

Introduction

1.1. Research question development

The origin and development of agriculture is a global phenomenon that greatly impacted human development and the relationship between humans and nature. China, as one of the independent centers of domestication worldwide, represents a crucial region for understanding how agriculture evolved from hunting and gathering and influenced human-environmental interaction.

Despite significant progress in the study of agricultural origin across different Chinese regions, few studies have investigated why intensive agriculture was ultimately established only in the monsoon regions of China, rather than the more interior parts of continental Inner Asia. How did people outside the core monsoon region of East Asia organize their subsistence practices during the agriculture transition? To what extent did people in these semi-arid or arid regions attempt to farm or adopt farming when intensive agriculture developed in the monsoon region? Answering these questions will enhance our comprehension of the threshold for the formation of early agricultural lifeways and enrich our knowledge of the diversity of cultural adaptation to Holocene environmental changes in East Asia.

To further investigate the aforementioned questions, it's crucial to analyze people's subsistence strategies at the transitional zones between areas where intensive agriculture thrived and those where no farming activities were ever established. Such areas mark tipping points where conditions or incentives for practicing agriculture have reached a threshold that calls for a choice between intensive agriculture and other subsistence practices (Chen 2011; Zhao et al. 2021a). Exploring people's subsistence choices in these regions can significantly enhance our understanding of why intensive agriculture developed in some areas but not in others.

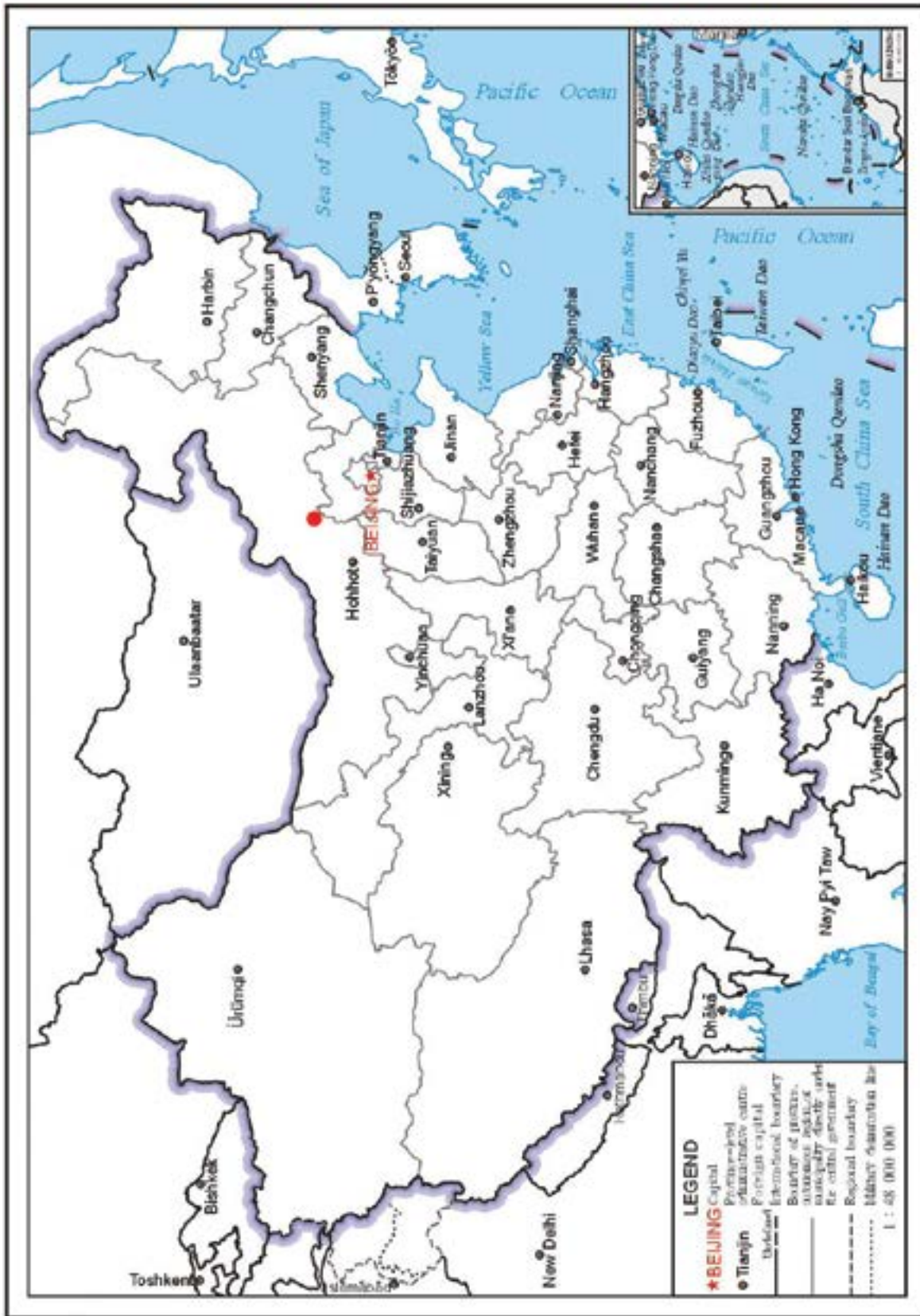
The Northern Yinshan Mountainous Region in Ulanqab Banner on the southern Steppe zone of Mongolian Plateau provides an ideal location for such an investigation (see Figure 1.1). On one hand, this region is situated near farming communities that are engaged in intensive agriculture, such as the Yangshao communities located to the south of the Yinshan Mountain region and the Hongshan-Lower Xiajiadian communities approximately 300-400 km away to the east in the West Liao River Valley (Zhang 2004; Liu et al. 2009). On the other hand, this region lies adjacent to the Gobi-Northern Steppe zone in the north, where no significant evidence of farming has ever been discovered. The transition from foraging to pastoralism there suggests a divergent development of

subsistence practices compared to the Monsoon region of North China (Janz et al. 2017).

Until recently, this region had been largely overlooked by prehistoric archaeological studies, leaving few published research results to provide a holistic understanding of how people's subsistence practices changed over time. However, the discovery and excavation of the Yumin site in 2014, which identified the earliest Neolithic remains in central Inner Mongolia, has attracted the attention of archaeologists to study prehistoric remains in this area. Intensive surveys have since been conducted around Yumin in Huade County during three seasons, resulting in the discovery of numerous sites yielding a large number of lithic remains from the Early Neolithic to the Early Bronze Age. Among these, the Simagou site has also been extensively excavated (Bao et al. 2016; Hu and Li 2018). The combination of excavated and surveyed data provides rich information for learning the specific patterns of subsistence practices. Thus, this study aims to employ a land-use perspective to synthesize the lithic remains with other lines of evidence to examine: (1) what subsistence strategies people applied to make use of the landscape resources from the Early Neolithic to the Early Bronze Age in the Northern Yinshan Mountainous Region; (2) whether or not this region experienced a subsistence transition to intensive agriculture like the core monsoon area of China; (3) Why or why not intensive agriculture developed in this region; (4) If no intensive agriculture emerged, whether any less intensive forms of farming activities ever existed and how they were integrated with other subsistence practices.

1.2. Previous study about the origin of agriculture in China

In China, archaeological approaches such as archaeobotany, zooarchaeology, and isotope analysis have been mainly used to investigate the agricultural origin. These methods have been applied to determine when and where domesticated plants and animals first appeared, and their contribution to the human diet over time (Wu 2014; Liu and Chen 2012; Zhao 2011). The studies reveal that it took more than 3000 years from the earliest evidence of the exploitation of the domesticated crops to the full establishment of intensive agriculture in North China (Yang et al. 2012; Ma et al. 2016; Jin et al. 2016). Prior to the emergence of intensive agriculture, a mixed subsistence economy characterized by the intensive exploitation of diverse wild resources and small-scale farming was identified in multiple areas of North China (Wu 2014; Liu et al. 2014; Barton et al. 2009; Liu et al. 2015). The transition from hunting and gathering to agriculture was a gradual process, with farming not initially providing significant advantages over the foraging economy.



● : the studied area

Figure 1.1. The location of the studied area.
(Courtesy of National Platform for Common Geospatial Information Services)

Although much research has been dedicated to studying human diets during the transition to agriculture in North China, fewer studies have focused on how people were socially, technologically, and economically organized to obtain or produce their food resources. This gap has hindered our understanding of the complexity of subsistence practices during the transition to agriculture and failed to provide a sufficient explanation for why people in different regions developed divergent subsistence strategies.

Zhang emphasized that early forms of farming were only a part of the overall subsistence system. Without a comprehensive understanding of how this system operated within cultural contexts, we cannot fully explore the reasons behind the agricultural origins process (Zhang 2008).

From a cultural ecology perspective and through synthesis of published material across the monsoon climatic zone of China, Chen emphasized that the adoption of intensive agriculture represents a systemic-level subsistence transformation. Such an adoption requires not only access to domesticated plants, but also a mature set of knowledge, techniques, skills, and institutional organizations related to the management of farming production. These requirements take time to develop and evolve, and can vary based on the initial conditions of habitat, resource structure, and cultural organization of diverse hunter-gatherer societies (Chen and Yu 2017a, b; Chen 2004).

Based on surveys and excavations at various sites, including Dadiwan, throughout the western Loess Plateau and the margins of the northern deserts, Barton proposes a pattern of periodic intensification of low-ranked seed crops and low-level food production under resource stress. As wild resources recovered, people returned to mobile hunting and gathering, alternating between these two subsistence practices for thousands of years until the diffusion of intensive agriculture from the east led to full engagement in agriculture and sedentism (Barton 2009). This scenario suggests that the initial adoption of farming did not necessarily lead to irreversible intensification of agriculture. Instead, people traded off different subsistence strategies under specific conditions and shifted their practices accordingly.

Through a synthesis of settlement patterns, house structures, site locations, flora remains, lithic artifacts, and potteries from regional surveys and test excavations in Fuxin County, Shelach investigated the socioeconomic processes behind the transition from nomadic hunter-gatherers to sedentary agriculturalists in the West Liao River Valley of Northeast China (Shelach-Lavi et al. 2016; Shelach-Lavi et al. 2019). The research indicates that sedentism evolved sooner than the domestication of plants and might be an important driving force behind domestication (Shelach-Lavi et al. 2019).

Although none of these studies focused on the steppe zone, they provide insight into how to evaluate changes in

subsistence practices in the northern Yinshan Mountainous region under specific cultural and environmental contexts. They demonstrate the complexities of subsistence practices during the transition to agriculture and emphasize the need to investigate how the entire subsistence system operated of which embedded mechanisms either lead to intensive agriculture or other forms of subsistence practices. These studies suggest that to comprehensively understand the operation of the subsistence system, it is necessary not only to identify resources people consumed and their contributions to the human diet but also to combine multiple lines of evidence to understand the interplay among technological, economic, and social organizations relevant to subsistence practices.

1.3. Cultural ecology as the theoretical background to investigate the origin of agriculture

Whether agriculture emerged in a region, either from the local pre-existing foraging economy or was adopted from neighboring regions, depends on the interplay between culture and environment. Neither aspect alone is adequate for explaining agricultural origin (MacNeish 1992; Barlow 2002). The existence of certain cultural elements and their roles in generating subsistence changes are constrained by environmental factors. However, environmental factors only provide initial conditions for changes in any cultural system. They cannot fully explain the diversity of cultural development under similar environmental conditions (Chen 2013b; Osorio et al. 2017; Contreras 2016). Thus, a theoretical approach that integrates cultural and environmental factors is indispensable for understanding changes in subsistence practices.

Cultural ecology is a theoretical approach that studies the cultural means people use to adapt to their environment. These cultural means are commonly referred to as “adaptive strategies” (Sutton and Anderson 2009). This approach suggests that people’s selection of subsistence strategies is based on both local environmental constraints and their own cultural systems, including structural patterns of techniques, socio-economic organization, ideologies, and more, under the principles of evolutionary mechanisms. The specific interplay of cultural and environmental factors forms a particular pattern of the adaptive strategy, and changes in this interplay can drive changes in the adaptive strategy itself (Simmons 1997; Kelly 2013; Steward 1977).

Cultural ecology theory is crucial for our study because of two reasons. Firstly, it provides guidance on what aspects we should analyze to understand the operation of cultural systems and their interplay with specific environmental conditions in the Northern Yinshan Mountainous Region. Studies of hunter-gatherer groups have shown that subsistence, mobility, and social integration are three inter-related axes that drive human adaptive behaviors. The particular strategy people use to make use of resources across the landscape is determined by the combination of these axes under specific environmental

backgrounds (Kelly 2013; Binford 1978b, 1980; Steward 1938; MacNeish 1992). Therefore, developing analytical approaches to investigate subsistence, mobility, and social integration through the perspective of human-environment correlations is vital to understanding subsistence practices in this region.

Secondly, cultural ecology provides theoretical ideas for exploring the reasons behind people's subsistence choices. Due to the complexities of the interplay between environmental constraints and cultural systems, people usually have more than one potential strategy they can apply to adapt to the environment under specific conditions. The ultimate choice of a strategy is usually influenced by the principles of evolutionary mechanisms (Rindos 1984). For example, increasing reproductive success is an internal goal of survival, so subsistence strategies involving high risks for human survival tend to be less favored than safer or more flexible ones with lower risks (Winterhalder 1986; Winterhalder and Golang 1997; Codding et al. 2011). Additionally, maximizing the net acquisition rate of energy is essential for increasing reproductive fitness, so people tend to apply subsistence strategies that provide a better return rate. The relative benefits and costs of different subsistence strategies are important considerations for people's subsistence choices (Chen 2013b; Winterhalder and Kennett 2006). Since any specific form of subsistence practice identified from archaeological evidence can be conceived as material expressions of one of human subsistence choices, the principles of evolutionary mechanisms can be analyzed under specific cultural and environmental contexts to assist us in explaining: (1) why or why not people have developed or adopted intensive agriculture in the Northern Yinshan Mountainous Region; (2) why people choose alternative subsistence practice rather than intensive agriculture if no intensive agriculture was proved to be ever established here.

1.4. Land-use: a key for exploring human's subsistence strategy across the transition to agriculture

The study of human land use aims to investigate how people manage, modify, and adapt to resource environments. It seeks to identify conditions created by the interplay between cultural systems and environmental constraints (Ebert 2001). Land-use studies, guided by cultural ecology theory, offer an illuminating and practical approach to understanding how people adapted culturally to the Northern Yinshan Mountainous Region during the transition period from hunting-gathering to agriculture in North China. This approach helps us learn about subsistence, mobility, and social integration from the perspective of human-environment interplay.

The subsistence strategy is reflected in the specific ways of human land use. A comprehensive study of land use patterns can inform us about (1) the types of subsistence resources people utilize and their relative importance to the

entire subsistence system, (2) how people were distributed across the landscape to exploit or produce food resources, such as whether they settled down in one place and made intensive use of the surrounding area or wandered across a large territory and made extensive use of resources in different environmental zones, and (3) how people were socially organized to make use of the landscape of resources, such as whether they integrated into large communities or lived as small groups to procure or produce food resources and whether they were independently organized or bound by close ties of interdependence. The information from the aforementioned three perspectives respectively corresponds to subsistence, mobility, and social integration, which are three interrelated axes that form the pattern of the subsistence strategy. Land-use studies reveal the features of these aspects and examine them under the spatial background to see how they are integrated within the context of human-environment interrelationships.

A comprehensive investigation of changes in land-use patterns provides a clear framework for evaluating the development of intensive agriculture or alternative subsistence practices in the Northern Yinshan Mountainous Region during the transition to agriculture. Land-use patterns differ between full-time agriculturists, hunter-gatherers, and part-time horticulturalists (Sutton and Anderson 2009). Intensive agriculture has more constrained land use near settlements and can support larger population aggregation and stable sedentism. If intensive agriculture was practiced in this region, we would expect to find fully sedentary settlements on a larger scale, located near the most suitable farmland. Alternatively, if people relied more heavily on hunting and gathering, we would expect to find diverse settlement types, either used permanently as main camp sites or temporarily as seasonal sites, distributed across different landforms with varying artifact assemblages reflecting different activities or seasons. By analyzing archaeological evidence in relation to land-use patterns and subsistence practices, we can examine whether people developed intensive agriculture or shifted towards other subsistence strategies through time in the Northern Yinshan Mountainous Region.

The study of land use provides insights into how changes in cultural and environmental conditions impact people's strategies for using land and generate changes in subsistence practices. The analysis of land use is not a static picture of how people use resources but reveals the dynamic pattern of how subsistence, mobility, and social integration interact to form adaptive strategies (Munoz et al. 2014; Chen and Yu 2017a). These factors are subject to change based on ever-changing cultural and environmental conditions (Chen 2011; Chen 2004; Contreras 2016). A comprehensive investigation of land-use patterns provides clues to evaluate how specific cultural and environmental changes affect the interplay of subsistence, mobility, and social integration, revealing important mechanisms leading to changes in people's subsistence practices. Because of the importance of the land-use study in

exploring research questions, it is the focus of our study, and the following roadmap presents how this study's analysis of the Northern Yinshan Mountainous Region's land-use patterns is organized.

1.5. Reader's roadmap

Chapter 2 presents the geographic information of the study region, outlines the chronological scheme, and describes artifact features from the survey and excavation. Chapter 3 introduces detailed information on the two excavated sites, data collection methods used in the field, evaluation of possible biases, and lines of evidence and methodologies for analysis. Chapter 4 analyzes the land-use patterns of the Early Neolithic based on excavated data, while Chapter 5 covers such patterns from survey data. Chapter 6 focuses on the Mid-Late Neolithic/Early Bronze Age land-use pattern from survey data. Chapter 7 compares land-use between Early Neolithic and Mid-Late Neolithic/Early Bronze Age, summarizing changes in subsistence practices over time in the Northern Yinshan Mountainous Region. In Chapter 8, the author generalizes the land-use pattern and its corresponding subsistence strategies, explains how it differs from neighboring areas, illustrates how this case study contributes to the broader understanding of agriculture's origins, evaluates the complementarity of land-use studies with other research means, and considers future directions for improving our knowledge.

