanzui site in Liaoning, and the Xiaoheyan site in Inner Mongolia.

## 3. Origin and development of dry farming

### 3.1. Settlement patterns

In the early Neolithic Age, millet cultivation was in its infancy, with generally small settlements mostly distributed in intermountain basins. Most settlements featured semi-subterranean houses with simple facilities, and few production tools, such as stone grinding slabs and rods, were found.

In the middle Neolithic Age, millet farming became the dominant subsistence strategy, and settlements expanded in scale, forming settlement clusters such as Xinglongwa and Zhaobaogou, with scattered small-to-medium settlements in marginal areas. Supporting tools such as stone shovels and sickles were unearthed. Moreover, large numbers of foxtail millet and broomcorn millet seeds were found by flotation in the Xinglongwa culture in Inner Mongolia, and round storage pits 1–2 meters in diameter for grain storage were found around houses [3].

In the late Neolithic Age, large or super-large settlements emerged, forming a three-level system from capital cities to central settlements and ordinary settlements, with clear functional divisions including residence, sacrifice, and storage. Jade and ritual objects were unearthed, indicating a complete hierarchical system. At the Erdaojingzi site in the upper West Liaohe River, 181,685 foxtail millet grains and 41,266 broomcorn millet grains were recovered by flotation, confirming large-scale agricultural production [4].

### 3.2. Changes in dry farming tool types

Dry farming in the areas north and south of the Yanshan Mountains can be traced back to about 13,000 years ago at the Donghulin site in Beijing. Chipped stone axes with sharp blades were used for land reclamation; fine stone blades inlaid into bone handles were used for harvesting millet; four-footed grinding slabs improved stability and crop processing efficiency, showing a certain level of production technology. Pottery jars and supports unearthed at the Cishan site were likely used for cooking grains and vegetables.

In the middle Neolithic Age, perforated stone shovels appeared in the Xinglongwa culture for binding wooden handles to enhance tilling efficiency; stone sickles with serrated blades were unearthed at the Cishan site for harvesting millet; bone-handled knives were popular in the Zhaobaogou culture, serving both harvesting and processing. Compared with the early Neolithic Age, tools were more diverse and multi-functional.

### 3.3. Faunal, floral remains, and isotopic data

As an early Neolithic site, the Donghulin site in Beijing provided key evidence for millet domestication through systematic flotation. More than 2,000 plant seeds were recovered, including 14 carbonized foxtail millet grains and 1 broomcorn millet grain, marking the emergence of dry farming in this region.

Isotopic analysis of Hongshan culture remains in Liaoning shows that human bone $\delta^{13}C$ values indicate millet-based diets, but the low dental caries rate (1.41%) at Niuheliang suggests limited carbohydrate intake, implying that gathering still played a certain role.

Contemporary archaeological finds elsewhere, such as stable isotope analysis of pig bones at the Yuezhuang site, show that domestic pigs fed on millet byproducts, confirming that farming supported animal husbandry with stable food sources. In the southern areas such as Donghulin and Shangzhai, foxtail millet remains were prominent in the early stage, and rice remains appeared in the late stage. Stable isotope analysis shows a higher proportion of $C_3$ crops than in the north, reflecting agricultural cultural exchanges [5].

### 3.4. Understanding of the origin of dry farming

Carbonized millet grains from the Donghulin site are nearly spherical, with length-width and length-thickness ratios similar to modern millet, consistent with domesticated crops. However, their size is smaller than that of modern *Setaria viridis*, possibly related to the evolution of green foxtail.

Flotation results from the Xinglonggou site in Inner Mongolia show a high proportion of foxtail millet, followed by broomcorn millet, along with many green foxtail seeds, suggesting coexistence of wild and cultivated plants. Storage was limited by productivity, with shallow pits.

Scientific archaeology and analysis of millet farming in the areas north and south of the Yanshan Mountains confirm that northern China is a key origin center of millet agriculture. The development of millet farming was closely related to climate, tool evolution, and human activities, laying an important foundation for subsequent dry farming development.

## 4. Relationships between the agricultural economy, society, and environment

### 4.1. Impact of agricultural development on social differentiation

In terms of social differentiation, large-scale grain storage pits, massive settlements, and abundant grain remains indicate collective management and distribution systems and early social organizations in the Neolithic Age.

Agricultural development also promoted the rise of handicrafts. Tools such as stone grinding slabs and rods demonstrated advanced craftsmanship [6]. Besides stone processing, a small number of jade jue and jade axes were found in early Neolithic tombs, reflecting high-level handicraft development [7].

Social differentiation was reflected not only in subsistence strategies but also in internal stratification within social groups.

### 4.2. Impact of environmental change on agricultural activities

During the Paleolithic-Neolithic transition and early Neolithic Age, global warming caused massive glacial retreat. Palynological assemblages at the Donghulin site show Gramineae accounted for 45%, with abundant tree pollen, facilitating millet growth and indicating small-scale development of wild millet-related plants.

In the middle Neolithic Age, temperatures in the Yanshan region dropped by 1.5–2°C, and precipitation decreased by about 50 mm, leading to grassland vegetation. Under cold-dry conditions, broomcorn millet accounted for about 40% at the Jiangjialiang site. Palynological and oxygen isotope data confirm a trend toward a cold-dry climate, favoring more broomcorn millet cultivation [8].

In the late Neolithic Age, palynological analysis in the upper West Liaohe River shows a decline in deciduous broad-leaved forests, expansion of birch and pine, and warm-dry steppe on low hills, shaping subsistence patterns. For example, the Hongshan culture benefited from a suitable climate, abundant water systems, and wildlife, supporting fishing, gathering, and hunting. Archaeological and paleosol data show that broomcorn millet was more drought-tolerant and stable, becoming more widespread than foxtail millet.

### 4.3. Agricultural diffusion and cultural interaction

Dry farming in the areas north and south of the Yanshan Mountains maintained technological exchanges with the middle and lower Yellow River. For instance, the Cishan site in Hebei influenced the Peiligang culture in Henan via the eastern Taihang piedmont corridor.

In terms of crop composition, millet proportions at the Jiangjialiang site were much lower than at contemporary Yangshao sites in the Central Plains, largely due to the cold-dry climate in northwestern Hebei, favoring more drought-tolerant broomcorn millet.

Subsistence interactions also occurred with the West Liaohe River basin. Millet agriculture in the Xinglongwa area originated from the southern Yanshan region while retaining northern settlement traditions. Tools such as stone grinding slabs were inherited from North China and developed into stone plows, supporting large-scale production. Stone tools at the Chahai site in western Liaoning resemble those at the Donghulin site, confirming agricultural influence from North China, indicating a shared millet culture sphere.

In the late Neolithic Age, Hongshan culture tools, such as stone plows, were inherited from the Zhaobaogou culture with improved specialization and thickness, reflecting technological progress and localized adaptation [9].

The Hongshan culture already practiced millet farming, which was inherited by the Xiaoheyan culture. However, a cold-dry climate in the late Neolithic Age further promoted broomcorn millet cultivation, showing adaptive adjustments of subsistence strategies to climate change [10].

## 5. Conclusion

Agricultural development is closely linked to civilization. From the emergence of farming to its continuous development, the expansion of crops and the evolution of production tools have transformed social life and propelled human society forward. Millet-based farming varied across regions, shaped by climate, environment, and human activities.

Increased grain output boosted population growth, and farming expansion stimulated cultural exchanges, radiating wider areas and advancing civilization. By systematically examining the origin, distribution, development, evolution, and diffusion of millet farming in the areas north and south of the Yanshan Mountains, researchers can clarify its developmental model and interactions with the surrounding environment.

From scattered millet grains at the early Donghulin site to large-scale storage in western Liaoning in the middle and late periods; from composite stone tools in the early stage to ritual systems in the late Hongshan culture, agriculture evolved continuously under the influence of environment, society, and human activities, always driving social progress.

Future research should further explore the evolutionary laws of agricultural civilization and deepen the study of agricultural archaeology and the origin of civilization.

## Disclosure statement

The author declares no conflict of interest.

## References

[1] Chen SQ, 2011, Adaptive Changes of Prehistoric Cultures in the Region North and South of the Yanshan Mountains–Great Wall. Acta Archaeologica Sinica, 2011(1): 1–22.

[2] Zhao ZJ, 2020, Archaeobotany and Agricultural Origin in the Neolithic Age. Agricultural History of China, 39(3):

3–13.

[3] Liu X, Hua JJ, 2024, Spatial Distribution and Evolution Prediction of Neolithic Cultures in Western Liaoning. Journal of Liaoning Normal University (Social Science Edition), 47(2): 22–30.

[4] Sun YG, 2014, Study on Plant Remains from the Neolithic to Early Bronze Age in the Upper West Liaohe River Basin, thesis, Inner Mongolia Normal University.

[5] Wang LX, 2022, Xinglongwa Site: Seeking the Mark of Chinese Prehistoric Civilization. Inner Mongolia Daily, June 23, 2022, 6.

[6] Li YH, 2008, On the Primitive Agricultural Remains of the Xinglongwa Culture: Based on Stone Shovels and Hoes. Journal of Chifeng University (Philosophy and Social Science Edition), 2008(7): 6–9.

[7] Chen T, Chen Y, 2024, Analysis of Plant Remains from the Jiangjialiang Site in Yangyuan, Hebei. Agricultural Archaeology, 2024(6): 51–57.

[8] Zhang JN, Xia ZK, 2013, The Significance of Millet Agriculture in the Formation of Chinese Civilization. Early China Studies, 2013(1): 228–240.

[9] Hou Y, 2007, On the Origin of Millet Agriculture in Northern China. Agricultural Archaeology, 2007(1): 152–155.

[10] Kang YL, 2023, Subsistence Patterns in the Late Hongshan Culture from Stone Production Tools. Journal of Chifeng University (Philosophy and Social Science Edition), 44(4): 5–11.