A REGIONAL ARCHAEOLOGY OF THE GUAN RIVER VALLEY, HENAN, CHINA

by

Yanxi Wang

(Under the Direction of Stephen A. Kowalewski)

ABSTRACT

This study examines the history of settlement patterns, land use practices, sociopolitical structure, and the inter-regional integration in the Guan Valley, Henan, China from 4000 B.C. to the modern period (A.D.1911). The Guan Valley is an environmentally diverse region and culturally peripheral to three cultural core areas: the Central Plain, the Yangtze River region, and the Guanzhong Basin.

This regional full-coverage survey located 96 sites in 135 km^2 in the middle Guan Valley. The earliest occupation dated to the Middle Yangshao period (4000-3500 B.C.). In the Late Yangshao (3500-2900 B.C.), occupations increased rapidly and expanded to the upper reach and tributaries of the Guan River. After an occupational rock bottom during the early states period (1900-771 B.C.), occupations recovered rapidly and reached a new level of organization complexity in the Eastern Zhou (770-221 B.C.). This pattern continued into the Qinhan period (220 B.C.-A.D. 220), when hamlets increased in number and expanded into hilly areas. After Qinhan, settlements decreased in number and hierarchy simplified.

A Land use analysis explores several environmental conditions associated with settlement locations. Compared to historic occupations (after 1900 B.C.), prehistoric settlements were more affected by some environmental variables, for example, flood risks. In the historic period, there was a growing trend towards the exploitation of hilly areas.

Regional primacy characterized settlement systems of most periods. The formation and maintenance of the primate center went through several changes-ceremonial center during Late Yangshao, gateway community during Longshan (2900-1900 B.C.), and administrative center since the Eastern Zhou.

The changing function of the main central place was an adaptive response to inter-regional integration between the valley and the surrounding cultural core areas. The ceremonial focus of the Late Yangshao sociopolitical system of the Guan Valley was shared inter-regionally. In the Longshan period, the "Qujialing Invasion" intensified long-distance trade with the Yangtze River region. In the historic period, the valley was gradually integrated into states and empires through military, administrative, and economic measures.

The Guan Valley now provides a case study to comparing the developmental trajectories of culturally peripheral and environmentally diverse regions, enriching our understanding of processual complexity in Chinese civilization.

INDEX WORDS: Guan River valley; archaeological survey; regional archaeology; settlement patterns; land use; catchment; regional primacy; integration.

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DEDICATION

To my family.

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CHAPTER 1

INTRODUCTION

This work is a case study of the trajectory of social complexity in China. As one of the earliest sites of domestication alongside a continuous cultural tradition, China provides an ideal locus for the exploration of sociocultural evolutionary sequences over time (i.e. Chang 2004; Linduff et al. 2004; Liu and Chen 2012). However, many contemporary scholars argue that evolutionary sequences alone provide insufficient insight into the development of cultural diversity and the mechanisms of cultural change. In response, archaeologists of China and other regions of the world have begun to turn their analytical gaze toward understanding the diversity of sociocultural innovation and change. Nevertheless, the dynamics of long-term change at the "cultural periphery" of Chinese civilization remains understudied. Given the regional diversity and the diversity generated by shifting cores and peripheries, exactly where does the "cultural sequence" reside?

This study examines ecological, sociopolitical, and economic change in one such "cultural periphery," at the settlement-, regional-, macro- and inter-regional scales. The study will show that as settlement patterns and land use practices exhibit strong regional characteristics and vary from one period to another, internal structure of regional settlements and land use practices were related to the region's role in inter-regional interaction.

1.1 Sociocultural Evolutionary Sequence

The evolutionary history of human societies is one of the most long-standing topics of anthropological inquiry (e. g. Fried 1967; Harris 1968; Sahlins and Service 1960; Service 1975). Drawing upon cross-cultural similarities, evolutionary anthropologists aim to understand the determinants and mechanisms of cultural change—the laws behind human history (Carneiro 2003). Over the past decades, anthropologists have constructed various useful cultural evolutionary frameworks (e.g. Steward 1955; Sahlins and Service 1960; Fried 1967; Carneiro 2003, White 1949).

These stages identified in such frameworks allow researchers to consider societies longitudinally and compare societies of different spatiotemporal frames, a practice through which they can identify of cross-cultural similarities. Although evolutionary schemes vary from one another in typology, definition, determinants, mechanisms, and developmental paths, there are some generally agreed upon and empirically-verified sequences described in the literature (Carneiro 2003; Flannery 1995).

The first evolutionary stage is that of the small-scale society or band or egalitarian society, which is generally characterized by small group size, hunting and gathering subsistence practices, residential mobility, and family as organizing unit for most social activities (Fried 1967; Flannery 1995; Service 1975). The next stage after band is more controversial in naming and definition. Scholars have widely critiqued Service's (1975) formulation of tribe for its worldwide rarity (e.g. Fried 1967; Renfrew 1982). Fried (1967) proposed that tribes should be combined with bands into the broader egalitarian society category, which Johnson and Earle (1987) call "local group" and Flannery (1995) calls "autonomous village." Other than Service's (1975) framework, most schemes associate this stage with the "Neolithic Evolution," which features animal and plant domestication and sedentism and developed first around 7000 B.C. in Mesopotamia, 6000 B.C. in China, and 5000-3000 B.C. in Mexico and Peru (Flannery 1995; Liu and Chen 2012). Autonomous villages developed varied social institutions maintain egalitarian sociopolitical organization (Flannery 1995).

Middle-range societies, sometimes called ranked societies or chiefdoms, appeared soon after autonomous villages in some regions where sedentism and agriculture developed early such as Mesopotamia (5000 B.C.), Egypt (4000-3000 B.C.), China (3000-2500 B.C.), and Central America (1200-800 B.C.) (Flannery 1995; Liu and Chen 2012). Some anthropologists propose a transitional stage between egalitarian and ranked societies, which Service (1975) calls tribe and Johnson and Earle (1987) term “big man collectivity.” Others either lump this stage with autonomous village or with simple chiefdom. Rank was generally manifested by wealth differentiation and hereditary prestige. The archaeology of the American Southeast and ethnography of Pacific island societies shows that chiefdoms have different sociopolitical structures. Thus, researchers have found it useful to divide chiefdoms into simple and complex categories (Steponaitis 1978), or simple, compound, and consolidated (Carneiro 1992).

Archaic states arose in Mesopotamia, India, Egypt, and China from 3000-2000 B.C.. In Mexico and Peru, archaic states emerged by the end of the first millennium B.C., while in the North America and Pacific they were never formed (Flannery 1995; Liu and Chen 2012). Stratification (social hierarchy with more than two ranks) and bureaucracy distinguish archaic states society from the previous stage. Archaeologically, archaic states at least show four levels of settlement hierarchy: small villages, large villages, towns, and cities. Intense warfare, a common characteristic of archaic states, was a driving factor in their rise and fall (Marcus 1992;

Postgate 2004). By expansion and conquest, some archaic states gradually subsumed their neighbors and formed multicultural entities, or empires.

The Evolutionary Sequence of Chinese Civilization

As one of the earliest culturally-continuous centers of domestication centers in the world, China provides an ideal context from which to form and test evolutionary theories. A region of continuous cultural development and domestication, China's state, and later, empire formation occurred with few interventions from outside. These features allow anthropologists to identify the determinant factors behind cultural development beyond cultural diffusion. For example, Chang (1984) argues that rather than the developments of an exchange network or agriculture, politics was the prime mover of the major societal changes that formed Chinese civilization.

In fact, much of archaeological work in China has been and still is directed towards the understanding of evolution of Chinese civilization. Before 1990s, evolutionary scheme of Marxism school which was influenced by Morgan dominated archaeologists' interpretation of social organizations (Liu 2004). This Chinese version of Marxism evolutionary theory proposes that determinant, which is the means of production is the dominant factor in the sociocultural evolution. For example, Guo's (1976) summary of Chinese history is organized into primitive, slave, feudal, and capitalist developmental stages. According to formulation, the development of the means of production, especially the transformation from stone to metal tool technology corresponds to craft specialization and the development of agriculture. This division of labor drove wealth differentiation and social stratification.

Influenced by the Marxist framework, Chinese archaeologists adopted various terms to describe prehistoric cultural changes that could not be entirely explained by technology. Following the Engels-Morgan model, these scholars identified a progression from matrilineal/matriarchal to patrilineal/patriarchal clans, tribes, and tribal alliances (or military democratic societies) before the formation of the state (Guo 1976; Li 1984; Shi 1983; Tian 1987). This theoretical framework, however, has been contradicted by archaeological evidence. For example, the transition from matrilineal to patrilineal society in Neolithic China is vague. Recent osteological and mitochondrial DNA analysis on some Neolithic cemeteries do not support the previously proposed matrilineal burial pattern (Jilin University 2001; Wang 1987). Also, the role of bronze implementation in producing a slave-based society is similarly contradicted by archaeological evidence, since stone tool technology and slavery were concurrent until the Eastern Zhou period (Liu and Chen 2012;).

Inspired by Service's (1975) Neo-Evolutionary model, several Chinese archaeologists have taken up the band-tribe-chiefdom-state model (e.g. Chen 1998; Xie 1996), but others rejected it for its vague notions of determinant forces. Dissatisfied with Western concepts, some Chinese archaeologists have begun to search for new frameworks with indigenous characteristics. Su (1997) has proposed a progression that ranges from archaic town to archaic state, regional state, and empire (*gucheng, guguo, fangguo, diguo*). Su's (1997) archaic town is a type of social organization that separated from ordinary villages, starting around 6000 B.C.. The archaic state represents a stable and independent political entity similar to a city-state that transcends clan-based tribes. Longshan period (3000-2000 B.C.) occupations are emblematic of the archaic state category. The regional state is similar to the Western conception of state, which constitutes a more stratified society with a mature sociopolitical structure such as the "Three Dynasties" (2000-600 B.C.). The last stage in Su's progression (1991, 1997), empire, emerged when major regional states began to compete for political dominance.

Wang (1998), Zhang (2002), and Yan (1997) have also developed alternative evolutionary frameworks that integrate Su's model with Western formulations. Though they differ in specific terminology, all of these models include the stages of archaic state, dynastic state, and empire. They diverge from Su in that they rely more on Service's concept of chiefdom to define the social organization of the archaic state. Yet, like Su, their evolutionary sequences lack logical consistency and a cohesive theoretical framework, making their models little more than checklists of cultural traits (Liu 2004).

1.2 From Evolutionary Sequences to Evolutionary Processes

In light of these evolutionary models and their structural limitations, the question remains: do evolutionary sequences accurately characterize the history of world civilizations? Despite the critiques of sociocultural evolutionism that challenge the existence and validity of "cultural laws", proponents of evolutionary theories acknowledge that the development of social organization is not always simple and unidirectional (Carneiro 2003; Gluckman 1965; Johnson 2000; Leone 1972; Marcus and Flannery 1996; Rambo 1991). Archaeological and ethnographic evidence shows that evolutionary sequences can be interrupted, misplaced, or even reversed, even within one region. For example, Johnson (2000: 130) argues that societies can "return to simpler forms of society, like the Ancient Maya after the Classic Maya Collapse or the ancestral pueblos of Chaco Canyon." Gluckman (1965) argues that variations in social organization are more continuous than disruptive. After comparing three regions in Mesoamerica, Blanton et al. (1993:16) point out that,

> [C]ultural change is not always linear, unvarying or unidirectional. Instead, in specific cases it typically involves periods of rapid change followed by plateaus of relative stability, or even collapse and reorganization in new formats, perhaps followed by further periods of substantial change, and so on.

Another weakness of the evolutionary sequence approach is that, as pointed out by Trigger (1989:329), "there was more diversity in world cultures than could be accounted for general evolutionary schemes." In response to this critique, many anthropologists have become interested in the processes behind increasing social complexity and how those processes explain the development of cultural diversity (e.g. Brumfiel and Earle 1987; Marcus 1983; Flannery 1983, 1999; Renfrew 1982). As Yoffee (1979:26) summarizes,

> In studying sociocultural change we need an open network of methodological principles, the practical application of which remains extremely complex. The very act of categorization into stages has tended to make researchers ignore the necessity of exploring subsytemic variability within "stages" and similarities of sociocultural variability across states.

Cultural Change: Observing Scale, Integration, and Complexity

Other than relying on a pre-determined idea of how change occurs, how should we observe sociocultural evolution and compare societies? Blanton et al. (1993:16) propose that "cultural evolution can be defined as change in societal scale, integration, and complexity." As Feinman (2012) concludes, the study of the interplay of scale, complexity, and integration in different human groups allows us to understand divergent pathways of social complexity.

Scale not only refers to the spatial extent of a society, but its population size. Scale determines the intensity of face-to-face interactions within and between communities, which decides the development of strategies and organization to mitigate interaction and prevent fission (Blanton et al. 1993). Anthropologists have long studied the relationship between scale and organizational complexity (e.g. Blau 1968, 1970; Carneiro 1967, 2003; Feinman 2012; Fletcher 2007; Johnson 1982). Several comparative studies have demonstrated the thresholds of human population levels that associate with changes in organizational complexity (Feinman 2012: Table 2.2).

Integration refers to interdependence and interaction between social units and members. Blanton et al. (1993:20) write,

> In a society with little integration, the units constituting it (for example, households, villages, districts, and so forth) are highly self-sufficient. Higher levels of integration imply more connections among units. Depending on the kind of component units, the connections are established as flows of material, energy, information, or people.

Regional studies often display two mechanisms of integration—economic integration, which refers to the intensity of exchange activities, and political integration, which "refer[s] to the extent to which units are autonomous in power and decision making" (Blanton et al. 1993: 21). Within these two major processes of integration, there is great variation in the ways different societies have integrated economically and politically (Alder and Wilshusen 1990; Blanton et al. 1996; Feinman 1995, 2012; Johnson 1982). Integration and scale strongly correlates with each other. Several scholars have observed that as population and territory reach certain levels, new integrative measures or institutions tend to emerge to strengthen group solidarity (e.g. Alder 1989; Feinman and Neitzel 1984). Integration also correlates with complexity; a more complex society tends to develop more variation in its integrative practices.

Complexity includes horizontal and hierarchical differentiation among social units (Blanton et al. 1993). The horizontal differentiation can be as specific as the number of occupations and professions (Carneiro 2003) or different offices and institutions at the same administrative rank (Blanton et al. 1993). Hierarchical differentiation refers to the separation between ranks or "hierarchical governance with a degree in concentration in decision-making" (Feinman 2012: Table 2.1). Economic institutions can also develop a hierarchical structure that consists of different types of markets (Blanton et al. 1993). As discussed above, complexity is related to scale and integration.

The multifaceted relationship between scale, integration, and complexity provides an analytical framework to study and compare cultural changes across societies. But what is the appropriate scale to observe the interactions between these three factors? As demonstrated by many comparative studies, to investigate integration and complexity, one has to observe social interactions at scales above person-to-person contact. The state level is difficult to manage and contains too many variants. A region is the scale within which social interactions are most concentrated, and a transitional scale which organizational complexity of community level and inter-regional level can also be expressed (Blanton et al. 1993; Feinman 2012; Flannery 2009; Kowalewski 2008). Thus, the regional scale is the most appropriate spatial scale to start an investigation of the course of cultural change (Fish and Kowalewski 2009). A region can be a geographic unit, such a drainage basin, or behavioral region, such as a small kingdom (Kowalewski 2008).

Regional Diversity in the Development of Chinese Social Complexity

In China, interest in regional studies has increased in the last two decades. With the rapid increase of archaeological data, archaeologists have begun to reconstruct cultural histories for regions other than the centers of cultural development, or “Cultural Core Zones” in the words of K.C. Chang (1984). One of the milestones in Chinese archaeology is the framework of *quxi leixing*—a model for regional systems and local cultural series. Proposed by Su Bingqi (1991), this model emphasizes the independent development of and interaction between different regional cultural traditions. The *quxi leixing* model was intended to provide a methodological framework for the reconstruction of Chinese history as the dominant paradigm shifted away from the mono-centered model to a multi-centered model (Liu 2004).

These six *quxi*, or regions, include: 1) Northern China around the Yan Mountains and the Great Wall; 2) Eastern China centered in Shandong; 3) the Central Plain; 4) the Southeastern region around the Tai Lake; 5) the Middle Yangtze River region from Sichuan Basin to the Jianghan Plain; and 6) Southern China. Each of these six regions has rather independent developmental trajectories and has been divided further into many phases (Su 1991). Despite critiques of theoretical vagueness and inconsistency of application (e.g. An 1993), Su's model incorporates a regional focus seeking to reconstruct cultural histories across China. Over the past two decades, archaeologists have developed regional chronologies of material culture for all six regions outlined by Su (Liu 2004; Liu and Chen 2012; Von Faulkenhausen 1995; see Table 1.1).

Other than traditional cultural historic studies, regional full-coverage surveys have been a key in providing systematic data on long-term regional cultural change. Kowalewski (2008) reviews regional settlement pattern surveys around the world that indicate the magnitude of population transitions, land use strategies, craft production, market exchange, territories, administrative functions, inter-community relationships, political control, and other institutions crucial for understanding and comparing the development of social complexity. In China, mounting regional data led archaeologists to develop regional syntheses of cultural history and social development (i.e. Ren and Wu 2010; Liu and Chen 2012). Meanwhile, the regional settlement pattern survey method was introduced and became a standard field procedure (Chinese 2010; Shuo 2009).

There have been twenty-eight regional surveys conducted in China since the 1990s. Combined with excavation and reconnaissance survey data, regional full-coverage surveys have revealed both general sociocultural evolutionary sequences and understandings of regional diversity with a level of detail and accuracy surpassing earlier evolutionary stage-based models (Table 1.2).

Autonomous villages appeared in the Central Plain and Northern China as early as 7000-6000 B.C., accompanying millet domestication (e.g. Crawford 2006; Liu 2006; Liu and Chen 2012; Zhao 2004). Although foraging was still integral to subsistence practices, domesticated animals and plants were also an important part of subsistence packages at 6000 B.C. (Liu and Chen 2012: Figure 5.4). Northern China was inhabited by small villages of sedentary agriculturalists across a range of environmental settings (Linduff et al. 2004). At the Central Plain, subsistence and settlement systems were highly variable during this period known as Peiligang. Large, permanent villages tend to be located at river terraces, while small villages and seasonal campsites were located in the foothills and mountain bluffs (Han 2009; Liu et al. 2009). Reconnaissance surveys have found 35 sites in total dated to this period in Henan Province (National Bureau 1991). At a larger spatial scale, data from the Jiahu and Luoyang Basin suggest a two-tiered division of settlement sizes: <2 ha and 2-6 ha (Zhao 2001). Other than size, little evidence has supported the presence of settlement stratification during this time (Liu 2004).

Similar autonomous villages were also found along the Middle and Lower Yangtze River. More than 40 Pengtoushan and Chengbeixi settlements dating back to 7000-5500 B.C. have been identified in the Middle Yangtze River region. These settlements are the earliest sites of rice cultivation, some with designed rice paddy and irrigation systems (MacNeish et al. 1998; Pei 1998; Yuan 2002; Zhao 1998). Most of these sites were small. The average site size is around 0.8 ha, while two of the largest, Bashidang and Pengtoushan, were 3.7 ha and 3 ha, respectively (Guo 1992). Most of these sites are located on terraces, which are 1-2 m above the current floodplain or are along the foothills. By the end of this period, some sites relocated to higher elevations (Wang 1998). There are no indications of clustering or settlement hierarchy during this period.

In the Late Neolithic period (5000-3000 B.C.), farming became a steady source of food in Northern China, the Central Plain, and Yangtze River regions. Farming villages intensified their social, political, and economic interactions with each other. In the Central Plain, Liu and Chen (2012: 210) summarize the three "most important issues" of Yangshao period as: "(1) the emergent elite authority expressed in ritual power, (2) the formation of ideological systems on an interregional scale, and (3) population expansion as the result of the long development of sedentary agriculture." Yangshao ceramic styles appear to have influenced the surrounding cultures, such as Hongshan in the northern steppe and Dawenkou in the lower Yellow River region (Liu and Chen 2012). Archaeological surveys in both the Central Plain and Northern China reveal evidence of increasing settlement nucleation, centralization, hierarchization, and social integration (i.e. Linduff et al. 2004; Liu et al. 2004). In Northern China, archaeologists have identified a high degree of sociopolitical centralization achieved by ritualistic practices (Drennan and Dai 2010; Linduff et al. 2004).

In general, settlements increased in number dramatically (surveys have identified more than 1000), while the size of those settlements varied widely. With the appearance of supra-village and rammed-earth walled settlements, an inter-regional three-level settlement hierarchy was found from the Central Plain to Guanzhong Basin (small: <9 ha; medium: 20-29 ha; large: 30-49 ha; supra: >50 ha) (Gong 2003; Xu 2001, 2002). This inter-regional settlement system contains many subsystems, with varying spatial coverage and clustering pattern. For example, Liu et al. (2004) divided Yangshao settlements in Yiluo Basin into three tiers (small: <2 ha;

middle: 2-10 ha; large: >10 ha). The Yiluo survey indicates that the average site population increased from 50 to 164 people per site by the end of Yangshao period (Qiao 2010).

The same increase in number and size of occupations was also seen in the Yangtze River regions (Guo 1992; Wang 1998; Zhang 2003). A three-level settlement hierarchy may have been established in some areas, but the evidence is not clear. Guo (1992) and Pei (2004) estimate that the population of the Daxi settlements was 254 people per site, an estimate much higher than contemporaneous sites in the Central Plain.

During 3500 -2600 B.C., the Yangtze River cultural system expanded northward into the Central Plain (Zhang 2003). Some scholars suggest that the expansion coincided with an increasingly warm and humid climate in the north (Guo 2004; Yan 2003; Wang 1998). Intensive rice cultivation diffused throughout the Yangtze tributaries in all directions at this time (Hou et al. 2010; Wang 1998). Site numbers increased to more than a thousand and formed more complex patterns than in other regions (Liu and Chen 2012). A three-level hierarchy was established in most clusters (small: <1 ha, medium: 1-10 ha; large: >10 ha) (Zhang 2003). Guo (1992) estimates that the population at this time was 716 people per site on average.

During the Epi-Neolithic period (3000-1900 B.C.), also called the Longshan period, archaeological records show intensified agriculture, high population densities, and increasingly complex societies in the Central Plain, Eastern China, and the Yangtze River regions. Most societies with high population levels were hierarchically organized, had well-established exchange networks, and engaged in intense inter-group warfare. Societies were stratified by political, economic, and ceremonial organizations. Thus, many archaeologists describe the sociopolitical structure of this period as chiefdoms (Drennan and Dai 2010; Liu 2004, 2012; Underhill 2008).

Surveys from Yuanqu, Zhouyuan, and Huangtucheng all show that the number of settlements increased substantially during this period (Drennan and Dai 2010; Ren 2008; Zhouyuan Archaeological Team 2005). In fact, there are more than three thousands sites dated to this period at the Central Plain and neighboring regions. Liu (2004) studies 17 settlement clusters in the Central Plain, which she/he classifies into four size-based categories (Small: < 20 ha; Medium: 20-69; Large: 70-199 ha; Supra: 200-300 ha).

Social structure became increasingly stratified in the Yangtze River region during the Epi-Neolithic period, or Shijiahe period. Ceremonial practices became increasingly complex and people constructed enormous earthworks that appear to have been related to flood control (Wang 2003; Liu and Chen 2012). Settlement hierarchy and spatial expansion reached their peaks during this period. The site count reached 3000, more than all the previous sites in this region combined. Larger sites grew faster than the smaller sites and settlement differentiation became more significant (Zhang 2003). The largest site, Shijiahe, reached 120 ha, and surrounded by more than 40 sites in an area of 8 sq. km, formed a central place of a four-tier settlement system (supra center: 120 ha; secondary walled settlements: 50-100 ha, tertiary settlements: 10-20 ha, quaternary settlements: 1-10 ha) (Shijiahe Archaeological Team 1993). Archaeologists consider this complex settlement system a proto-state or paramount chiefdom (Huang 2010; Zhang 2003). Other than the Shijiahe settlement system, a stable three-tier settlement hierarchy has also been found in other areas of the Jianghan Plain and Northern China, some of which were under the control of Shijiahe.

In contrast to the widespread collapse of settlement systems in Eastern China, Northern China, and the Yangtze River regions, the early states of Erlitou, Yinxu, and Western Zhou were formed successively from 2000/1900 B.C.-771 B.C. in the Central Plain, marking a new scale of integration (Liu 2004). Agriculture formed the foundation of the state economy through tax and levee systems and administrative bureaucracies (Zhao 2005). Multi-cropping and irrigation greatly increased agricultural efficiency and productivity. Most regional settlement systems were incorporated into the state and developed as the state power rise and fall (Liu 2004). The Luoyang, Yiluo, and Zhouyuan surveys all identified a four-level settlement hierarchy in the core areas of the states, with capitals expanded from villages or medium settlements to more than 300 ha each in a short time span (IACASS 2005; Liu 1996; Zhouyuan Archaeological Team 2005).

In regions removed from the capitals, a three-tier hierarchy system remained, but the largest sites, which may have functioned as secondary or tertiary state centers of state, declined in size (Drennan and Dai 2010; Ren 2008). These regional centers may have functioned to control strategic and exotic resources for states. Territorial expansion coincided with political localization, producing a multi-centered political landscape during this period. During the peak of state power, the Shang dynasty controlled the Yantgze River region (Liu 2004). In Northern China, this period was characterized by population replacement and a transition from agriculture to pastoralism. The region maintained a low occupation density and was gradually marginalized in the historic period (Linduff et al. 2004; Shelach 1999).

1.3 Insufficient Coverage in Regional Settlement Pattern Surveys: What Don't We Know?

Regional settlement pattern surveys have revealed both evolutionary sequences and regional diversity in some of parts of the "Cultural Core Zones," or *quxi* (regions), especially the Central Plain, Yangtze River regions, Northern China, and Eastern China. This focus is encouraged by Su's (1991) model of the multi-centered formation of Chinese civilization that discussed earlier. Yet there are several insufficiencies in topical and spatial coverage of these regional surveys.

As much as this model illuminates the history of several core zones, it insufficiently accounts for what happened on the cultural peripheries, where inter-regional integration may have played a more significant role in shaping history. As noted above, the core zones were cultural peripheries during some periods. For example, during the Early State period, the Yangtze River regions, the Eastern China and Northern China were peripheral to the state system centered at the Central Plain. Similarly, cultural peripheries may have functioned as core zones or were more active in inter-regional integration during some periods than others.

As pointed out by Balkansky (2006), region-centered paradigm is incomplete to explain cultural changes at periphery. However, the history of non-core regions relies heavily on cultural diffusion models by using cultural history to investigate the time and intensity of cultural diffusion from, of course, the core zones. Chinese archaeologists have frequently used core/periphery models to explain the cultural historic political-economic interactions between core and peripheral areas (Chase-Dunn and Hall 1991, 1997; Peregrine 1996). In such studies, peripheral areas' cultural histories have been understood principally through their connections with core regions. Similarly, the sociopolitical trajectories of peripheries have been subjected to changes in core region as well. .

In addition to the insufficient focus on the development of cultural peripheries, there has also been a lack of attention to on the diversities of land use strategies designed to cope with various ecological challenges. Though China was one of the earliest agricultural civilizations, scholars have under-appreciated the range of agricultural adaptations to the tremendous ecological diversity. Most regional cull-coverage surveys concentrate on broad alluvial plains that facilitate agricultural intensification and population centralization. Of 14 regional surveys with published reports, more than half focus on these alluvial environments (Table 1.1). Upland and piedmont areas have rarely been surveyed systematically and, in some cases, have been ignored intentionally. As a consequence, archaeologists have little knowledge of how agricultural intensification proceeded in non-alluvial environments.

The final drawback of Su's evolutionary model is a historic discontinuity produced by a lack of attention to historic settlement patterns. Some surveys chose not to record historic settlements dated to after 600 B.C., while other surveys record them, but choose not to discuss their patterns in full detail. This discontinuity in the reconstruction of past corresponds to the scholarly break between prehistoric and historic archaeology in China (discussed in Von Faulkenhausen 1993). However, historic archaeology provides important insights into the transition from states to expansionist empires. As is widely recorded, this transition produces a new level of organizational complexity that is crucial to a holistic understanding of sociocultural evolution.

1.4 The Research Framework

This project is designed to address the insufficiencies outlined above and examine the sociocultural evolutionary trajectory of an ecologically diverse and culturally peripheral region from its early stages as a collection of autonomous villages to the age of empires. Following Blanton et al. (1993), I approach the evolutionary trajectory by examining the interplay of scale, integration, and complexity. This research is guided by three questions:

1. How did regional settlement patterns change in a culturally peripheral and environmentally diverse region?

2. How did farmers cope with ecological diversity? Specifically, how did land use practices vary and change within an environmentally diverse region?
3. What kind of integration mechanisms (political, economic, both, or others) influenced occupation and land use history? And how did these mechanisms promote sociocultural evolution from a village-based society to part of imperial society?

To answer these questions, I conducted a regional full-coverage survey in the drainage basin of the Guan River valley in southwestern Henan, China. This region features great environmental diversity, cultural marginality, and a historic continuum, features that are necessary to answer the proposed research questions. The Guan River valley is comprised of mountains, eroded terraces, and alluvial plains. The topographic and landform variations of the region are distinct from those areas documented by other surveys, and reflected by uneven modern population distribution and diversity in modern economic structure. To address the question of mountain occupation pattern, a montane site (Xiaoshui) identified in previous reconnaissance survey ensures that the regional full-coverage survey could reveal the full range of occupation patterns and land-use practices including both mountains and alluvial plains.

Located at the intersection of three Cultural Core Zones--the Central Plain, the Guanzhong Basin, and the Yangtze River regions (specifically the Jianghan Plain)—the region has been subjected to cultural integration from all three zones since prehistoric period. On the other hand, the geophysical segregation prevents the valley from direct political control of the core zones, which also provides a degree of flexibility and independence to the local cultural systems. This cultural marginality is also indicated by studies on regional material cultures, which reflect characteristics of core zones as well as regional features (Fan 1997, 2000).

The regional full-coverage survey provides a substantial amount of data to address the proposed questions. The regional settlement patterns outline change and continuity in the amount, spatial distribution, and organization of human occupations across nine periods from the Middle Yangshao period around 4000 B.C., when autonomous villages first appeared in the valley, to the Post-Tangsong period characterized by the rise and fall of empires. Settlement patterns also lead to reconstruction of regional demographic history, which allows comparison across ecological niches and periods in the region as well as comparisons with other regions.

Land use practice, which illustrates adaptive variations to diverse ecological and cultural conditions, is reflected by the interactive relationship between human settlements and environment. To observe land use changes in the valley, I apply ecodynamic modeling to evaluate and compare environmental conditions of each settlement in each period. These environmental conditions include agricultural catchment, slope, distance to waterways, landform, soil, flow accumulation, and aspect, which are essential to modern farming practices in the study area. In prehistoric and historic periods, environmental conditions varied from one settlement to another and from one period to another.

The variation among forms of regional integration is demonstrated by a period-to-period investigation of integration strategies. The formation and maintenance regional system were achieved through different integrative mechanisms—political, economic, religious, military, administrative—that varied from one period to another. Over time more and more cultural institutions appeared that facilitated the progressive integration of autonomous communities into regional, state, and imperial sociopolitical formations.

From the analysis of regional sociopolitical integration, I proceed to an inter-regional network analysis which shows that the loss of regional autonomy and increasing integration into a larger system was not a passive process. The region played an active role in the development of an inter-regional economic network through its flexible integrative strategies. The region's participation in inter-regional interactions drove the reconfiguration of regional settlement patterns, land use practices, and regional integration, which contributed to the increasing complexity that characterized the evolution from an autonomous village society to an imperial society.

The study on the Guan Valley illustrates that the history of human occupation was not spatially homogeneous or temporally continuous. The variability in land use practices and integrative processes has been the defining element in the development of occupation history at the valley. As proposed by Feinman and Nicholas (1990: 241-242), "small and agriculturally marginal areas must be studies in their own right to be understood, and by so doing, new questions will be generated about the areas that they adjoin." The study on the history of Guan Valley, a cultural peripheral region, develops new understanding on inter-regional interactions that leads to the formation of Chinese civilization.

Table 1.1 Regional cultural history of China.

Dates	Periods	Guan River	Middle Yellow River Central Plain	Middle Yellow River Guanzhong Basin	Lower Yellow River Shandong	Middle Yangtze River Jianghan Plain	Lower Yangtze River Jiangsu & Anhui	Northeast China Chifeng
206 B. C.	Han Dynasty	Han	Han	Han	Han	Han	Han	Han
221 B. C.	Qin Dynasty	Qin	Qin	Qin	Qin	Qin	Qin	Qin
770 B. C.	Eastern Zhou	Qin & Chu	Han	Jin	Qin	Chu	Chu	Yan
1046 B. C.	Western Zhou	Zhou	Zhou	Zhou	Zhou	Zhou	Zhou	Upper Xiajiadian
1600 B.C.	Shang Dynasty	Shang	Erligang & Yinxu	Erligang & Yinxu	Shang	Shang	Shang	?
1900 B. C.	Erlitou	Erlitou	Erlitou & Xiaqiyuan	Erlitou	Yueshi & Longshan	Erlitou	Maqiao	Lower Xiajiadian(2200-1600)
3000 B. C.	Epi-Neolithic	Shijiahe, Longshan & Kexingzhuang	Late Longshan	Keshengzhuang II	Late Dawenkou & Longshan	Shijiahe	Liangzhu	Xiaoheyan
3500 B.C.	Late Late Neolithic	Qujialing	Early Longshan	Keshengzhuang	Dawenkou	Qujialing	Beiyinyangying	Hongshan(4500-3000)
5000 B.C.	Early Late Neolithic	Yangshao	Yangshao	Yangshao	Beixin	Daxi	Hemudu	Zhaobaogou(5000-4500)
7000/6000 B.C.	Middle Neolithic	Peiligang	Peiligang	Laoguantai	Houli	Pengtoushan & Chengbeixi		Xinglongwa(6000-5000)
10, 000 B.C.	Early Neolithic							

Table 1.2 Regional development trajectories in China.

Period	Agriculture	Sociopolitical Structure	Settlement	Regional Settlement Pattern	Settlement Hierarchy	Max. Site	People /Site
Eastern Zhou	Multi-cropping; iron tools; large-scale irrigation	Regional states	Increasing well-designed multi-function cities; urbanization	Delineation of clusters decreased; small settlements disperse.	3-tier		
Western Zhou	Metal tools replacing stone tools for agriculture; irrigation	Central state with larger territory and the rise of regional power: social differentiation increases	Large elite structures and royal cemeteries; residential division in capitals.	Large clusters; dispersed within clusters	3-tier	>3000 ha	
Erlitou to Yinxu	Flood prevention and irrigation system; calendar; discription of climate	State with capitals and secondary centers: increase social differentiation; rise and fall of state control	Capital city with palaces, craft specialization zones, etc.	Nucleation around state capitals or disperse, some in special locations	4-tier:one capital	300 ha	200
Epi-Neolithic	Increasing domestic species; wheat appeared	Middle-range societies: social differentiation; intensified warfare and interaction	More walled towns, some with ditch; wide ditch in the Yangtze River region	Filling landscape of terraces, plains, and inland	3 to 4-tier: walled towns as centers	120 ha	>100
Late Neolithic	More intensified agriculture of millet and rice; more domesticated species	Supra-village structure: stronger integration	Walled settlement appeared, some with ditches.	Nucleated; delineated; distributed more widely	3-tier:<2ha;2-10ha;>10ha		100
Middle Neolithic	Mixed agriculture and foraging	Appearance of supra-regional cultural system; mostly small villages	Village with planned domestic and public area, storage pits, and trenches surrounded the village	River terraces, foothills, bluffs	2-tier in some region: <2ha or 2-6ha	30 ha	20-40

Table 1.3 Regional surveys in China.

NO	Name or Location of Project(s)	Area (km²)	Year of project (s)	Dates	Landscape	Elevation(m)	Precipitation(mm/yr)	Research Goal
	Guan Valley	135	2012	4000 BC-1911 AD	Mountains, hills, eroded terraces,	220-500	830	Economic complexity
1	Shijiahe	8	1990, 1991	Neolithic	Plain	20-40	1000	Settlement pattern of Shijiahe polity
2	Hulu River Basin	>1000	1990	6000-220 BC	River valley	1200-1400	574	Environmental transformation; sites distribution and function
3	Rizhao	1000	1995-2000, 2003-2008	2600 BC-200AD	Coastal basins to piedmont	0-130	813	Regional social development in Eastern China
4	Huanhe River Valley	800	1997-1998	5000-1200BC	Alluvial plain	70-100	600	Shang settlement pattern
5	Huangtucheng	209	2006-2007	5000BC-200AD	Plain	27-32	950	Core/periphery interaction, regional social development
6	Chifeng Yingjinhe River Valley	1234	1999-2001; 2006-2007	6000BC-1100AD	Valley floor and uplands	600-1300	320-400	Social development in non-core area; agriculture-pastoralism
7	Banzhijian River Valley	221	1996-1999	Before 221 BC	Small hills	700-1000	320-400	Site distribution and preservation
8	Yuncheng Basin	1500	2003-2006	5000BC-1500BC	Plain	300-500	525	Early development of social complexity
9	Yiluohe River Valley	124	1998-2000	6500-221 BC	Alluvial basin	120	635	State formation
10	Chengdu Plain	153	2005-2011			500?	918	
11	Zhouyuan Qixinghe River Valley	240	2002	5000-1200BC	Loess ridges and river terraces	550-700	592	Fromation of the Western Zhou
12	Ma'anshan Caishihe River	74	2006-2007	3000BC-1800 AD	Valley floor and piedmont	0-50	1080	Local development
13	Daiha		2002, 2004			1200-1400	350-450	Method comparison; social development
14	Luoyang Basin	638	2001-2003	6500-221 BC	Alluvial basin	630	110-150	State formation and early social development

CHAPTER 2

THE STUDY AREA—THE GUAN RIVER VALLEY

The study area, the Guan River valley, provides ideal conditions for the study of human adaptation to environmental patchiness and cultural marginality. The geomorphology of this region, which encompasses mountains, hills, eroded terraces, and alluvial plains, has posed obstacles for farming communities who have occupied this region since the Middle Holocene. Although adjacent in Euclidian distance to two major "Cultural Core Zones" of Chinese civilization (the Central Plain and Guanzhong Basin), the valley has been isolated by the Qinling Mountain Range.

Despite such isolation, the environmental patchiness has provided local occupants with great opportunities to explore a variety of land-use practices and economic strategies. To this day, modern economic practices are more adaptable and flexible than neighboring regions. Also, despite the geographic impediments of the Qinling Mountain Range, the valley is located near several historically important passages that connect North and South China as well as three "Cultural Core Zones." This strategic location suggests that the region would have been sensitive to inter-regional processes.

In addition to these preconditions, the Guan Valley was chosen as the study area for additional reasons. As part of the macroregion, the Guan Valley suffered less from the detrimental flood in 2010, which deposited meters of flood sediments on most of known sites in the Dan River valley and the Lower Guan River valley. Also, the Guan Valley has been relatively understudied and is endangered. From my visit to the valley in 2011, modern cities expand rapidly thus we may lose archaeological survey conditions in the near future. Last but not least, local villages and governments are very friendly and supportive, which left us no trouble but a very pleasant field experience.

2.1 The Qinling Mountain Range

As part of the Qinling geological and ecological system, the Guan River valley is located at the southeastern piedmont of Qinling Mountain Range. The Qinling Mountain Range is one of the most important geographic and cultural boundaries in China and strongly shaped the human occupation history of the Guan River valley.

The Qinling Mountain Range belongs to the Qinling orogenic belt, separating the North China Block and the Yangtze Block (Mattauer et al. 1985). It provides a natural boundary between North and South China and supports a huge variety of plant and wildlife (Figure 2.2). The mountain range extends more than 1,600 km from west to the east, and 200-300 km from north to south. The northern slopes are cut by many faults and are generally steeper. The southern slopes are gentler, crossed by west-eastward fault belts and fold-fault belts. The Eastern Qinling Mountains are comprised of Xiao Mountain, Xiong'er-Song Mountain, and Funiu Mountain, arrayed from north to south. The highest peak is around 2,300 m in elevation.

The Qinling Mountains also form the watershed between the Yellow River basin to the north, and the Yangtze River basin in the south. The Yellow River basin was historically home to temperate, semi-arid deciduous broadleaf forests. The Yangtze River basin, with milder winters and monsoons in spring and summer, contained semi-tropical, evergreen broadleaf forests. To the east of the Qinling Mountains is the Lower Yellow River alluvial plain, extending to the east coastline, which was historically and remains the most populated and agriculturally productive land in China.

As many mountains of the chain are 2,000-3,000 m in elevation, the Qinling Mountains have long posed a natural barrier for traffic between North and South China, especially traffic between the Yangtze River Valley and the Guanzhong Basin. Only a few accessible passages or bypasses connect these regions separated by mountains. The natural separation has contributed to the formation of distinct "Cultural Core Zones" throughout the history of Chinese civilization. The passages and bypasses, nevertheless, were important for military defense and inter-regional communication over millennia.

2.2 The Guan River System

The Guan River, which translates to "the river of storks," is 251 km long and falls 1,340 m from its origin in the Qinling Mountains to its lower stream. The headwater of the Guan River is located at Funiu Mountain, the largest mountain at the Eastern Qinling Mountains, which is also the natural dividing crest of the Huai River and Han River watersheds. The upper stream, which is to the north of the confluence of the Shewei River and Guan River, flows eastward through a highly elevated mountainous region, creating small river terraces along the river.

After the Shewei River joins from the east, the middle reach of the Guan River redirects to the south, cutting through the southeast edge of Qinling Mountains. Several dams were built here to harness the power of the natural descent of the river. As a result, the river level has risen and covers previously-formed alluvial plains. The hilly landscape, though still dominates, retreating gradually in the Middle Guan River valley, where the Shangdan fold-fault belt provides a 33% decrease in gradient. The elevation drops and large alluvial plains form on both sides of the Guan River as wide as 2 km.

After the Ding River joins from the west, the Guan River valley is bounded by mountains again for about 10 km. When the Tao River joins the Guan River from the west and forms the lower reach, the valley floor expands, creating broad floodplains along the rivers. The Guan River joins the Dan River, another watercourse flowing through the Qinling Mountains, and finally runs into the Han River, the largest tributary of the Yangtze River system. All the tributaries of the Guan River spring from the mountains.

2.3 The Study Area

The survey area covers approximately 125-135 km^2 (Figure 2.1) of the middle Guan River valley, connecting the narrow river valley in the upper stream and the broader valley floor in the fold-fault belt. The village of Xiaoshui by the side of the Shewei River where a known site, Xiaoshui, is located forms the northern boundary of the survey area. The inclusion of the Xiaoshui site was intended to ensure the inclusion of mountainous settlements. The Guzhuang River, a tributary of the Guan River that flows from northeast to southwest and joins the Guan River near the city of Xixia, forms the east and southeast boundary of the survey area. The southwest boundary is the Ding River, also a tributary that originates from the mountains to the west. The western boundary is a north-southward irrigation canal that joins the Ding River from the west. The name of the canal varies between villages and there is no known record of its historical name or who constructed it.

Although there are medium-to-high mountains in the survey area, the team only surveyed the areas below 550 m in elevation. Mountains above that elevation are mostly uninhabited and covered by deciduous forests today. The visibility is low at high elevations and they can be unsafe to travel by foot. However, in order to understand the mountainous occupation patterns, subsistence economy, and land use, the team surveyed some low-medium elevation mountains to the north of the fold-fault belt, east of the Guan Valley. This mountain, known as Tiandiling

("Mountain of Heaven and Earth"), has been developed for tourism. The team followed the main roads across this mountain and surveyed open lands along the road.

In addition to the geophysical distinctiveness of Guan River valley in the Qinling Mountain Range, the study area also exhibits a plethora of geophysical characteristics created by mountain and fluvial systems. These characteristics have contributed to a diversity of human adaptations distinct from neighboring farming centers. In the following section, I will introduce the geophysical setting as well as the modern demography and economy of the study area. This information will provide important insights into the ancient occupation and land use patterns. Most of the information here is taken from local reports written between 1986 and 2000 (Xixia 2010).

Terrain and Land Cover

Terrain and landform are some of the most significant influences on the occupation and economy of the study area. According to the 1993 agricultural resource survey, there are four main types of terrain in Xixia: medium-to-high mountains (57.3%), low mountains (28.1%), hills and valleys (11.4%), and alluvial basin (3.2%). Table 2.5 shows the geophysical features of these four terrains. The study area covers all four terrains, but focuses primarily on eroded terraces (c.a. 60%), alluvial basin (c.a. 30%), and hills and low mountains (c.a. 10%).

The alluvial basin is distributed along the Guan River and the tributaries. As most alluvial basins in this region are small and bounded by mountains, the largest alluvial basin is to the east of the Guan River near the modern-day city of Xixia. It extends to 2-3 km in the Shangnan fold-fault belt, where decreased elevation encourages the formation of an alluvial basin. This is also the most populated zone in the study area today.

The eroded terraces and valleys, which are a part of the Shangnan fold-fault belt, characterize more than half of the survey area. Erosion is the dominate factor in carving the geomorphic forms with drainage flows more or less perpendicular to northern mountains, creating north-southward lineal valleys that sometimes extend more than 3 km. The eroded terraces accompany branching on both sides, exhibiting a tree-like pattern. The valley bottom varies in width, bounded by benches and ridges on both sides (Meng and Zhang 2000; Wang et al. 2003). Pei and Song's (2006) geological survey also reveals that, the folded bedrocks encourage the formation of 2-3-km-wide terraces as the 3rd-level terrace of the Guan River fluvial system, located to the west of the alluvial basin near the modern-day city.

Although the study area is mostly covered by different kinds of agricultural crops, only less than 12% of lands are used for farming in Xixia today. 75.8% of the land is wooded, which is 17 times higher than the average woodland ratio in the Henan province. Most woodlands are found in the mountainous area, though it is also found in eroded terraces and valleys, where farming conditions are not ideal. For example, since hill ridges are mostly narrow and eroded more easily, some ridges are covered by fruit trees or other woods instead of farmlands, which shows low visibility for surveyors.

Climate

Since the Guan River valley is located at the eastern edge of the Qinling transitional geographic zone, it is warmer and more humid than the western areas of the mountain range. With sub-tropical monsoon-continental climate, the region has four distinctive seasons. In general, the climate is favored by farmers and herders today. In the fall and winter, the northwest wind is weakened by the mountains, keeping the average temperature at 15.2°C, and the annual precipitation at about 830 mm.

However, elevation plays an important role in local climate variability. Table 2.1 shows the difference in average temperature, precipitation and length of frost-free days of four administrative counties in the study area (Table 2.1). The lapse rate of temperature and precipitation is about 0.45°C drop and 25 mm increase for every 100 m increase in elevation (Table 2.2). Temperature inversion also occurs in some mountains and valleys between 200-600 m in elevation. In addition, climate fluctuates between years (i.e. the precipitation reaches 1058.2 mm in 2000; Table 2.3). In 2010, the precipitation exceeded 228 mm in three days and caused massive flooding on the alluvial plain. Other extreme climate events, including heavy rain and hail also occur regularly, which cause serious loss in property and lives, especially to farmers (Table 2.4).

Although the intra-regional climatic difference is not strong, the combination of climatic variation, elevation variation, and the land's slope creates significant variability in the conditions that strongly influence farmers' land use strategies.

Modern Population and Economics

The environmental patchiness contributes to an uneven distribution of population and considerable economic variation. According to the demographic survey in 2000, the population of Xixia is about 430,000. The population density decreases as elevation increases. City aside, the lowest elevated county, Danshui, has a population density 9.4 times higher than the highest elevated county, Taipingzhen, which has a density of 32.3 people/sq. km. In general, eight counties in the southern lower regions have an average density of 202 people/km^2, while 10 counties in the northern mountains contain only 66 people/sq. km.

Today the local economy is characterized by an imbalance between the agricultural population and agricultural economy. The majority of the population continues to work in agriculture, despite a minor drop of the agrarian population from 92.2% in 1986 to 88% in 2000. The most commonly cultivated food crops are wheat (48%), maize (30%), rice (6%) and sweet potatoes (10%), a portfolio typical of the southern Henan Province. Lentils comprise 4-5% of crop cultivation. According to local farmers, rice cultivation, which was much more widespread and the major economic component in the alluvial basin during the early half of the twentieth century, has decreased rapidly in recent decades due to its high labor input and low economic value (Table 2.6).

Instead of traditional cereal crops, cash crops are main income source for farmers in Xixia. In the mid-1990s, the local government launched a new economic plan focusing on the exploitation of mountain resources. Kiwifruit, shiitake mushroom, and *fructus corni* (a medical plant) became the center of economic growth, all well-suited to the mountain climate. In less than 10 years, the extent of kiwifruit plantations ranks the second largest in country. Xixia also produces 1/10 of country's shiitake mushroom and 2/3 of *fructus corni*. Thanks to the diversity of mountane herbal species, Xixia is also one of the major providers of herbal medicines in China. Despite its isolated location, the county of Shuanglong in the northern mountains is the largest shiitake mushroom market in the country. Other than farming, logging, livestock rearing, and fishing are also important in agricultural economy.

Other than cash crops, the mining industry was and still is another important economic component. Mostly distributed in the mountains, these resources include marble and granite, gold, graphite, etc. Mining has also posed challenges for local farmers. Mining has not only polluted the water, but has also diminished an already limited supply of farmland. This conflict between mining and agriculture was confirmed by many informants during the survey.

Paleoclimate and Paleoenvironment of the Guan Valley

A general review of paleoclimate records can provide some insight into humans' adaptation to climate change in the Guan Valley. However, as pointed out by Liu and Chen (2012), the climatic fluctuations recorded across China vary considerably in temporal dimension, spatial coverage, and strength. This variation has caused enormous frustration for scholars attempting to comprehend the relationship between environmental change and cultural transformation.

Nevertheless, some climatic events appear to have larger effects and coverage correlating to socio-cultural transformations in the Guan Valley. For example, the cooling/drying interval at 3200-3000 B.C. coincided with highly-ritualized Hongshan societies in the north China and the development and decline of Yangshao culture in the Central Plain. As discussed further in Chapter 5, this event also coincided with a rapid population increase in the Guan Valley.

Another influential climate event was the weakening of the monsoon system around 2000 B.C., causing a series of droughts in western and northeastern China and flooding in Central China and the Yangtze River region. This event coincides with the fall of Shijiahe and Liangzhu societies along the Yangtze River, the fall of Longshan societies in the Central Plain, and the transition from agriculture to agropastoralism in western and northern China (Xixia 2012: 37-39). The settlement pattern of the Guan Valley also shows a dramatic occupation decrease during this period.

2.4 Archaeology of the Study Area

In previous section, I described how the environmental patchiness of the Guan Valley poses a variety of challenges and leads to uneven population distribution and economic development in the present. In addition to environmental patchiness, the marginality of the Guan

Valley in the cultural landscape of ancient China has been another influential factor in the history of the Guan Valley. This cultural history is also fundamental to the construction of a relative chronology of the Guan Valley, which will serve the basis of the regional settlement pattern analysis.

Located at the intersection of three “Cultural Core Zones,”--the Central Plain, the Guanzhong Basin and the Jianghan Plain--the valley has been continuously subjected to intercultural contact (Table 2.7). The regional material culture in nearby areas shows a continuous balancing between local tradition and the introduction of cultural institutions from the outside (Fan 1997, 2000; see also Table 2.7). On the other hand, the geophysical segregation of the valley protected it from direct political control by the core zones and provided the local cultural systems with a degree of flexibility and independence.

Archaeological data from the Middle Guan River valley is limited. Only two small-scale salvage excavations were conducted in the 1990s and the reports are still unpublished. Reconnaissance surveys conducted by National Cultural Bureau in 1991 and 2008 have revealed five prehistoric sites in Xixia. These sites are reported to range from 0.8 ha to 18 ha in extent and were occupied in multiple periods.

Aside from these minimal reports, our understanding of the cultural history of the Guan Valley is derived from two sources. The first is the archaeological data from immediately surrounding areas to the east, south and west, which have been excavated intensively in the past two decades due to reservoir construction. These regions, due to their geographic proximity and cultural similarity, were part of the Guan Valley macroregion discussed in later chapters (Chapter 8 and 9). The second includes regional studies of other regions, especially the three “Cultural Core Zones.” Table 2.7 shows the material cultures of these neighboring regions and

Table 2.8 lists the typical artifact assemblages of these material cultures of origin. As shown in Chapter 9, the inter-regional communication between the Guan Valley and these regions influenced the historical trajectory of the Guan Valley.

The Guan Valley is connected to the Central Plain mainly through Nanyang Basin, which is 50 km to the east of the valley. Thus, the archaeology of the Nanyang Basin offers important insights into regional development and inter-regional interactions between the Guan Valley and the Central Plain. During the Middle Neolithic, residents of the Nanyang Basin practiced millet agriculture and intensive foraging, with a material culture similar to the Central Plain (Fan 2000). By the Late and Epi-Neolithic periods, a stylistic change in utilitarian goods and burials indicates the expansion of Jianghan Plain societies (Fan 2000; Huang 2010). A rather localized ceramic assemblage suggests its relatively independent development after the collapse of the Shijiahe polity at 2000 B.C. (Fan 2000).

During the 2nd millennium B.C., the Nanyang Basin was affiliated with states in the Central Plain (He 2011). Villages increased in number but decreased in size during this period (Fan 2000). When the state of Zhou developed in the Guanzhong Basin, the Nanyang Basin was integrated into the state political system first, but gradually developed into several independent regional systems. In the Eastern Zhou period, the Nanyang Basin was under the control of Chu, centered at the Jianghan Plain. In the Qin and Han periods, the basin was integrated into a dynastic sociopolitical system (Fan 2000).

The Guan Valley is connected to the Jianghan Plain and Guanzhong Basin through Xichuan region, where the Lower Guan River merges into the Dan River. The Xichuan region is 50 km south of the study area and has seen numerous excavations. This area has a similar cultural history to the Nanyang Basin in the Neolithic period, with several exceptions: the material culture has stronger local characteristics. Some cultural practices, such as burials and house designs are more similar to the Guanzhong Basin during the Yangshao and Longshan period, suggesting more intensive communication with the Guanzhong Basin as compared to the Nanyang Basin. The Jianghan Plain material culture also appeared earlier here. This complexity in material culture may be due to the Dan River, which provides a more expedient transportation route between the Jianghan Plain and the Xichuan region, as well as between the Xichuan region and Guanzhong Basin.

The upper reach of the Dan River, which is about 70 km to the west of the study area, was also an important region in the cultural history of the Guan Valley. It is separated from the study area by mountains, thus might have had a smaller effect than other areas on the cultural sequence of the study area. Compared to the lower reach, this upper reach is closer to the center of the Guanzhong Plain and was continuously under its influence. Even in the strongest period of Central Plain and Jianghan Plain cultural dominance, elements of Guanzhong cultures persisted in this region. Qujialing and Shijiahe material culture from the Jianghan Plain reached this region by 2500 B.C., but the component and expression varied significantly between sites. In the Shang period, the material culture was highly localized, mixed with various Shang elements and local traditions. This characteristic continued into the Western Zhou period. Although this region is close to the capital of Western Zhou, the material culture still shows strong local signatures. In the Eastern Zhou and Qinhan periods, the region was integrated into, first, the state of Qin and, then, the empires.

Although archaeological data on the Guan Valley is limited, the above review of the cultural history of neighboring regions shows how the Guan Valley, which has always been geographically marginal, could also have been connected to the "Cultural Core Zones." This cultural condition, together with environmental conditions, has contributed to the regional history of the Guan Valley.

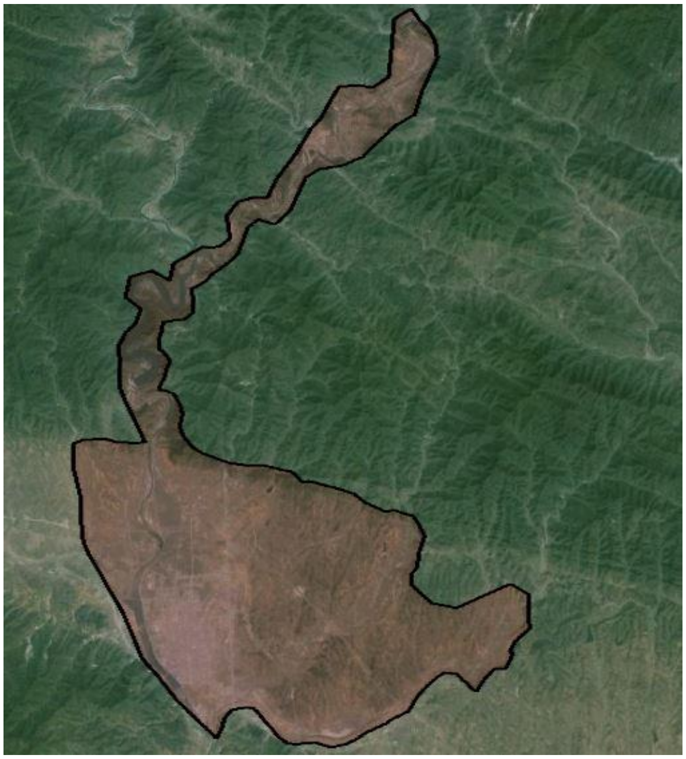


Figure 2.1 The survey area.

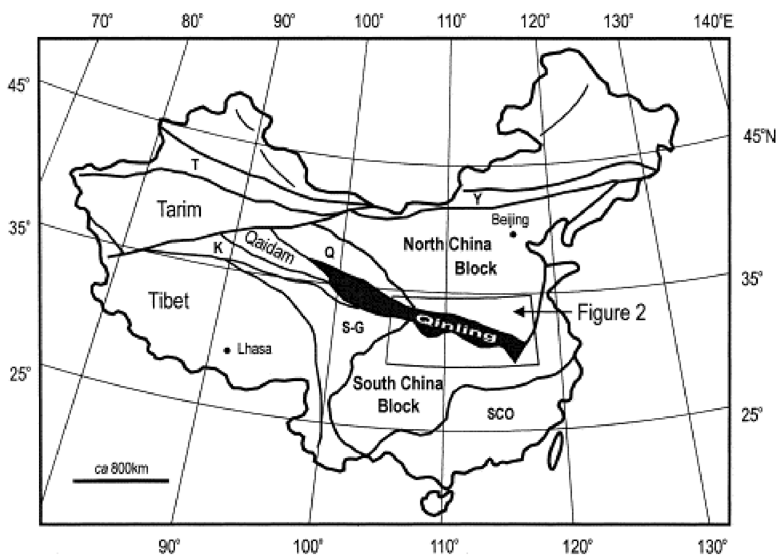


Figure 2.2 The Qinling Mountain Range (http://www.uni-graz.at/~hauzenbe/qinling.html, visited on Feb 11 2014)

CHAPTER 3

METHODS

The majority of field data used in this dissertation was collected through a regional, pedestrian, full-coverage survey of the Middle Guan River valley from December 2012 to March 2013 (Figure 2.1). The Middle Guan River valley is bounded by mountains to the north (Figure 3.1) and by floodplains to the south (Figure 3.2). Eroded, narrow terraces run parallel to the eastern edge of the valley for three kilometers (Figure 3.3). The landscape diversity posed challenges to conventional survey methods, necessitating several adjustments to achieve the most systematic and efficient result. Fortunately this was achieved through methodological preparation and only a few alternations in the field methods.

3.1 Preparation: Methodology and Operation

Regional, full-coverage survey maps at a large spatial scale reveal settlement patterns, artifacts, and the spatial relationship between settlements and landscape in successive periods. With this information, archaeologists are able to investigate (but are not restricted to) regional resource use, community movements, demographic change, sociopolitical complexity, craft specialization, and inter-regional exchange system over time (Kowalewski 2008).

To prepare for the fieldwork, I used existing literature to develop a systematic methodology for carrying out the survey in the Guan Valley. This research design not only includes a set of survey procedures for various landscapes, but also balances survey coverage and intensity. Table 3.1 compares the field methods used by other regional surveys in China. It shows that length of fieldwork has varied from a few weeks to ten years. The survey coverage varies from full coverage to fragmental coverage. Survey intensity, which is mainly reflected by the spacing between survey members, varies from 10 to 60 meters. Other measurements of survey intensity, such as the use of other field methods (i.e. shovel test, coring and profile observation) also differ between projects. The identification of sites varies from a unified and arbitrary standard of 1 or more sherds to multiple identification criteria. Table 3.1 also shows an increasing use of techniques to increase accuracy and efficiency, such as multiple maps, aerial photography, GPS, geophysical equipment, etc.

In each survey, researchers tailored their methods to their site-specific research goals. Some surveys, such as the Banzhijian River Project, are oriented toward cultural preservation and direct future excavation. Others are more research-oriented. Liu et al. (2004) conducted a full-coverage survey to reconstruct the settlement pattern and hierarchy that led to the rise of the state in the Erlitou period. The Qixing River Survey studied the changes in settlement patterns before and after the founding of the Western Zhou in this area and the inconsistency between archaeological culture and sociopolitical dominance (Zhouyuan Archaeological Team 2005). Surveys with similar research questions have been carried out in Luoyang, Lingbao, Dengfeng, and Anyang, detailing the evolution of regional settlement systems of known early state capitals (i.e. CASS 2005; Zhao 2001). Outside the Central Plain, the Shijiahe Regional Survey studies the founding and collapse of the regional settlement system of the Shijiahe polity in the Jianghan Plain (Shijiahe Archaeological Team 1993). These surveys mostly center on the known sites and the nearby strips of river terraces where sites of certain periods under study are the densest.

In addition to the studies of capital settlement systems in the core region, some archaeologists have been interested in the settlement history beyond the core region. The Rizhao Survey near the mouth of the Yellow River, the Chifeng and the Daihai surveys in Inner Mongolia were carried out to study the diversity of socioeconomic process in the early Chinese civilization (CICARP 2003; DSACAR 2005; Underhill et al. 2008). Ren (2008) surveyed the Huai River Plain to understand core-periphery interactions during the Neolithic to Early States periods. The Yuanqu survey sought to understand the regional social transformation under the integration from the core areas (Drennan and Dai 2010). These surveys were mostly delineated by natural barriers and the collections are more systematic and less arbitrary than other surveys.

The goal of the Guan River valley Survey is to understand the regional settlement history, landscape change, and the interactions between the Guan River valley and surrounding regions from the Neolithic period to the historic period. To achieve the best results, the survey area must provide a comprehensive view of human occupation across all topographic forms. Thus I adopted full-coverage, instead of fragment coverage as my major field method. The collection was systematic and standardized. Other field methods are complementary but not required for the purpose of methodological consistency.

This methodological framework necessitated specific preparatory actions, the goals of which were: 1) to be familiar with the historic and modern background of the survey area; 2) to prepare the survey team with necessary equipment and training; 3) to delineate the preliminary boundary of the survey area according to research interests and logistics.

Goal 1: Be familiar with historic and modern information on the survey area

The specific tasks included: 1) collecting historical information on administration, land use, population, environment and local economy; 2) compiling information on the natural features of the survey area, such as economic resources, fluvial systems, vegetation, geography, geology, and climate; 3) compiling the existing knowledge of modern local administration, land use, economy, and demographic structures and distribution. This information was gathered from local cultural and statistical bureaus and several scholarly resources.

Goal 2: Prepare the survey team with necessary equipment and training

The tasks included: 1) building a skilled and knowledgeable survey team. The team consisted of undergraduate and graduate archaeology students and trained archaeologists from the Henan Institute of Archaeology and Relics; 2) familiarizing the team with the archaeological sequence of the study area and nearby regions, especially the styles and features of ceramics; 3) familiarizing the team with the regional survey methods and operational procedures; 4) preparing maps for the survey area (primary map sources included 2010 1:5000 Google Earth maps and 1:50000 topographic maps); 5) preparing GPS and field laboratory equipment; and 5) arranging accommodations and transportation for the team.

Goal 3: Delineate preliminary boundary of survey area according to research interests and logistic

The tasks included: 1) delineating multiple possible natural boundaries of the survey area covering an area from 80 km^2 to 150 km^2; 2) delineating the possible survey area into several parts and ranking them according to research priorities: we want to cover all four major landforms, including mountains, hills, eroded terraces and alluvial plains. Also, the spatial continuity of survey area is required; and 3) building a preliminary survey order.

3.2 Systematic Full-Coverage Regional Survey

The fieldwork included: 1) recording sites by the distribution of artifacts and features; 2) systematically collecting ceramics, lithics, and other types of artifacts; 3) documenting the agricultural practices and structures such as canals and terraces; 4) recording the geophysical features of sites (i.e. soil, elevation, land cover, slopes, deposition, and distance to the river); 5) locating lithic sources; 6) collecting data on modern land use practices and cultural practices; and 7) collecting evidence of site formation processes.

For this fieldwork, I adapt methods used by large surveys in Shandong, the Yiluo River region, and the Chifeng area. The Chifeng report discusses survey methods and collection and analysis strategies in detail and points out the importance of adjusting methods to various landscapes and scales of analyses (CICARP 2003). This report provides the general guidelines used for fieldwork in this survey.

Visibility

The surface visibility in the survey area varies. The visibility across the survey area is generally good in the wheat and vegetable fields before the crops start to grow in March. The kiwifruit fields and newly plowed land have the best visibility, as the surface has little to no vegetation cover (Figure 3.4). Where the mountains are covered by vegetation, visibility is minimal. However, montane visibility is good on newly plowed lands scattered across the slopes and on open trails (Figure 3.5). The city and villages are mostly covered by modern occupation, but gardens, small fields, and construction sites provide good visibility (Figure 3.6). Rice fields and lotus fields, however, have no artifacts even with good visibility, as farmers invest considerable time removing large objects to ensure good harvests.

The fluvial and colluvial processes contribute the most to the formation of sites in the study area. Flood events occur regularly at all major rivers in the survey area. Some open sections reveal more than one meter of deposition from a single flood event (Figure 3.7). The weathering and rainwash creates massive terraces and gullies as well. But continuous farming activities and construction are able to maintain artifacts on the surface, although there are open sections showing sites deposited under modern surface.

The Walk

The crew consisted of five people, and the survey took 217 person days. The survey plan was determined the night before each day of surveying. The survey routes were designed according to the number of surveyor and landforms. The spacing between surveyors was limited to 25-50 m, with all surveyors walking in a "Z" shape in the same direction at the same speed to systematically cover the area in front of them. One surveyor held a GPS device to record the geographic coordinates of sites while another surveyor held the 1:5000 Google Earth map to coordinate the survey pattern and map the findings. Other surveyors recorded information on land cover, landform, soil type, and other noteworthy information (Figure 3.8).

However, this method was not as feasible on the terraces and mountains as it was on the plains. Therefore the team adjusted field methods accordingly. On bench terraces, which consist of narrow and prolonged terraces mostly along rivers and alongside hills, each surveyor surveyed one bench if the bench was narrower than 50 m (Figure 3.9). All surveyors proceeded in the same direction, but adjusted their route according to the direction of the benches, landform, and slope. On large mountains or hilly areas with little visibility, two researchers surveyed each hilltop, proceeding along the crests or trails (see Figure 3.5). On mountain or hilly areas with relatively good visibility, especially the massive eroded terraces on the east of survey area, 1-2 surveyors walked along the ridges, 1-2 surveyor surveyed the gullies, and the rest of surveyors walked on the slopes with open land (see Figure 3.10). In all cases, the spacing between surveyors was less than 50 m. If a terrace with a gully could not be covered in one passage, the team made multiple passages until the strip of gully and terrace was fully covered. In this way, as many surfaces with exposed artifacts as possible could be covered. Steep slopes or heavily obscured surfaces were skipped for the purpose of safety. With this arrangement, the team covered ca. 0.5-2 km^2 per day, depending on survey conditions in the mountains and plains and the intensity of artifact collection.

Identification and Recording of Sites

Site sizes were measured by pacing and a geographic position system (GPS) and recorded on Google Earth maps. Sites were indicated by the distribution of artifacts (including ceramics, lithic artifacts, bricks, metal artifacts and porcelains etc.), architectural foundation, daubs, wells, irrigation and terraces, earthen walls, and other archaeological remains. Among them, ceramics were the most common artifacts in the survey and, therefore, the most dependable evidence of site locations.

Sites on the alluvial plains were defined in the same way as in the Chifeng, Yiluo, Luoyang surveys, as the occurrence of at least 3 artifacts of the same time period within a 100m area (CICARP 2003:42-43). If a team member found one sherd on the surface, this sherd was kept until there was no other sherd found within 100 m. If a second sherd was found, more effort was made to find a third one. If there was a third one found in this area, this location was recorded and numbered as a site (i.e. S001, where S stands for site). Then, the team continued to find out the extent of scattered, and make decision on collection plan. If the site was larger than 100 m^2, the site was divided into units of 2500 m^2 and collected one by one. The collection units were the basic units used to measure the size of each site and its components.

As in the Chifeng and Huangtucheng surveys, two collection methods were used depending on artifact density. In collection units with low densities (less than 20 artifacts in one 2500 m^2 unit), the team collected all the artifacts on the surface. In collection units with more than 20 artifacts, the team adopted "systematic collection," where the team collected all artifacts within a randomly drawn 3 m circle in the unit. If there were less than 20 artifacts in this circle, another circle was drawn and collected until the collection reached 20 sherds. All collection units were mapped, numbered (i.e. C001, where C stands for the collection unit) and location, GPS coordinates, land cover, landform, and visibility were recorded. The site area was shown as continuous collection units on the map. A photograph of this site was taken as well.

Only a small percentage of historic period bricks and tiles were collected as samples (Figure 3.11), but the location of all bricks and tiles were recorded. The same procedure was also applied to other features such as architectural foundation, burials, and agricultural terraces.

Laboratory Analysis

Laboratory work included: 1) identifying artifacts by period; 2) delineating components based on distribution of contemporary artifacts in a site; and 3) plotting sites and components with ArcGIS.

The component was the basic temporal-spatial unit for any analysis in this study. Accurately identifying components from each period was the key to understanding settlement pattern changes. Since artifacts needed to be washed and examined, the component analysis was conducted in the laboratory instead of the field. The team members learned diagnostic traits of artifacts across all phases from Wuhan University and the Henan Institute of Archaeology and Relics senior archaeologists. Each artifact from each collection unit was described according to color, texture, temper, and types. Then, they were grouped by phase and the counts of all features were tabulated for further analysis.

Contemporary artifacts of each collection unit were put into one bag and labelled with the date, collector’s name, collection unit number, quantity, and chronology. The team identified nine periods from 5000 B.C to the present.

Some most diagnostic sherds were selected as samples for chronology control and display. These samples were numbered, photographed, and drawn by professionals. The generated sample log, artifact analysis forms, and information for each collection unit were all entered into a database. Some ceramics, especially ceramic tiles were selected for NAA (Neutron Activation Analysis). Less than 1g from each of these ceramics was sampled by drilling. The powders were then bagged, labeled, and tabulated in the database. Then all the artifacts were stored at the Xixia Institute of Culture and Relics.

The continuous distribution of contemporary artifacts composes a component. The component locations were plotted into a Geographic Information System (GIS) (see Chapter 5 for settlement maps). The size of each component was measured by using ArcGIS. All this information on artifacts, collection units, and components was entered into a database cross-referenced by collection unit.

Table 3.1 A methodological comparison of regional surveys.

NO	Survey Area	Team Size	Spac-ing	Coverage	Other Method	Collection	Min. She-rd	Positioning
	Guan River	6	25	Full-coverage	Profile&Coring	Systematic	1;3	GPS,1:10000 & 1:50000 maps
1	Shijiahe	2			Profile&Coring			1:2000 map
2	Hulu River Basin					Systematic		
3	Rizhao	6-8	40-50	Full-coverage	Profile&Coring	50*50	1	1:10000 map
4	Huanhe River Valley	3-6	10-20; 50-60	Higher terraces	Coring&Testing	Sampling		Maps, air photos, satellite Image
5	Huangtucheng	5	25	Full-coverage	Profile	50*50;25*25	1	1:10000 map
6	Chifeng Yingjinhe River Valley	4	50	Full-coverage		100*100	3	Air photo
7	Banzhijian River Valley			Full-coverage	Feature	Sampling	1	GPS, 1:50000, and air Photo
8	Yuncheng Basin			Terraces	Profile	Sampling		1:10000 map
9	Yiluohe River Valley	7-10	15-30	Terraces	Profile&Coring	Sampling	3-5	GPS,1:10000 map
10	Chengdu Plain				Geophysical			
11	Zhouyuan Qixinghe River Valley			Terraces				GPS; air photo
12	Ma'anshan Caishihe River							
13	Daiha	3-4	20	Full-coverage		100*100	1	Air photo
14	Luoyang Basin	6-8	20-30	Higher terraces		All identifiable artifacts	3-5	GPS and 1:10000 map

Figure 3.1 The mountainous landscape in the north of survey area

Figure 3.2 The extended flood plains in the south of survey area

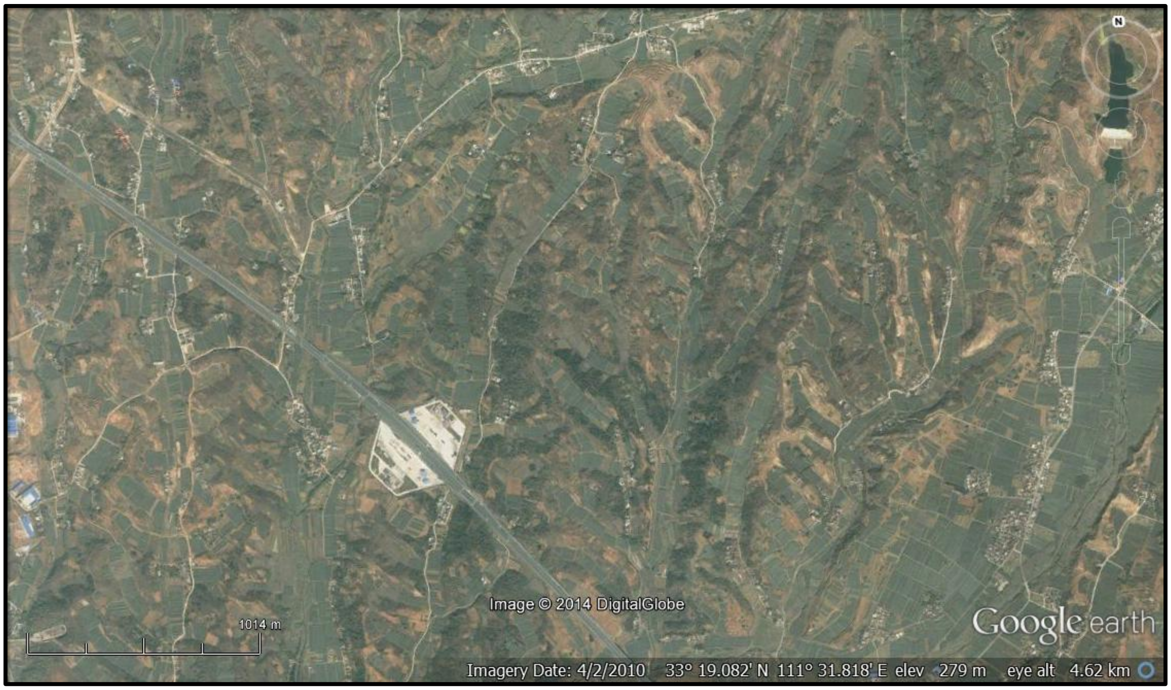


Figure 3.3 The eroded terraces in the east of survey area

Figure 3.4 The kiwifruit field

Figure 3.5   Surveying mountain with open land

Figure 3.6   Surveying the city

Figure 3.7 The flood deposit on the section (S018)

Figure 3.8 Surveying the alluvial plain

Figure 3.9 The bench terraces

Figure 3.10 The landscape of eroded terrace and valley

Figure 3.11 A Han tomb brick

CHAPTER 4

SITES AND ARTIFACTS

The Guan River valley Survey located 96 archaeological sites across the 135 sq. km of survey area during the field season from December 2012 to March 2013 (Figure 4.1). In contrast, a recent reconnaissance survey in 2011 only recorded 9 sites in the same coverage area, four of which were removed during city construction before the project began in the fall of 2012. More than 50% of sites discovered in the regional survey were single-component sites, distributed in a variety of environmental settings from alluvial plain to hilltop. As shown on the map, there are only few sites between the upper reach and lower reach of the river, due to inundation of alluvial plains by dam constructions and low visibility on mountains. Other than this occupation gap, the diversity of environmental niches was occupied by different sites, indicating the significant temporal-spatial diversity of human occupation in the Guan River valley. In other cases, such as the site of Yanggang, a single environmental niche was continuously used for almost five thousand years. This chapter will describe some of the particular sites identified by the survey to illustrate the temporal-spatial diversity of human occupation in the Guan Valley.

4.1 Sites

S001

S001 was first found and named Yanggang by a national reconnaissance survey in the 1980s, and has been preserved with the title of "Provincial Preservation Site" for its size and lengthy occupation. This conservation status, under which only agricultural activities are permitted, has protected Yanggang from the destruction visited on other similar sites by urban construction. Nevertheless, a rural road cut the site into two parts. The village of Yanggang also covers part of the site. The regional survey shows that the site is 32.7 ha, which makes it the second largest site in the survey area. Yanggang site was occupied during all 9 periods, from the Middle Yangshao period to the modern era (Figure 4.2).

S001 is located on a series of terraces near the confluence of the Guan River and Ding River, the best farmland in the western part of the Guan River valley. The Guan River meanders 1 km away from the site, creating a flat, broad alluvial plain that buffers human occupation from river deposition. A 100-year flood in 2010 reached as far as 300 m from the river and covered large part of the plain. Today S001 centers on a mound with its eastern edge cut through by a rural road. The north and south ends of the site are bounded by villages. The area west of the mound has the largest concentration of rice fields. The mound is 1-2 m above the alluvial plain. The west, north, and south sides of the mound slope gently. The surface of mound is uneven, with ditches, trails, and terraces cutting the mound into small, irregularly-shaped fields. The vegetation is mostly wheat, rice, vegetables, mushroom greenhouses, and kiwi trees, interspersed with uncultivated bushes and trees. Overall, the site has been partly disturbed by erosion, irrigation, and plowing.

Artifact density at S001 is high, especially on the top of mound. Thirty one out of 75 collection units were systematically collected (more than 20 artifacts in one unit; see Chapter 3). This high density could have been a product of erosion, since the gradual loss of topsoil reveals buried artifacts. In addition to sherds, artifacts also included lithics, shell, bone, metal artifacts, and porcelain. There was no evidence of house foundations or other structures on the surface of Yanggang, but large chunks of adobe building material were found in many locales.

The size of occupation at Yanggang was contingent to the period of occupation. Figure 4.3 shows the spatial coverage of occupations at Yanggang over time. The site went through a dramatic change during the long course of the Neolithic and the Bronze Ages. After occupation appeared in the Middle Yangshao period, the site quickly reached its peak in the Late Yangshao period with a concentrated occupation area of 24.8 ha. The occupation persisted at a similar or even denser level of population during the Longshan period. The site then dwindled dramatically in the Shangzhou period. Although the occupation recovered slightly during the Eastern Zhou period, it was loose and scattered.

S004

S004 is a 0.25 ha site located at a 3rd-order river terrace less than 30 m from and 10 m above the Guan River. The flow of the river created bench-like 1-2 m high terraces. The back swamp underneath the terrace is narrow and covered with cobbles. The 1st-order terrace is arc-shaped and 3 m wide at its widest point. The 2nd-order terrace is about 8 m wider. Both sections contain layers of flood deposits, consisting of small gravels. Some layers are as thick as 1 m.

The terraces were recently plowed for sweet potato cultivation. Thus the land was open with high visibility. The soil was barren and with a lot of gravel. The 3rd-order terrace, where the site is located, extends further to the east. However, most lands were not used for farming. There is a temple 50 m away from the site, named “Wulong Miao” (Black Dragon Temple). As a black dragon is a symbol of water, it has been worshiped by farmers during times of flooding.

Ceramics scattered on the surface near the river and some were found in the section. Most sherds date to the Tangsong period, but a small proportion date to the Longshan period, indicating the use of near-river terraces, which were at high risk of flood damage in the Neolithic period.

S018

S018 is a 3.5 ha site located near the east bank of the Guan River. The site is surrounded by waterways in three directions, the Guan River 30 m to its west and the Xiaobei River to the north. An irrigation canal, the Shimenyan, separates S018 on the west. Highway G40 crosses the Guan River and is located less than 10 m to the north of the site (Figure 4.4).

The site is highly disturbed. The remains of highway construction were visible around the site. The course of Xiaobei River was recently broadened to remove the 2010 flood deposit. The Shimenyan canal, which was built in the early 20th century, is dredged regularly. Overall, the topsoil of S018 was subject to recent, large-scale anthropogenic movement in addition to the natural processes of fluvial deposition.

In spite of all this movement of soil, the location and nature of S018 is identifiable. Because of recent constructions, part of the area is open with little vegetation. The surface was densely scattered with ancient tiles, half of which were still fully intact. These ceramic tiles are red or red-yellowish color with cord-marks, indicative of the primitive technique dating to the Eastern Zhou period. Other than tiles, no domestic pottery was found at this site. The consistency of artifacts and the quantity and distribution of tiles exclude the possibility of site movement.

The surface was also scattered with calcite nodules, which are common in the hilly areas and rarely exist in large quantity on the alluvial plain as where S018 is. Since the Neolithic period, calcite nodules have been used as a construction material. All this evidence points to the conclusion that S018 dates to the Eastern Zhou period.

S022 and S023

S022 is the largest site in the survey area (57.2 ha). It was found and named the Xiaoshui site in the 1990s during a reconnaissance survey. The site is located to the west of the Shewei River, which joins Guan River downstream. The river meanders at Xiaoshui, creating the largest alluvial plain in the river basin. S022 is bounded by mountains on all sides and the river seems to be the only route connecting the site with its neighbors (Figure 4.5).

The triangular stretch of alluvial plain is divided by terraces into irregularly-shaped fields. There is a dam 200-300 m from the river. Farmers continue to cultivate the area between the dam and river. The village is almost 600 m from the river. Still, the village was inundated by more than 1 m -high water in the 2010 flood. The west of village is the piedmont, which has been developed into small farming terraces (Figure 4.6). The farming conditions are far than ideal here. The slopes are steep and soil erosion is severe. Some terraces have 6-7 m retaining walls. The soil is also much less fertile on the piedmont, especially in newly developed fields, which are distinguishable from older fields by the density of pebbles and gravel in the soil.

The modern village of Xiaoshui has 1,000-2,000 people, and owns only 300 m^2 per person of land on average for farming, which is less than ¼ of the land Yanggang farmers have. More than 70% of the domestic income is from mushroom cultivation, the same rate as many nearby villages in mountains. However, their heavy reliance on a single source of subsistence has contributed to economic vulnerability. A bad year for mushrooms, such as 2010, can cause widespread economic devastation in the village.

Despite its the environmental constraints, Xiaoshui, like Yanggang, has been continuously occupied. The area was first occupied in the Late Yangshao period, reaching its apex as the largest occupation in the survey area during the Eastern Zhou and Han periods (Figure 4.6). The majority of occupations have been concentrated on the alluvial plain, with only a small section on the piedmont. However, S023 is located almost 400 m away from the village on the piedmont. This implies that the lack of findings on the piedmont could have been attributed to erosion.

Compared to S001, S022 has a much lower artifact density. The geographic constraints produced by the mountains contributed to Xiaoshui's distinctive economic adaptations and residential patterns.

S037

S037 is one of the largest sites in the Neolithic period (10.3 ha). A highway cuts through the site and the west side of the site is now occupied by a pharmaceutical company. S037 is the only site that was excavated in the study area. In 2011, a team excavated the site as a salvage effort during the construction of Highway G40. To date, no results have been published (Figure 4.7).

S037 is located on a mound to the north of Xiaobei River, 1.5 km from the Guan River. This location marks a transition from alluvial plain to eroded terraces and gullies. The remaining mound is about 2.5 ha and elevated 10 m above the ground. Parts of mound were already restored for farming. The overall visibility is good and the surface of mound presented many large sherds and chunks of adobe at a similar density as S001, but the pieces themselves were much larger.

The site extends beyond the mound to a strip of flood plain near the river, where a modern village and most of the area's farmlands are. My first impression was that erosion had brought the sherds from the mound. However, the dating of sherds points to the fact that the occupation moved towards the plain gradually—the Yangshao occupation was half-concentrated on the mound, and half on the plain. Since the Longshan period, the occupation moved down the hill to the plain, corresponding with small occupations across the Xiaobei River. In the Eastern Zhou and Qinhan periods, the occupations stayed on the plain.

S037 not only represents a large-sized Late-Yangshao village, it also illustrates changes in site use and formation over time.

S047

S047 is a small Eastern Zhou site of only 0.25 ha. This site is located on the top of a mountain at the transition between mountains and valley. Farmers continue to use many mountains along this transition zone periodically to grow sweet potatoes in the fall. Sweet potatoes have minimal soil fertility and irrigation requirements and, as such, are ideal for mountainous areas. Patches of farmlands are scattered around the mountain top. S047 is located in one of the newly plowed fields (Figure 4.8).

The north and west sides of site are both steep slopes. The east side connects to a higher area, but there is no trail between them. Only the south side of the site is accessible to the outside The closest village is 700 m away.

Sherds were concentrated in one small piece of land on the mountaintop. There were no sherds found nearby. Most sherds were domestic pottery and some were tiles, mostly in large pieces. The potteries may be concentrated underground. Considering the sherd concentration, the site's location and inaccessibility, this site is more likely to have been a cemetery than a residential village. This solitary cemetery was rare in the Eastern Zhou period, when large cemeteries close to the cities were more common.

S048

S048 is a Neolithic site of 1.65 ha. Similar to S047, the site is very close to the mountains. However, this site is located at the valley bottom between mountains. The valley was created by the Badie River which originates from and flows out of the mountains. The elevation drop of Badie River channel eroded terraces into the alluvial plains downstream. The village is named

“Dakuaidi,” which means “large farmland,” a description which makes sense as this alluvial plain is the largest flat farmland in the surrounding landscape.

However, S048 is not positioned on the broad alluvial plain. It is at the valley bottom upstream and bounded by the mountains on both sides. The valley bottom is only 30-40 m wide the most. The west edge is comprised of terraces and the east bounded by the river and the steep, rocky slopes of the mountain (Figure 4.9).

The site was occupied in the Late Yangshao and Longshan periods and was the most remote and elevated site besides Xiaoshui. The nearest contemporary site is more than 3 km away.

S060

S060 is 1.9 ha in area. The site is located at the top of a terrace (Figure 4.10 and 11). The surface of the terrace, or the ridge, is 50-100m wide, with a steep cliff-like edge on the west side, and a gentler slope on the east. The eroded valley bottom is 30-40m lower and has been engineered into flat, layered farming terraces. The valley bottom is bounded by another similar terrace ridge on the other side. This is typical of the eroded terrace landscape that spreads out to the east of Guan River flood plain. S060 is the largest site found on the ridge.

As the terrace landscape is prone to erosion, the soil is more barren on the higher ridge than on the valley bottom. At the time of the survey, the ridge was newly plowed following the corn harvest. Since the soil is calcareous, porous, and easily eroded, it is not ideal for wheat.

Considering the erosive nature of landscape, it was surprising that sherds of S060 were concentrated on the terrace ridge, while almost nothing was found on the valley floor. Only 2-3 sherds were found 130 m to the southwest of S060 on the alluvial plain (C446). As these sherds were very likely to have been brought down by erosion, they were not included as a part of S060.

It is possible that the site was buried rapidly after abandonment and only exposed latter by plowing. The sherd density was very high at S060 and extended a few hundred meters down the ridge, which could have been attributable to recent plowing. The survey also found a large number of adobes, carbon particles, and calcite nodules.

The site is mostly a single component that dates to the Late Yangshao period. There is also a feature, possibly a trash pit protruding on the retaining wall of near the valley bottom, which dates to the Han period.

S067

S067 is 4.7 ha in area. It is located on a river terrace on the south bank of the Guzhuang River (Figure 4.12). The river meanders here and created a triangular-shaped alluvial terrace. The river is also bounded by mountains on the other side, increasing the fluvial down-cutting that continuously deepened the river channel. All these processes produced a 3-5m high platform/terrace on the south bank of river, where the site is positioned.

S067's elevation ensures its safety from floods. The distance to river does not decrease the flood probability of occupation on the alluvial plain further away from the river. There are riverbed deposits to the north of S067 on the alluvial plain. Although the size of S067 is restricted by the size of the terrace, the occupation continued from the Late Yangshao to the Qinhan period.

S076

S076 is a 2.9 ha site. Similar to S018, it is also situated less than 100 m to the Guan River. The site is located in a newly developed neighborhood and disrupted seriously by urbanization. However, the nature of the disruption reveals a high sherd density. Sherds were found in all the exposed land in this area, mostly construction sites and small gardens and garbage pits (Figure 4.13).

The site was mostly used as a residential area from the Eastern Zhou to Qinhan periods. Sherd distribution shows that the Eastern Zhou occupation was the densest and largest. Other than domestic wares and tiles, which were found in most Eastern Zhou settlements, S076 also had tomb bricks, suggesting a multi-functioned occupation (Figure 4.14).

In fact, the size of this Eastern Zhou occupation is dramatically underestimated in reconnaissance surveys. There was continuous occupation along the eastern bank of the Guan River bank stretching more than 1.5km from S076 to S078. Sherds were found at all the visible, but extremely limited number of exposed lands in this area. The eastern boundary of this site is unknown since there is no exposed land on that side anymore.

S084, S085, S086, S087

These four sites were a part of an Eastern-Zhou-to-Qinhan city that was found by a reconnaissance survey in 1980s (Figure 4.15). Locals still call it "White Feather City," a name recorded in historic accounts. Similar to the Yanggang site, these sites were also provincial protection sites. However, unlike Yanggang, which has been preserved as farmland, these sites were turned into a city park in downtown of Xixia in 2012 (Figure 4.16). The park had no artifact remains on the surface. However, the trenches dug around the park reveals some artifacts. To follow the survey rule, the artifacts were scattered more than 100m away from each other, thus they were defined as four sites. However, the park area should be considered within the area of Eastern Zhou and Qinhan settlements. Therefore the size of site and occupation was likely much larger than the collected area. The sites are located to the west of the central Guan River alluvial plain, less than 2.5km from the river.

Together, the sites are 20 ha, of which the current city park covers about 10 ha. The park includes the largest mound, which is 2-3 m above the ground and was likely to have been the city center. There are a few small mounds spread around the park that have not been replaced by modern houses. The survey shows that the surrounding mounds were also integral parts of the city. As such, the size of city was significantly underestimated. From current remains, the most of constructions are on these mounds, as the artifacts concentration indicates. However, the space between mounds is currently covered by modern houses and reveals no artifacts. There are also small sites surrounding S084, which may have been part of the city depending on the time of occupation.

Unlike S078, the survey only found tiles at these sites; there was no domestic pottery which was the most common artifacts in most sites. This suggests that the city ruins had specialized zones which will be further discussed in Chapter 5.

S092

S092 is a 0.25 ha site located on the valley floor between eroded terraces (Figure 4.17). It is representative of many other sites found in similar environmental settings that date to the Han period. Most of these terraces are oriented from north to south and sometimes extend for 1-2km. The valley floor is 30-100 m wide and 10-30m lower than the terrace ridge. There are branches in the terrace landscape that follow the forking of the valley.

The valley bottoms have been sculpted into terraces well-suited for growing wheat, corn, or other vegetables. The surrounding slopes sometimes have terraces, but are mostly are too steep for year-round farming. As the elevation drops from the top to the bottom of valley, the irrigation is easy to manage on the valley bottom but not as much on the slopes.

Most of terraced landscape is sparsely populated today. Existing settlements mostly consist of small villages and clusters of households distant from the larger towns on the alluvial plains. Sites in this environment setting show similar characteristics—low artifact densities and discontinuous occupation. In most cases, sherds were scattered along the valley bottom for hundreds of meters long, but always less than 3 pieces within 100 m radius. As such, according to the survey rule, they cannot be identified as sites.

This type of occupation is mostly dated to Qin and Han period. All evidence shows that it represents an unprecedented agrarian community structure, discussed further in the next few chapters.

4.2 Artifacts

There are only few features identified in the survey, which include a farming terrace of unknown period (S010C097), and three burials dated to Han period (S001C045, S082C412, S083C413). S082 and S083 were both looted recently, with looting holes and broken pots on the surface (Figure 4.18). S001C045 yields a tomb brick that was typical of Han burials. Thus we were able date burials accurately.

We collected 6483 pieces of sherds from 392 collection units. There are 33 units were collected systematically, which means that due to the high sherd density in these unit, we only collected all sherds from a circle of 3 m radius that was drawn randomly in the unit (see Chapter 3 for more information on the method). After sites were identified and collected systematically, artifact analysis was the next important procedure for understanding the nature of components at each site and settlement patterns between them. In addition, artifact analysis also shows the quantity, types, and other features of artifacts, which illustrate temporal-spatial variations in the production, distribution, and use of artifacts between sites. All sherds are curated at the Xixia Institute of Cultural Relics.

Here I will introduce some of the diagnostic ceramic sherds for each period, emphasizing their strong chronological or spatial signatures. As introduced in last chapter, the history of material culture of the Guan Valley is complex, especially in the Neolithic period. These diagnostic sherds and their features provide a chronological sequence framework essential to the dating of artifacts. The description will also provide readers an idea of the nature of collections from the Guan Valley. C stands for collection units. The number indicates the collection unit from which the artifacts were originally collected.

Please note that the following periods are archaeological, or cultural historic period, not dynastic period. The Shang to Western Zhou period, which will be abbreviated to Shangzhou period in this study, refers to an archaeological period that roughly overlaps with the historic periods of Shang dynasty and Western Zhou dynasty. The Qinhan period refers to the material culture of Qin dynasty, which existed between 220 and 205 B.C., and Han dynasty, which existed from 206 B.C. to A.D. 220. The Tangsong period include Tang dynasty, which began by A.D. 618, and Song dynasty, which began by A.D. 960. However, archaeologically, accompanying with increasing use of porcelain, the Tangsong period is used to describe an archaeological material culture that started roughly by 300 A.D. 200-300.

The Middle Yangshao Period (4000-3500 B.C.)

Bo container mouth sherd (C074): fine clay with no intended tempering. The sherd is yellow-reddish color with a brown band around the mouth. It has round lips, a constrained mouth, and curved body. The remaining height is 3.4 cm (Figure 4.19:1).

The Late Yangshao Period (3500-2900 B.C.)

Pen basin mouth sherd (C338): sand tempered and grey in color. The sherd has a thick round lip and a titling folded edge on an open mouth. The remaining height is 1.4cm (Figure 4.19:2).

Bo container mouth sherd (C253): fine clay with no intended tempering. The sherd is red in color. It also has a round lip, constrained mouth, and curved body. The remaining height is 4.6cm (Figure 4.19:4).

Bo container mouth sherd (C045): sand tempered and brown-grey in color. The sherd has pointing lips with an open mouth and curved body. The remaining height is 5.5 cm (Figure 4.19:3).

Gang urn mouth sherd (C071): sand tempered and red in color. It has tilted pointing lips on a constrained mouth and constrained neck. The sherd shows that the mouth is 34.8 cm in diameter. The remaining height is 5cm (Figure 4.19:5).

Ding tripod foot (C253): sand tempered and red in color. The foot is wide and flattened with circular finger pressing marks. The remaining height is 5.6 cm (Figure 4.20: 3).

Ding tripod foot (C406): sand tempered and grey in color. The foot is shaped into a pedal--flattened, wide, and flat on top and restrained on bottom. The remaining height is 2.7 cm (Figure 4.20: 1).

Guan pot mouth sherd (C018): sand tempered and red in color. The sherd shows a thick square-shaped lip on an open tilting mouth. The remaining height is 2.5 cm (Figure 4.20: 2).

The Longshan Period (2900-1900 B.C.)

Ding tripod foot (C045): fine clay with no intended tempering. It is grey in color, flat on top with a V-shaped mark. There are also ridges on each side of the foot. The remaining height of this foot is 9.6 cm (Figure 4.20: 4).

Ding tripod foot (C045): fine clay with no intended tempering. It is brown-grey in color, rather flattened with a ridge on it. The remaining height of this foot is 5.2 cm (Figure 4.20: 5).

Guan pot mouth sherd (C026): fine clay with no intended tempering. It is black on the surface, but grey underneath. It has a round lip with a tilting mouth on a straight neck. It has 4 cm of remaining length (Figure 4.21: 4).

Jia goblet body sherd (C026): fine clay with no intended tempering and grey in color. It is thin, has a straight body with a circular of ridge on it. The remaining length is 2.4 cm (Figure 4.21: 1).

Jia goblet foot (C056): thin, made of fine clay with no intended tempering, and grey in color. The foot has a pointing end and a finger pressing mark inside. The remaining length is 4.6 cm (Figure 4.21: 3).

Bei goblet body sherd (C003): thin and made of fine clay with no intended tempering. The sherd is grey in color and decorated with red bands around it. The body is curved. The remaining height is 7.5 cm (Figure 4.21: 2).

Ding tripod foot (C027): sand tempered and orange-yellow in color. The foot is flat with a finger pressing mark on it. The remaining height is 12.4 cm (Figure 4.21: 5).

Ding tripod foot (C406): sand tempered and grey in color. The foot is flattened with three finger pressing marks on top of it. The remaining height is 3 cm (Figure 4.22: 3).

Lid sherd (C046): sand tempered and brown color. The lid is 8 cm in diameter and 2 cm in remaining height (Figure 4.22: 5).

Ding tripod body sherd (C046): sand tempered and brown-grey in color. The sherd is from the lower body. It shows a rather straight upper body and a flat bottom. The remaining height is 3.8 cm (Figure 4.22: 1).

Gui tripod foot (C043): fine clay with no intended tempering. The foot is red and hollow inside. It also has a pointed end. The remaining height is 3.2 cm (Figure 4.22: 2).

Guan pot shoulder sherd (C043): fine clay and grey in color. The shoulder is folded and decorated with check marks. The remaining height is 4 cm (Figure 4.22: 4).

Guan pot mouth sherd (C043): sand tempered and yellow in color. It has open mouth but the lip faces inward. There is a circle of additional band with finger pressing marks on top of it. The remaining height is 4 cm (Figure 4.23: 1).

Fanglun weaving wheel (C028): sand tempered and grey color. The wheel is flat and circular with a hole in the middle. It is 4cm in diameter (Figure 4.23: 2).

Ding tripod foot (C035): sand tempered and red in color. The foot is triangular in shape with a finger pressing marks on top and two ridges below the mark. The remaining height is 8.4 cm (Figure 4.23: 3).

Ding tripod foot (C028): sand tempered and red in color. The foot is wide and flattened with an additional wavy band on it. The remaining height is 5.8 cm (Figure 4.24: 4).

Shang to Western Zhou Period (1900-771 B.C.)

Guan pot mouth sherd (C057): sand tempered and in black color. The sherd shows square-shaped lips with an open mouth and a straight neck. The mouth is 12.6 cm in diameter and 4.6 cm in remaining height (Figure 4.24: 1).

Guan pot (or pen basin) mouth sherd (C057): fine clay and in grey color. The lip is thick, square-shaped, and flat on top. The neck tilts. The remaining height is 2.1 cm (Figure 4.24: 5).

Guan pot mouth sherd (C260): sand tempered and red in color. It is decorated with several string marks. The remaining height is 4.5 cm (Figure 4.24: 3).

Guan pot shoulder sherd (C260): sand tempered and red in color. It is decorated with an additional band with finger pressing marks. The remaining height is 3.8 cm (Figure 4.24: 2).

Li tripod foot (C260): sand tempered and in red color. The foot has pointed end and a remaining height of 5.6 cm (Figure 4.25: 1).

Li tripod foot (C394): sand tempered and red in color. The foot is wider on top and narrower on bottom and decorated all over with cord marks. The remaining height is 5.8 cm (Figure 4.25: 2).

Zun wine vessel mouth sherd (C047): fine clay and black-grey in color. The sherd shows round lips with a flaring mouth. The neck is decorated with an additional band with finger pressing marks and a circle of string marks. The mouth is 23 cm in diameter and 3.6 in remaining height (Figure 4.25: 3).

Guan pot mouth sherd (C031): fine clay and black-grey in color. It has a near-square-shaped lip with pointing edge and an extended neck. The remaining height is 3.6 cm (Figure 4.25: 4).

Ban side-handle (C033): sand tempered and grey in color. The handle is curved inward and decorated with string marks. The remaining height is 4.4 cm (Figure 4.25: 5).

The Eastern Zhou Period (770-221 B.C.)

Li tripod foot (C003): sand tempered and grey in color. It is half-cone-shaped with a flat end. The foot is decorated with intricate cord marks. The remaining height is 8 cm (Figure 4.26: 1).

Guan pot mouth sherd (C389): fine clay and grey in color. The sherd shows a curling lip on an open mouth. The mouth is 24.6 cm in diameter and 3 cm in remaining height (Figure 4.26: 3).

Dou plate sherd (C400): sand tempered and grey in color. It shows a flaring mouth and shallow plate. The mouth is 12.8 cm in diameter and 2.2 cm in depth (Figure 4.26: 2).

Pen basin mouth sherd (C141): sand tempered and grey in color. The round lip folded outward with a flat rim. The mouth is 17.2 cm in diameter and 3.4 cm in remaining height (Figure 4.26: 4).

Semi-circular roof tile (C422): sand tempered and grey in color. The tile is decorated with cord marks outside and finger pressing marks inside. The remaining width is 11.6 cm and length is 14 cm (Figure 4.27: 1).

The Qinhan Period (220 B.C.- A.D. 220)

Brick (C422): sand tempered and grey in color. The top surface is decorated with diamond marks and the bottom with cord marks. There are additional buttons on top as well. The brick is 3.2 cm thick, 8.2 cm in remaining length, and 10.6 cm in remaining width (Figure 4.27: 2).

Flat roof tile (C396): sand tempered and grey in color. The top surface is decorated with cord marks and fabric marks on the bottom. The remaining width is 8.8 cm, the length is 13 cm, and the width is 1.2 cm (Figure 4.28: 1).

Pen basin mouth sherd (C239): fine clay and grey in color. It has a round lip with open mouth. The neck is decorated with concave string marks. The remaining height is 3.6 cm (Figure 4.28: 2).

The Tangsong Period (A.D. 220-1279)

Wan bowl bottom sherd (C052): black glaze and white color beneath porcelain. The remaining height is 3.4 cm (Figure 4.29: 1).

Wan bowl bottom sherd (C049): yellow glaze and white color beneath porcelain. The remaining height is 2.6 cm (Figure 4.29: 2).

Guan pot body sherd (C426): fine clay and grey in color. The neck is decorated with an intricate plant pattern. The remaining height is 3.2 cm (Figure 4.29: 3).

Guan pot body sherd (C401): yellow-glazed pottery. The body is decorated with a lotus flower pattern. The remaining height is 9.7 cm (Figure 4.29: 4).

Table 4.1 Chronology of the Guan River valley.

Ages	Date	Period
Historic	A.D. 1230-1911	Post-Tangsong
	A.D. 221-1279	Tangsong
	220 B.C.-A.D. 220	Qinhan
	770-221 B.C.	Eastern Zhou
	1900-771 B.C.	Shang to Western Zhou
Prehistoric	2500-1900 B.C.	Late Longshan
	2900-2500 B.C.	Early Longshan
	3500-2900 B.C.	Late Yangshao
	4000-3500 B.C.	Middle Yangshao

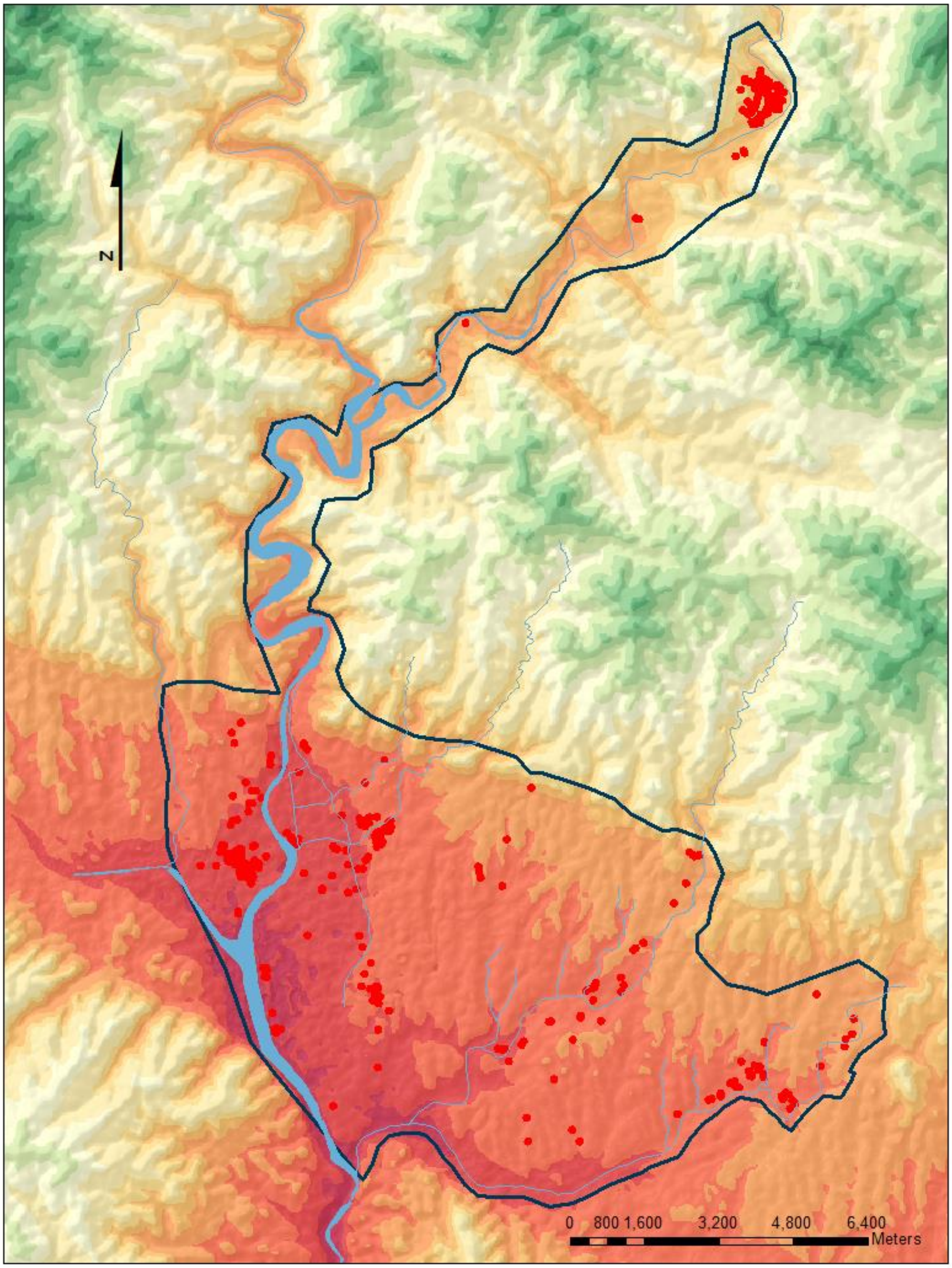


Figure 4.1 The site map

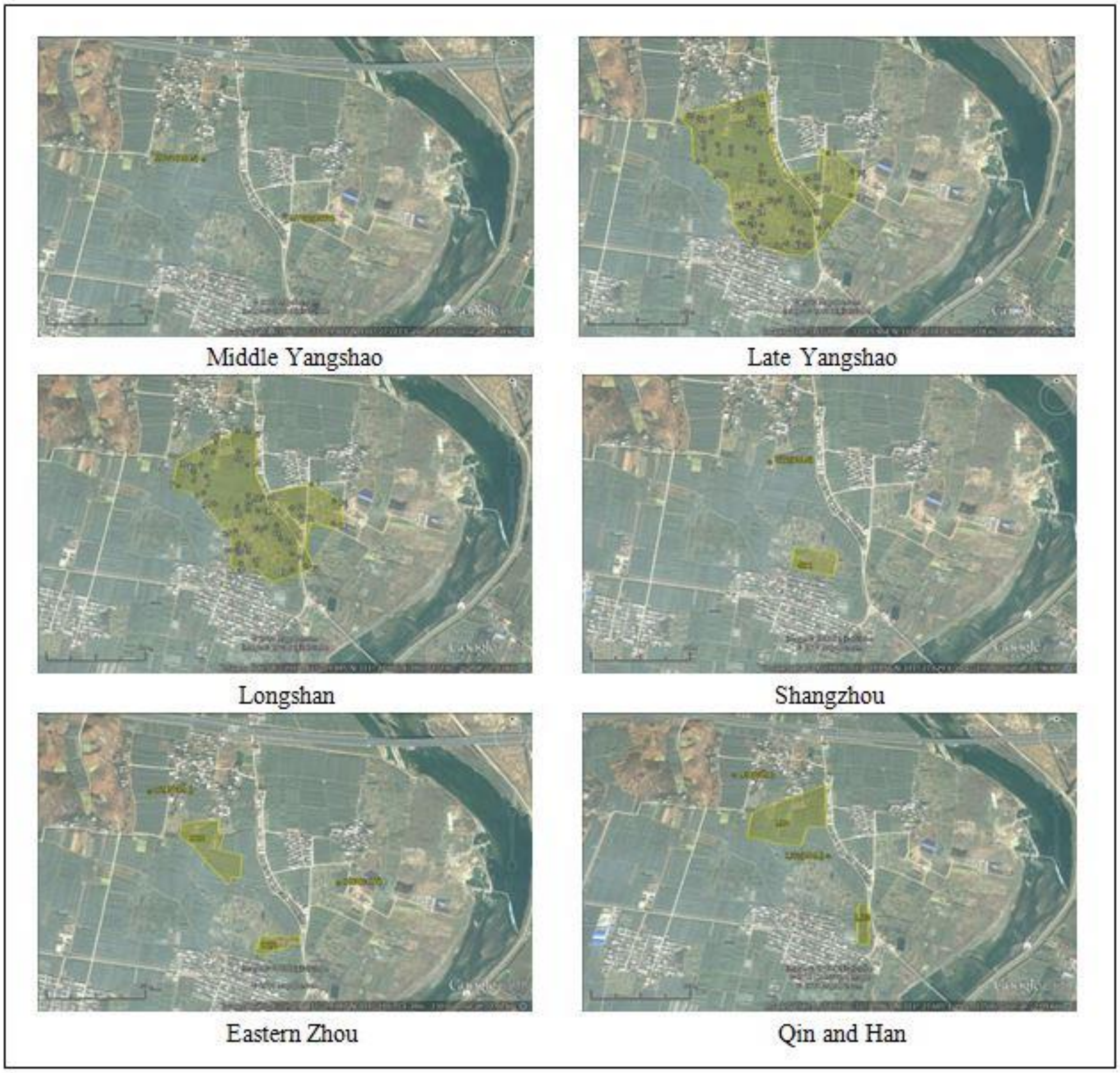


Figure 4.2 The occupation change at the S001 (Numbers are collection units)

Figure 4.3 Locations of S004 (C079) and neighboring sites.

Figure 4.4 Occupations at S018

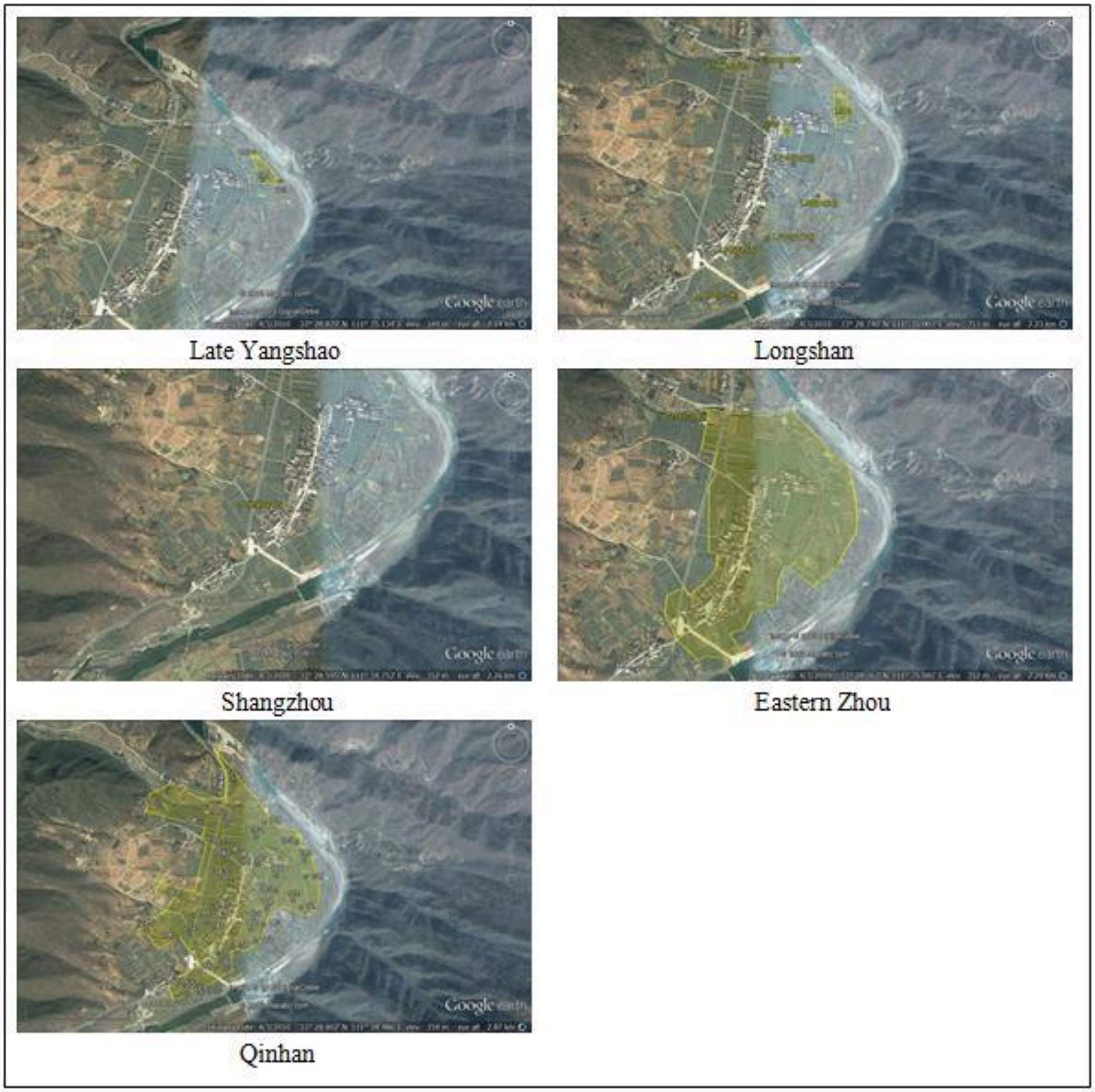


Figure 4.5 Occupations at S022 and S023.

Figure 4.6 The landscape of S022 and S023

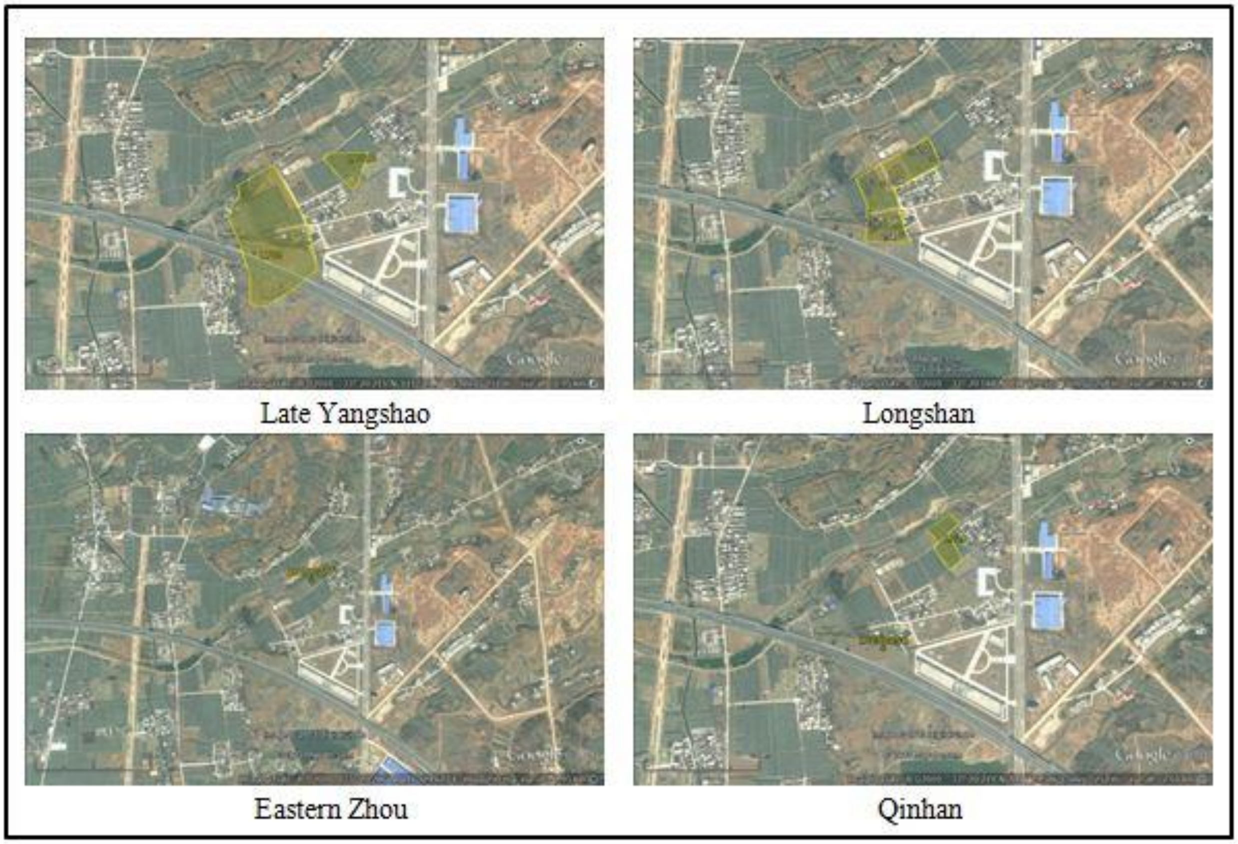


Figure 4.7 Occupations at S037

Figure 4.8 The landscape of S047. The site is on the flat, newly plowed land at the bottom of photograph (facing north).

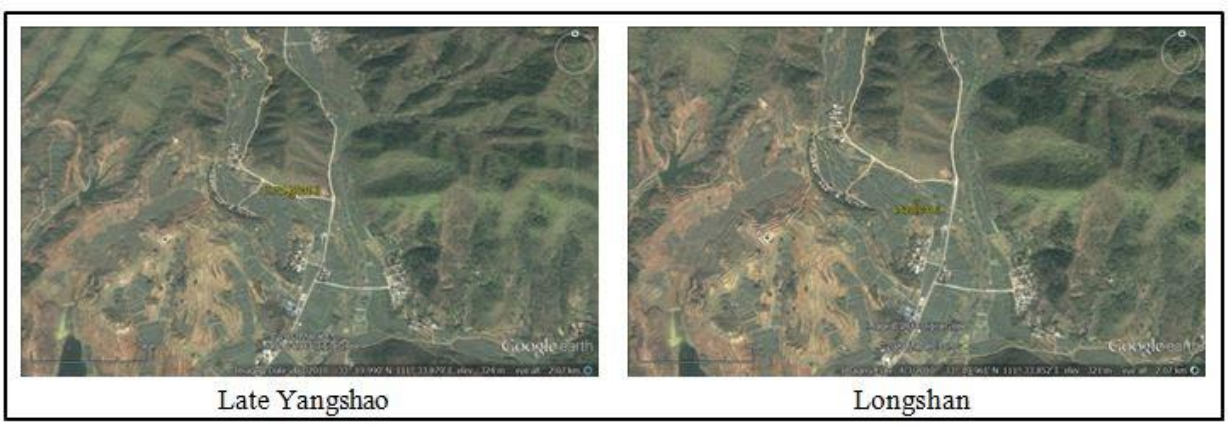


Figure 4.9 Occupations at S048.

Figure 4.10 The landscape of S060. The elevated, newly plowed land at bottom of the photograph is the site (facing east).

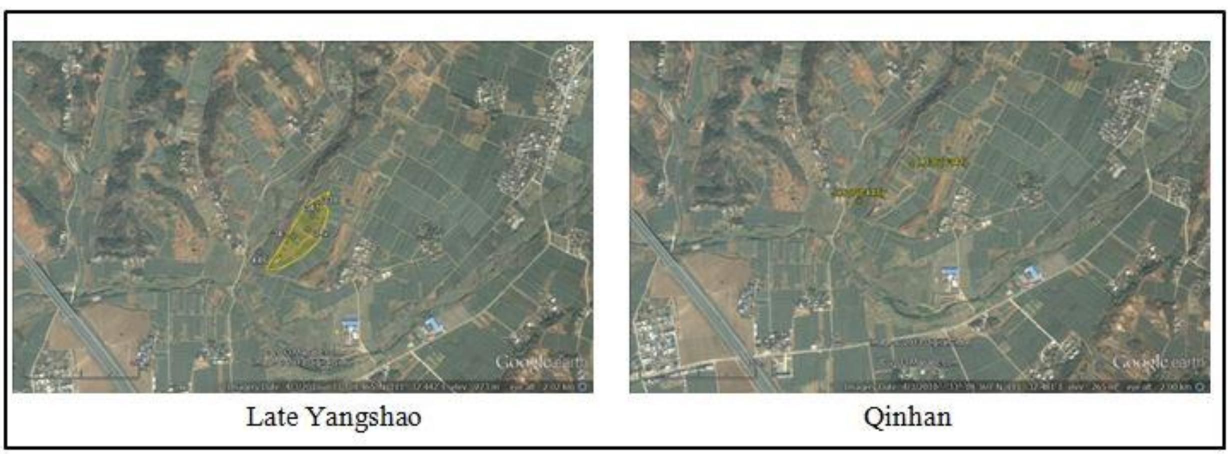


Figure 4.11 Occupations at S060.

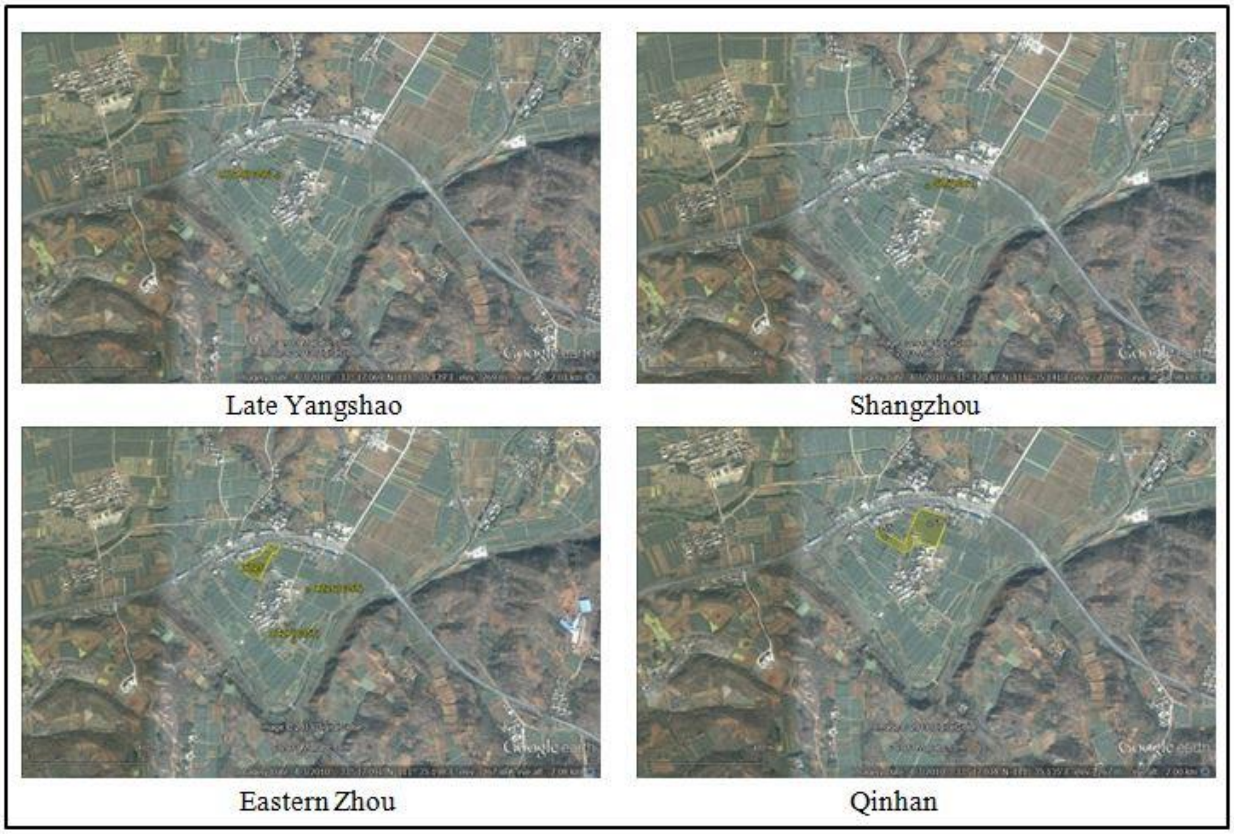


Figure 4.12 Occupations at S067.

Figure 4.13 The surroundings of S076

Figure 4.14 Occupations at S076.

Figure 4.15 Occupations at S084 and surrounding sites.

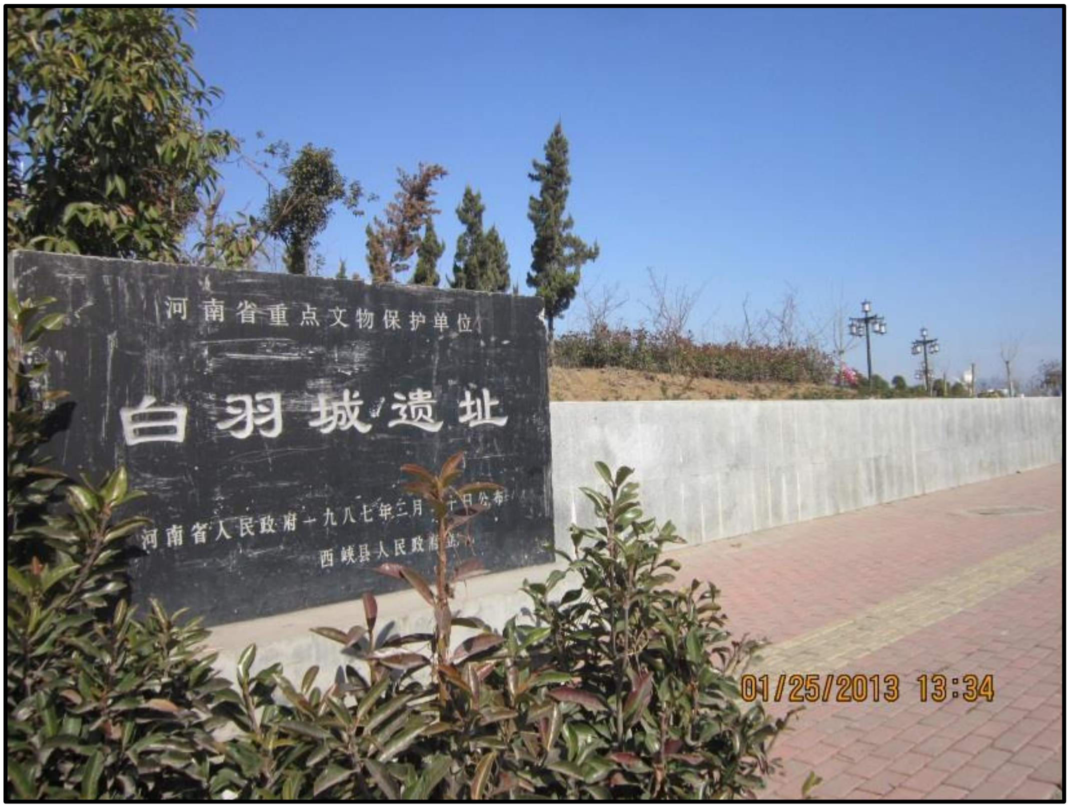


Figure 4.16 The city park above the “Baiyu City” ruins.

Figure 4.17 Landscape and occupation of S092.

Figure 4.18 The looted S082.

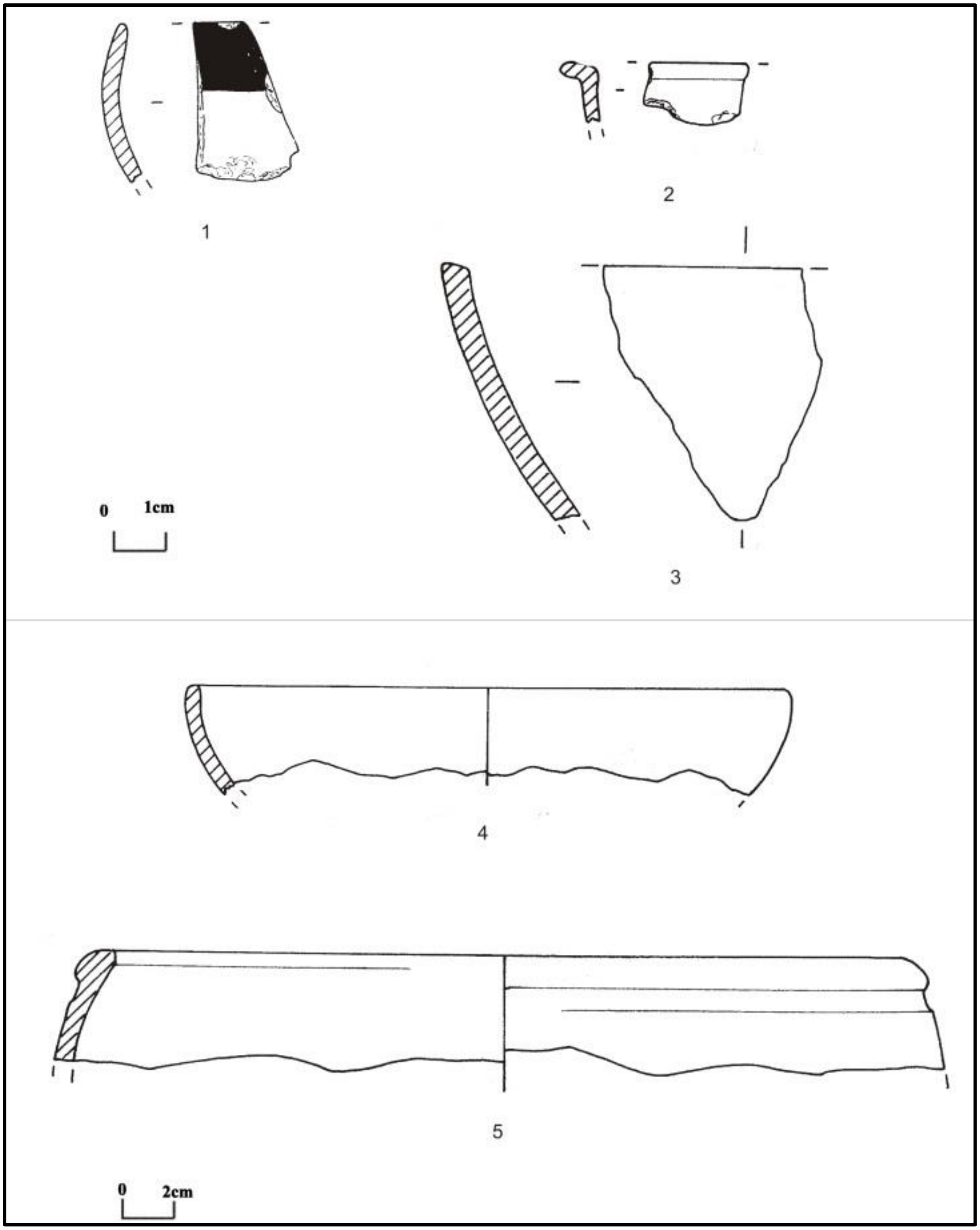


Figure 4.19 Artifacts (Middle Yangshao to Late Yangshao period).

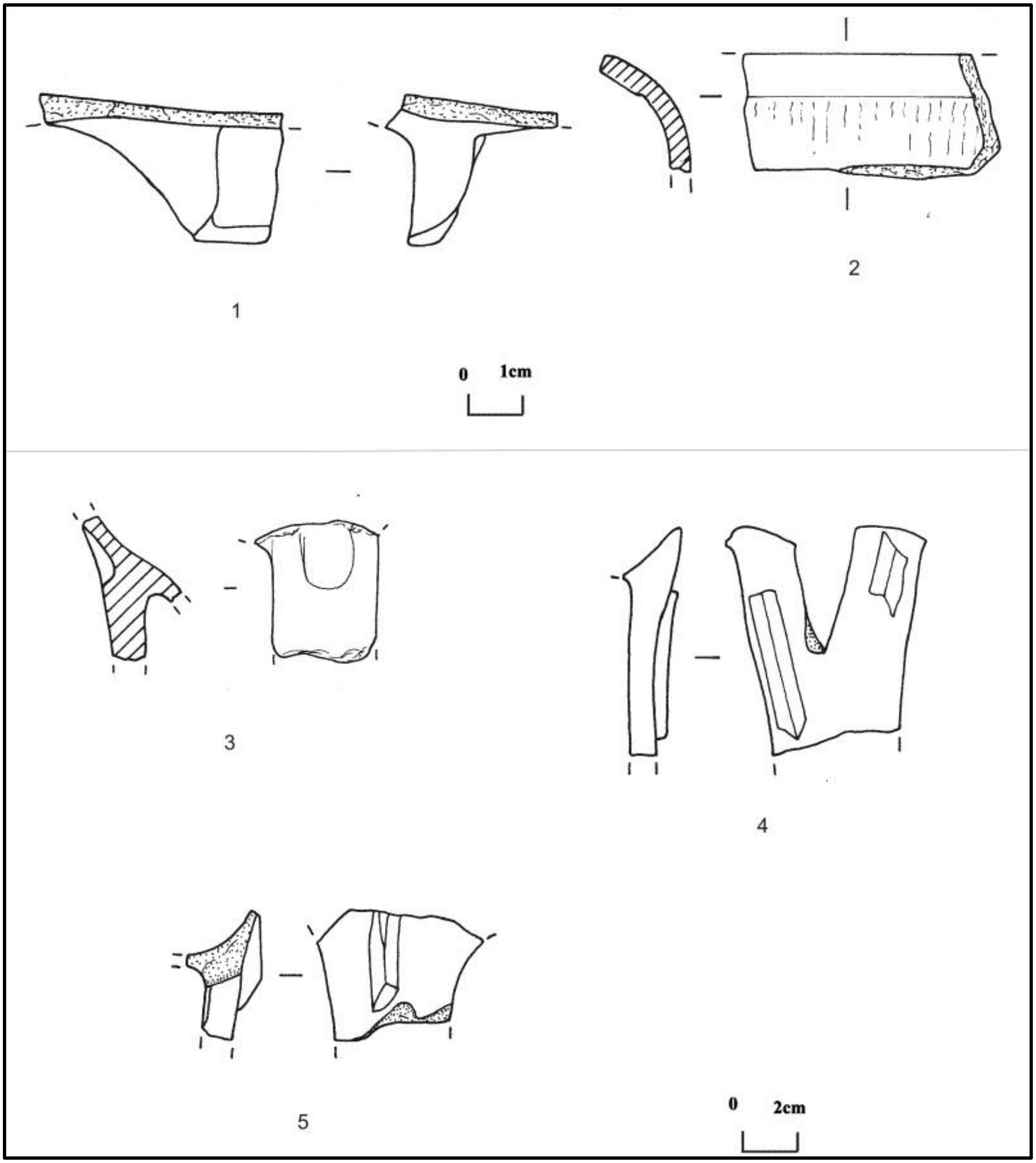


Figure 4.20 Artifacts (Late Yangshao to Longshan period).

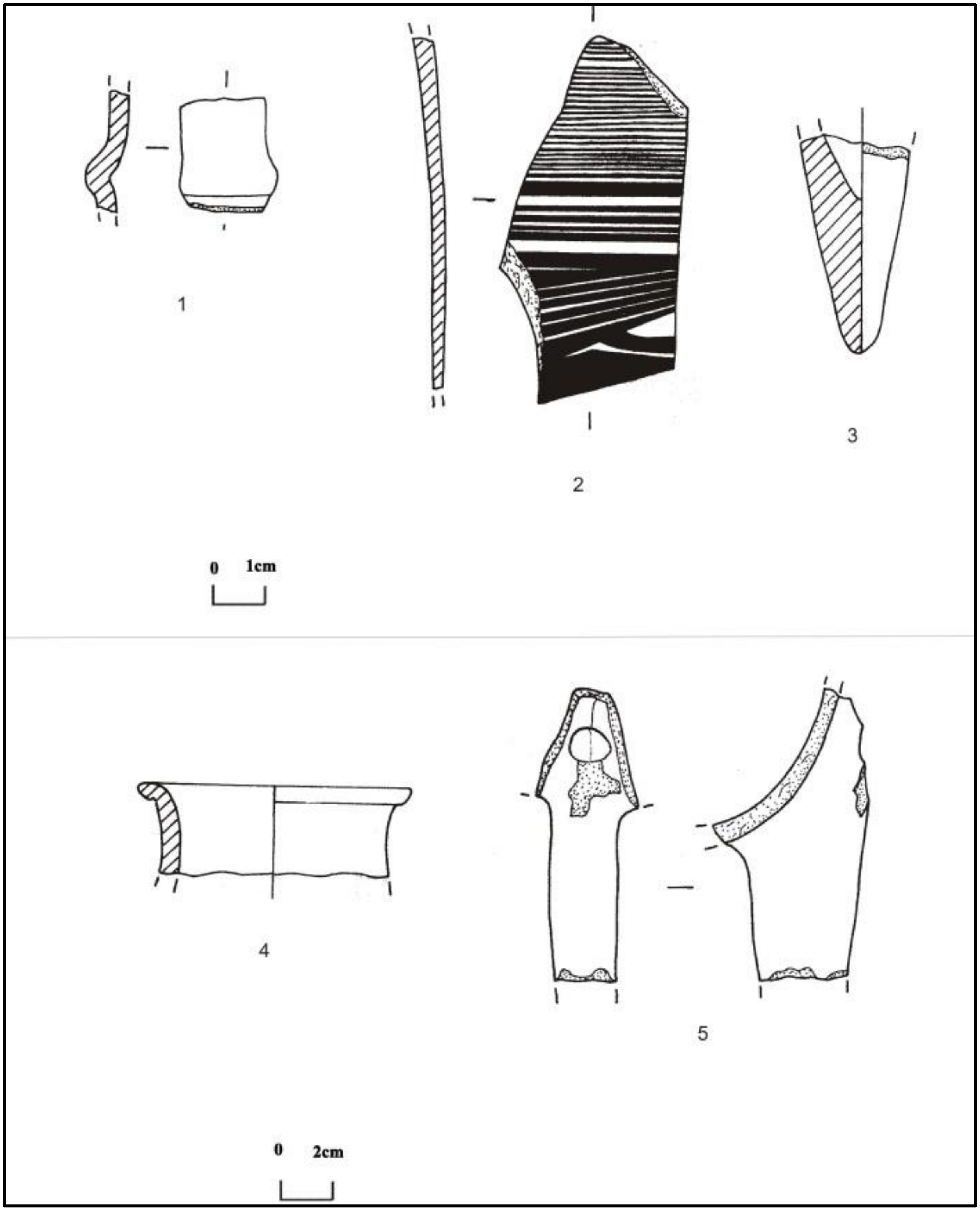


Figure 4.21 Artifacts (Longshan period).

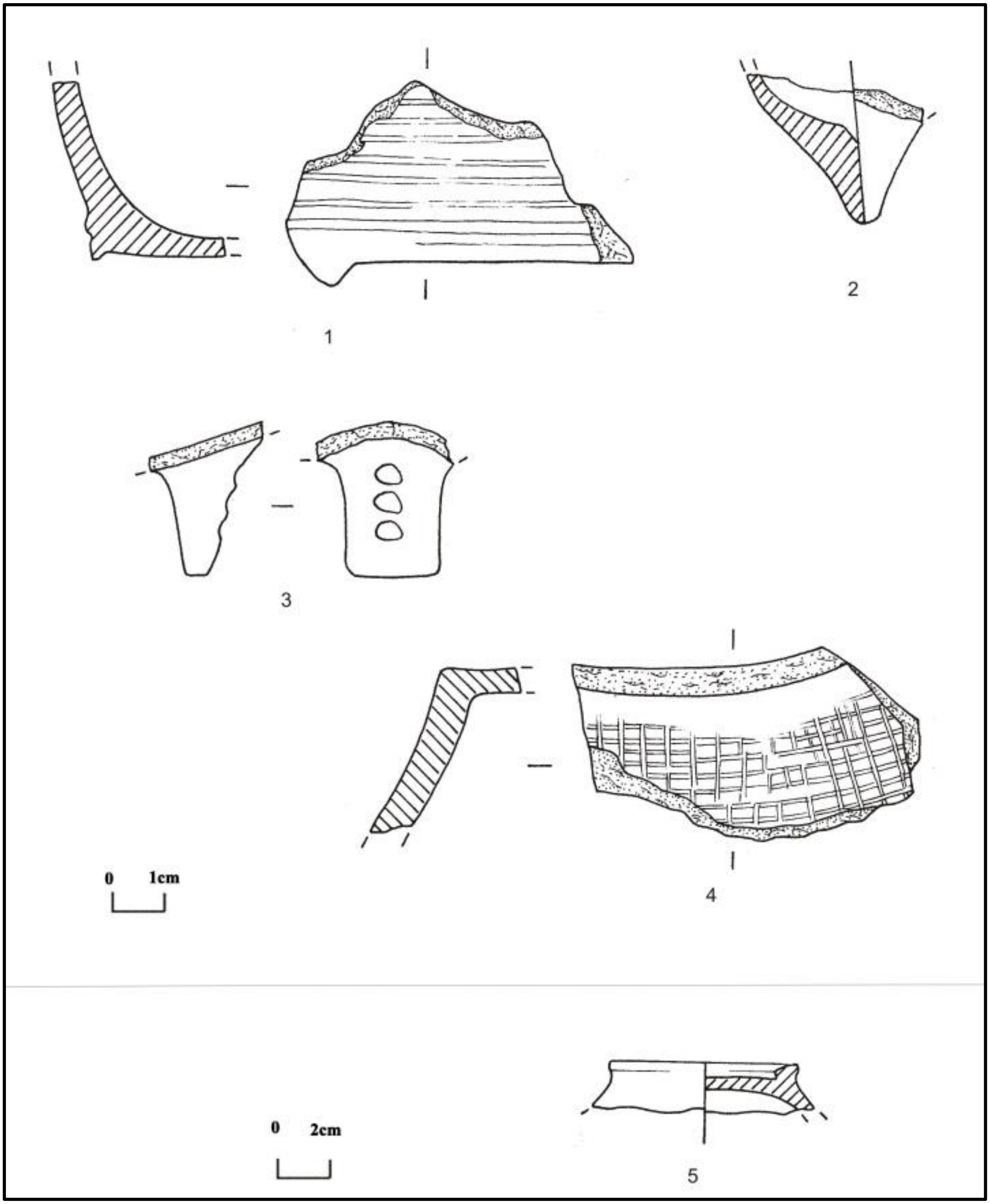


Figure 4.22 Artifacts (Longshan period).

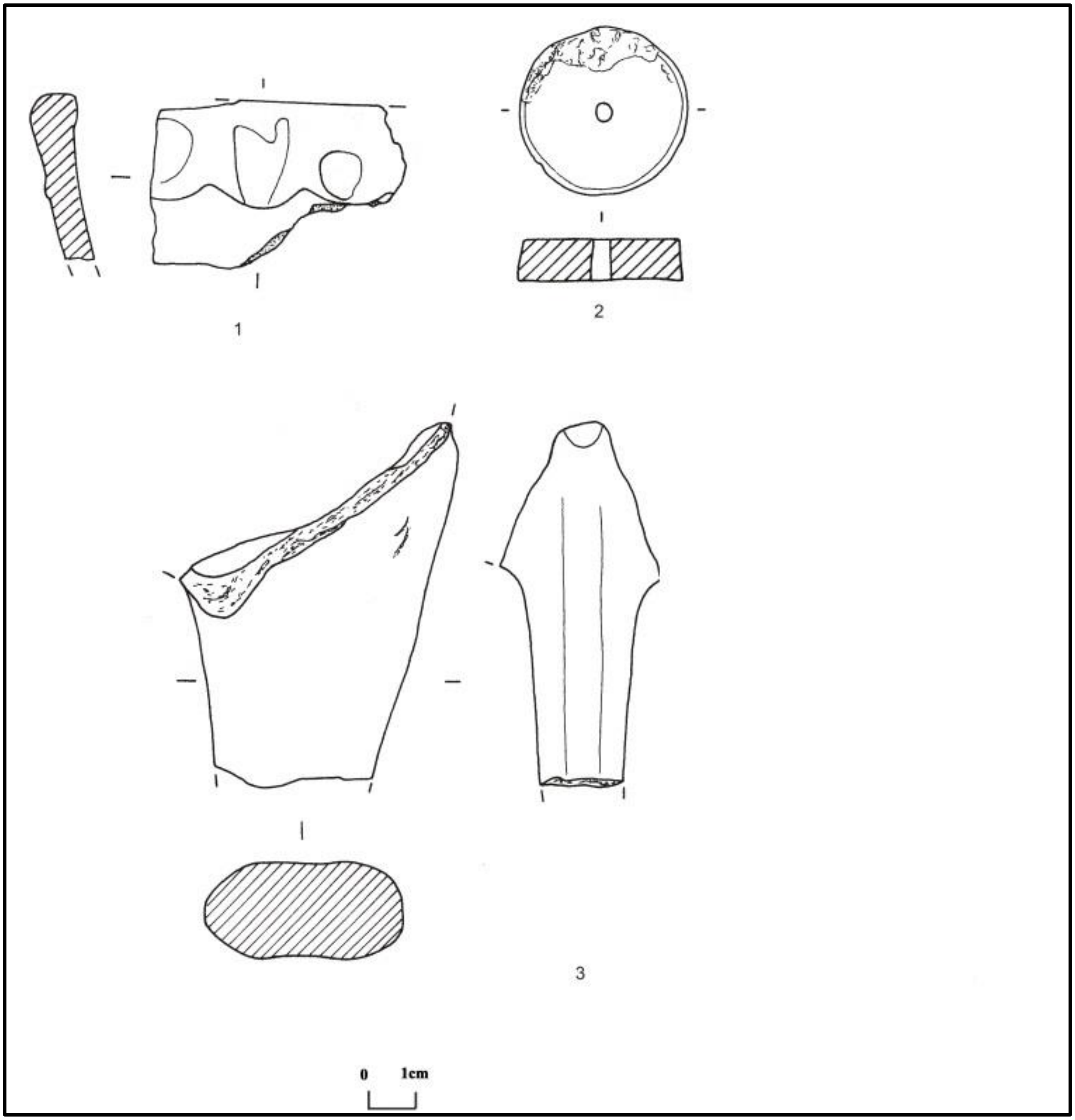


Figure 4.23 Artifacts (Longshan period).

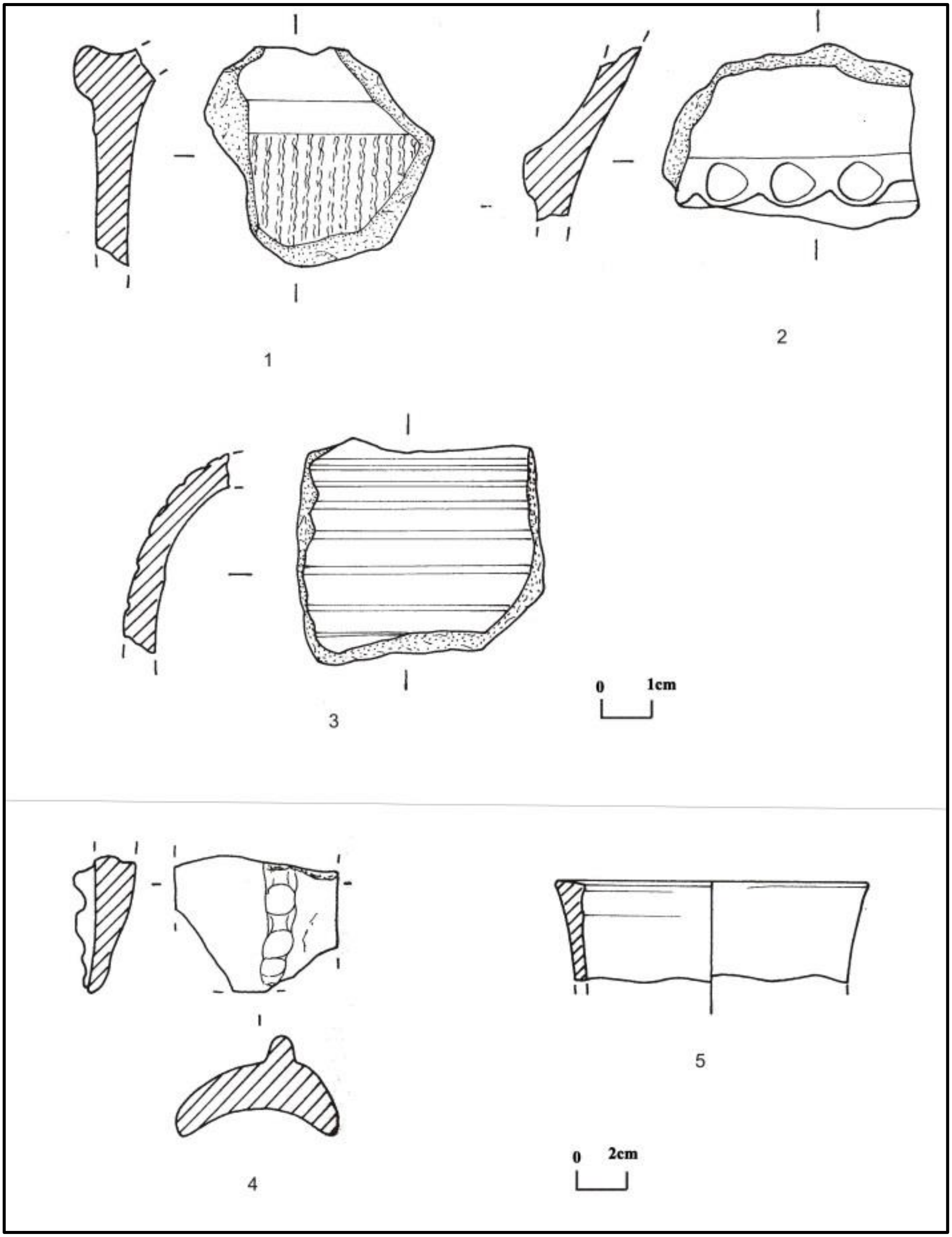


Figure 4.24 Artifacts (Shangzhou period).

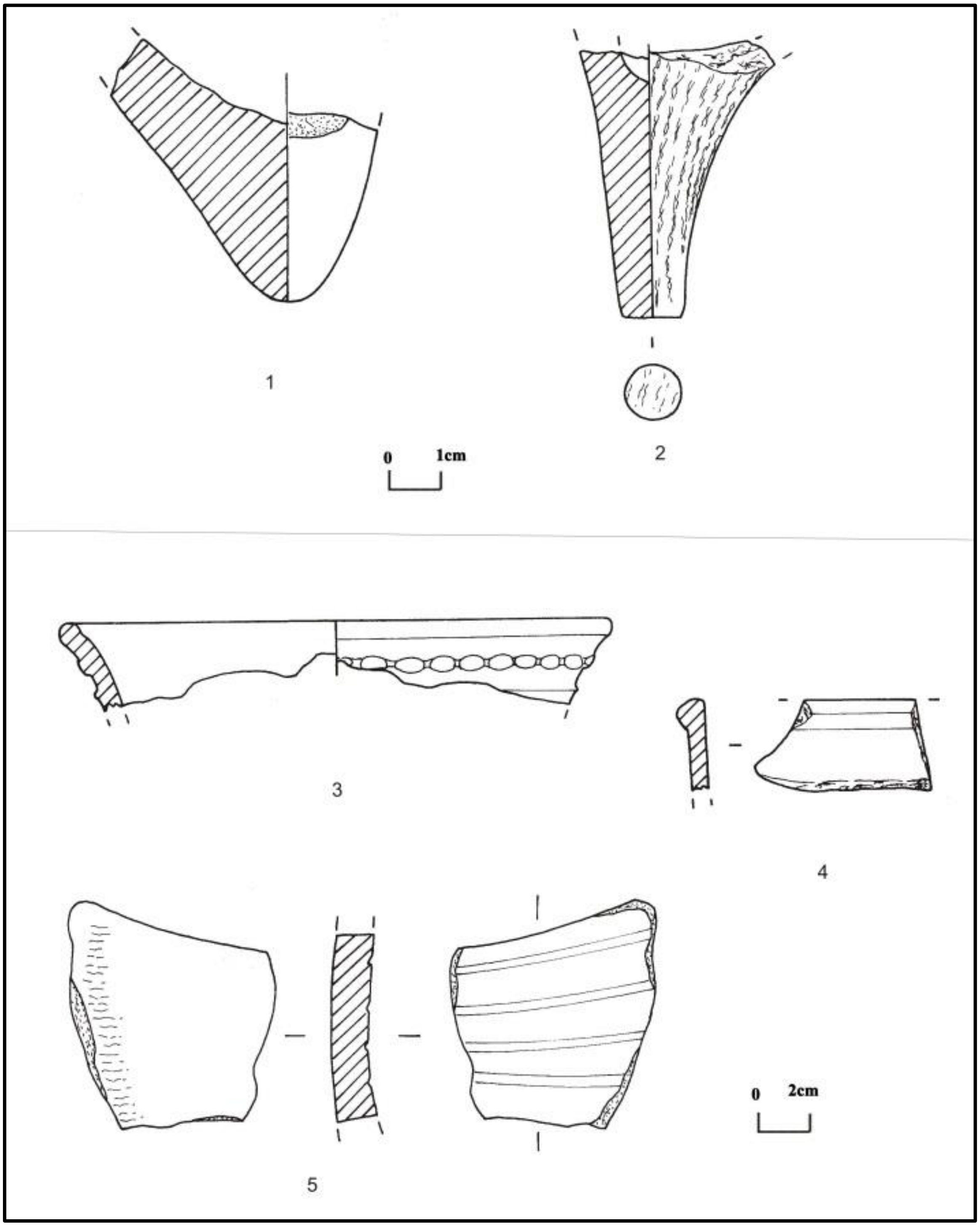


Figure 4.25 Artifacts (Shangzhou period).

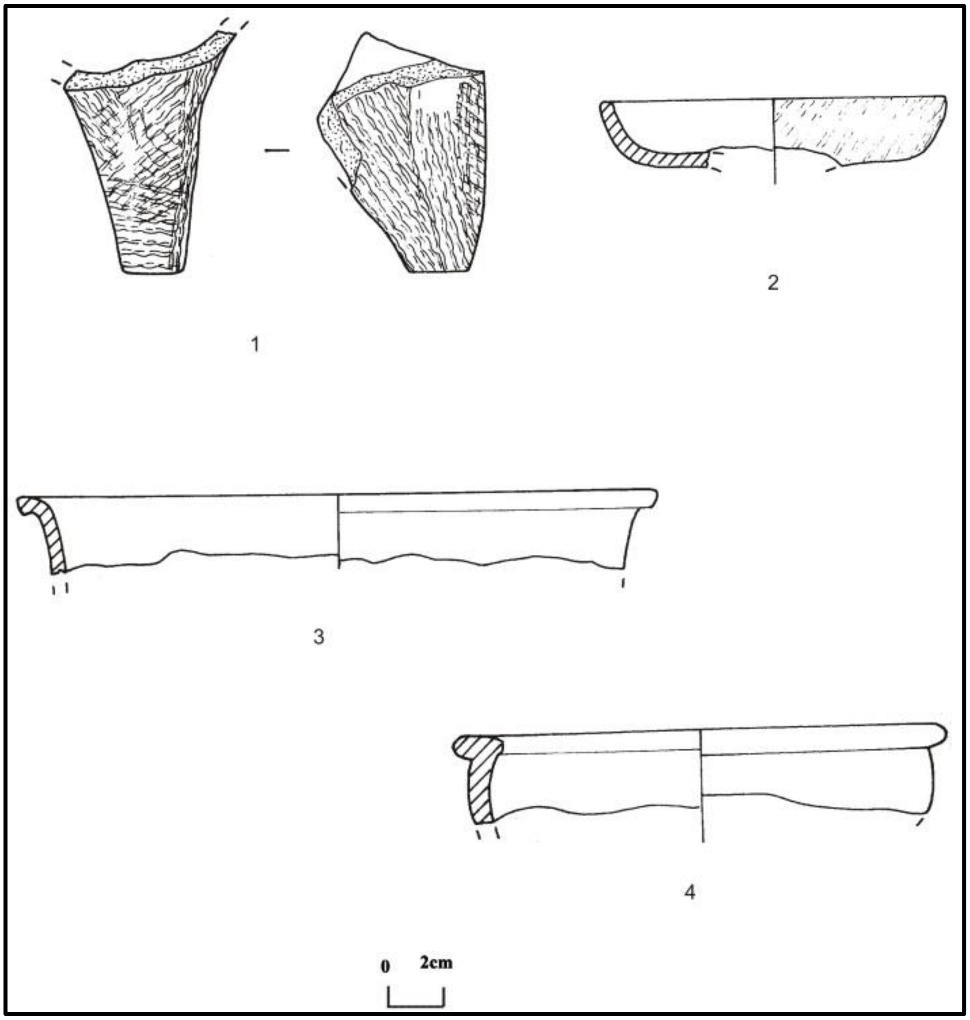


Figure 4.26 Artifacts (Eastern Zhou period).

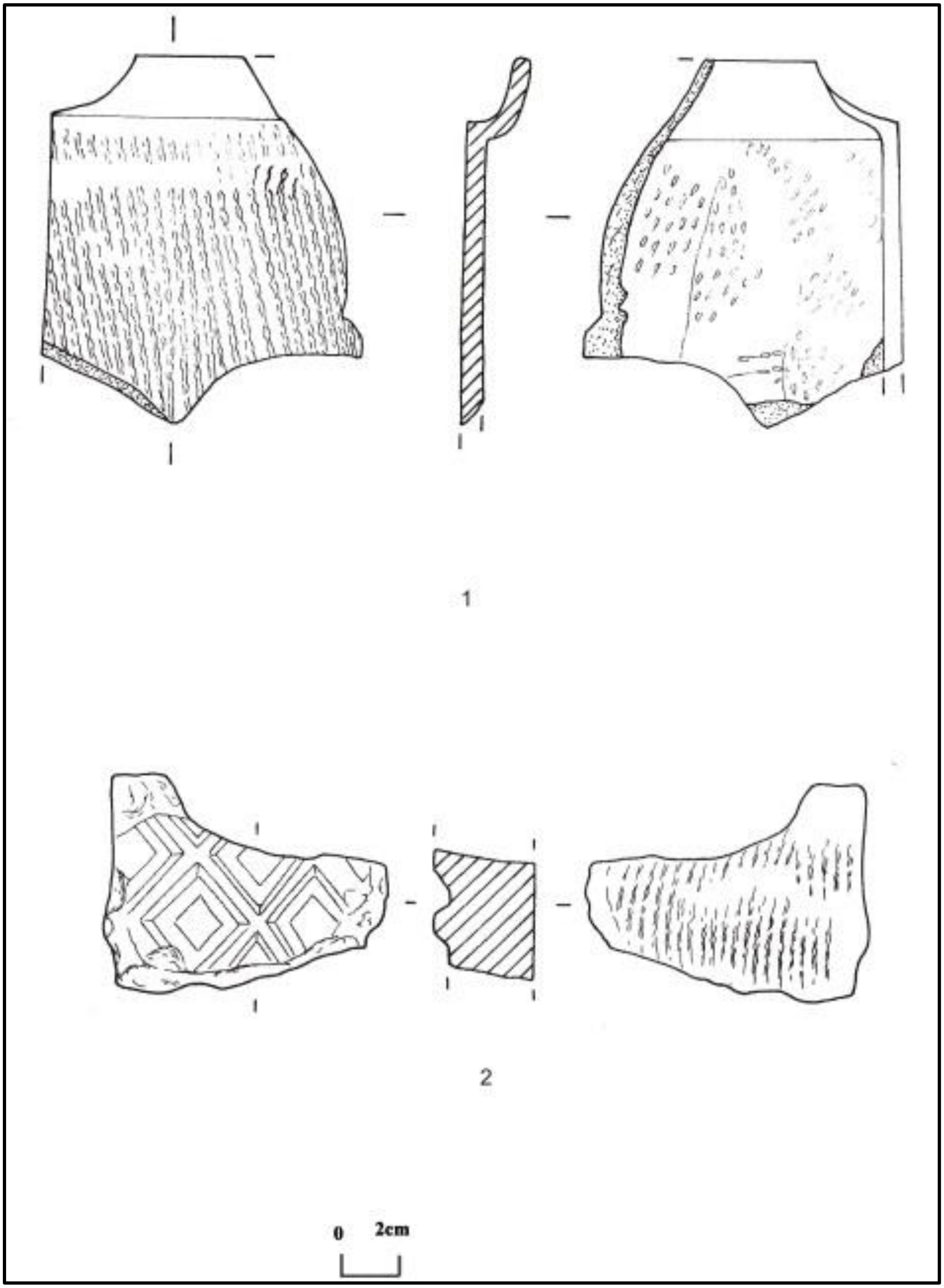


Figure 4.27 Artifacts (Eastern Zhou period).

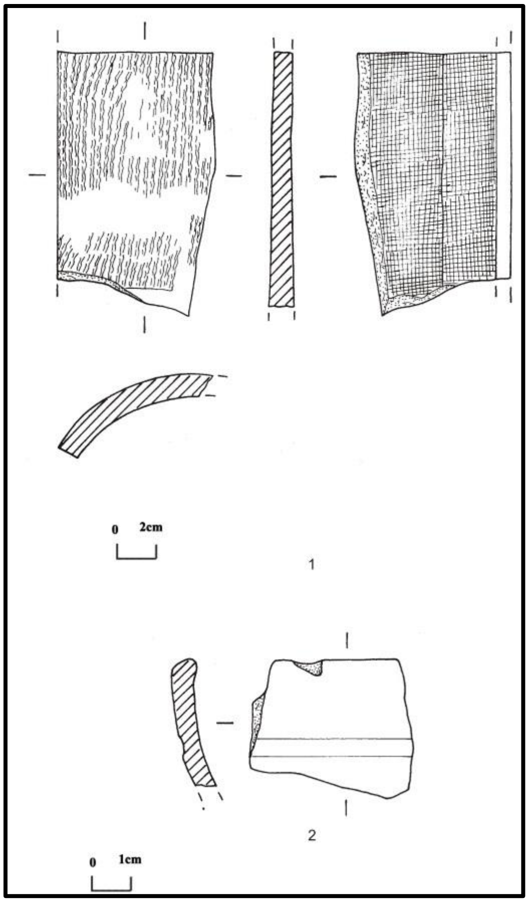


Figure 4.28 Artifacts (Tangsong period).

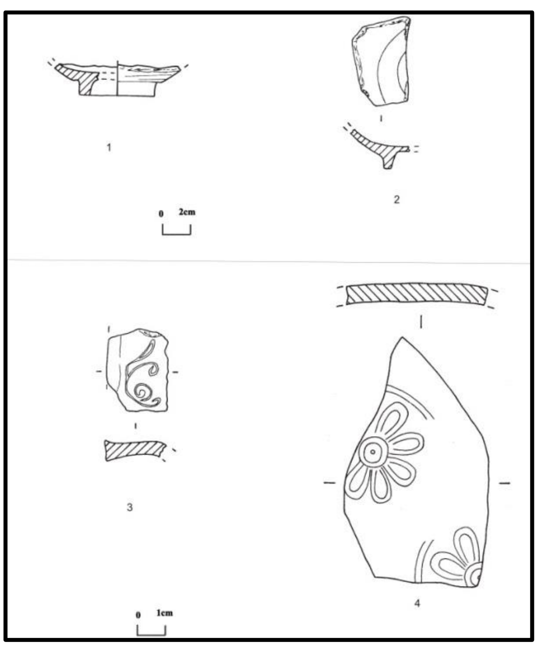


Figure 4.29 Artifacts (Post-Tangsong period).

CHAPTER 5

REGIONAL SETTLEMENT PATTERN

Regional full-coverage survey is possibly the best way to reveal regional settlement patterns, which illustrates changes and continuity in settlements and populations well as provides important insights into societal organization and organization changes (Fish and Kowalewski 2008). As one of the major results of this project, in this chapter, I will discuss the period-to-period settlement pattern in the Middle Guan River valley from the Middle Yangshao period to the Post-Tangsong period. For each period, I describe the number, size, distribution, the spatial patterning and structure of settlements. Settlement patterns show that there was more continuity during the Neolithic periods and during the historic periods. The most significant transformation in settlement pattern took place during the Eastern Zhou, with not only increase in the number and area of settlements, but also in the organization of settlement system.

I adopt a numbering system to differentiate the site and collection unit numbering system. Each settlement is marked with the abbreviation of its occupational phase, such as LYS for Late Yangshao, followed by a number. The settlement sequence number follows the sequence of collection unit numbers as well as site numbers—the smaller the collection unit and site number, the smaller the settlement number. Also, similar to the site identification rule, if the distance between two settlements is further than 100 m, they are numbered and counted as two separate settlements, even though these settlements belong to the same site. For example, S001 contains two Middle Yangshao components, which are named MYS1 and MYS2.

As settlement maps are effective for identifying spatial patterns (Figure 5.1-10), I also use other spatial tools to measure and compare such patterns quantitatively, including Nearest Neighbor Analysis (Clark and Evans 1954) and Ripley's K (Bevan and Conolly 2006) for measuring clustering/dispersion pattern. Dispersion or clustering of settlement reveals the spatial relationship of regional settlement system, and is an important indication of population nucleation, territorial expansion, socioeconomic gravity, and intensity of social interactions. For example, a compact, clustered settlement system in a small area can be interpreted as a nucleated, urban center with a rural area surrounding it. If settlements cluster in a great distance and spatially separate from other settlements, it may indicate a large social organization with clear territory. In contrast, a disperse settlement pattern indicates a relatively autonomous, less integrated, and socio-politically undifferentiated regional landscape.

Nearest Neighbor Analysis (NAA) is a distance-based analysis of point patterns used to compare the dispersion/clustering pattern of settlements. It measures the Euclidian distance between each point to its nearest neighbor, which is compared to the expected values for a random selection of points. The index result is between 0-2.15, where the smaller the value, the more clustered the pattern is. If the value is greater than 1, the trend is towards dispersion. In the study area, since there is a large unoccupied space between the upper reach and the lower reach of the Guan River, NAA measures all sites as well as sites only at lower reach to reveal the difference caused by spatial separation of sites between the lower reach and the upper valley.

Figure 5.11 presents a line chart of NAA results of each period except the Middle Yangshao period for the lack of data. The results from all sites and from only lower reach sites show similar trends. As most values are below 1, the settlements patterns are generally categorized as being clustered. The degree of clustering decrease from the Late Neolithic to the Shangzhou period (shown by the increase in NAA values), and then increase till the Qinhan period. The high NAA value of Shangzhou period is possibly because of the only site in the upper stream, which increases the point-to-point distance measurements significantly.

Ripley's K calculates the average cumulative frequency of points at a given radius over a range of distance. The observed value, which is calculated for differ distances, is compared with the average cumulative frequency of the expected random distribution of points. Observed values that are higher than expected suggest clustering, while lower observed values suggest dispersion. The Ripley's K function is generally transformed into an L(r) function that plots the expected value into a horizontal line intersecting the (0, 0) point. Figure 5.12 presents the calculated results for all sites and lower reach sites at each period with no border correction. The x-axis shows the automatically selected radius, while the y-axis shows the L (r) function. If the observed values lie above the zero line, which is the dotted line in the graph. The pattern suggests aggregation. The solid line near the dotted line shows the confidence interval for null hypothesis of no aggregation.

Figure 5.12 shows a striking difference in the clustering patterns between all sites and lower reach sites. The former patterns are more consistent, possibly due to the inclusion of large unoccupied areas between the upper and lower reach in the calculation. The results for lower reach present a clearer contrast in the dispersion —the Late Yangshao and Longshan show a clear peak value, while in later periods the peak values are ambiguous. The Ripley's K graph can be used to identify the largest cumulative features within certain distance. In this study, a clear peak value is possible indication of the size of settlement clusters, which is shown as the distance with the largest L(r) value on y-axis.

Other than the dispersion/clustering pattern, another important index for settlement pattern is the settlement hierarchy. I divide settlements into tiers based on size. The site size falls into breaks naturally in most cases. Based on all settlement size data in the Guan Valley, settlements are categorized into no more than four tiers depending on the period. The first tier settlement is larger than 10 ha, the second is between 1-10 ha, and the third is smaller than 1 ha. The largest settlement at the Eastern Zhou and Qinhan periods are larger than 40 ha, 2-3 times larger than the second largest settlement. The paramount sizes of these two settlements make them outliers in the settlement hierarchy, thus belong to a supra-tier.

In general, the occupation at the Guan River valley started in the Middle Late Yangshao period, and reached first peak during the Late Yangshao period. After a period of low settlement density, the occupation grew tremendously during the Eastern Zhou and reached the highest point during the Qinhan period. After Qinhan, the occupation decreased again (Figure 5.13). However, Eastern Zhou and Qinhan periods have the lowest ceramic density (Figure 5.14). This inconsistency in artifact density suggests that the occupation pattern and intensity varies from period to period. The spatial patterning, as indicated by Nearest Neighbor index and Ripley's K's graph, shows a general clustering pattern across all period. Yet the intensity and the nature of aggregation also vary, especially between the Neolithic period and the historic period. The settlement hierarchy varies from 1 to 4 tiers (Figure 5.15), and the ratio of settlements of each tier varies from one period to another (Figure 5.16), suggesting great fluctuation in the hierarchical structure of settlement system.

5.1 Middle Yangshao Period (MYS): 4000-3500 B.C.

Although there are some Paleolithic findings in the survey area (Pei and Song 2006), there is no evidence suggesting the area was occupied during the early and middle Neolithic period. There are two hypotheses for this occupational gap. First is in relation to deposition processes, for example, a disastrous flood event that buried pre-Middle Yangshao sites. The second hypothesis, which will discuss further in Chapter 9, is that the region was abandoned by the microlithic groups. The earliest occupations (MYS1-2) date to the Middle Yangshao period of the Late Neolithic (Figure 5.1). Since some of the Middle Yangshao-style ceramics were used during the Late Yangshao period (Ren and Wu 2010), for the purpose of discretion, I combined small quantities of the Middle Yangshao ceramics in a Late-Yangshao-dominated collection into the Late Yangshao collections. As such, the occupation of the Middle Yangshao period presented here is a conservative speculation.

According to surface survey, MYS1 and MYS2 were the first settlements to appear in the region since the Holocene. They were both in the Yanggang terrace, about 400 m apart. Both occupations were no bigger than 0.25 ha. The ceramic density is high enough to confirm that the sites were not formed through transportation of artifacts (Figure 5.14).

Both occupations were located near the confluence of the Guan and the Ding River, about 800-900 m to the east of the Guan River and 1400 m to the southwest of the Ding River. The fluvial history and agricultural practices have shaped this area into layers of cross-cutting terraces. MYS1 was close to the highest spot of the Yanggang terraces. On the modern landscape, the terraces are 1-2 m above the alluvial plain, appearing as a platform when viewed from the east and south. The sedimentation profile of the section shows that the platform feature was created and heightened by road and house constructions. As the Guan River meandered to the east of the Yanggang area, the threat of flood is greater on eastern side of the river than it is on the western side. Nevertheless, floods were probably still a considerable concern for the Yanggang residence during the Neolithic period. The flood record from the 2010 shows that the inundation reached as far as 600-700 m from the bank in the Yanggang area, leaving sandy deposit that is still visible at MYS2 today. However, continuous and intensive farming activities have exposed artifacts much closer to the river. Thus alluviation may not have been a significant factor in the low occupation density during the Middle Yangshao period.

5.2 Late Yangshao Period (LYS): 3500-2900 B.C.

A series of drastic changes transformed the regional settlement system during the Laye Yangshao period (Figure 5.2). The number of settlements increased to 22. A three-tier settlement hierarchy was established in the region: 1-tier: larger than 10 ha; 2-tier: 1-10 ha; 3-tier: less than 1 ha (Table 5.1). Settlements formed into circumscribed and compact clusters, with large unoccupied areas between them (Figure 5.2). Most of the large centers were positioned on elevated areas, while occupations on flat alluvial plains are usually small. Although almost all settlements were located near the river, they were no longer restricted to the Guan River main stream; instead, settlements expanded to the river terraces and nearby hillsides of all major tributaries of the Guan River. For example, LYS17 was on an arc-shaped hill alongside the Badie River. The hilltop is at least 30 m high and 50-100 m wide, with steep slopes on both sides.

LYS14 was located at a long, narrow terrace of the Badie River where the river flows out of the mountains.

Settlement clustering began at this period. Figure 5.2 shows five clear and discrete clusters, occupying the main stream and three tributaries of the Guan River from the north to the south: the Xiaobei River, the Badie River, and the Guzhuang River. The NNA shows that the level of clustering is at the highest point historically (0.2857; see Figure 5.11). From the Ripley's K's graph, settlements are most clustered within a 750 m radius area, and increasingly dispersed rapidly beyond that radius (Figure 5.12). The distance between clusters varies from 1 km to 20 km. Areas between clusters lacked occupation, leaving a large proportion of the survey area unoccupied. The unevenness of valley landscape further increases the traveling time between settlement clusters if contacts between clusters existed during this phase.

Ripley's K graph provides a 750 m radius area as an average coverage of the settlement cluster, which allows me to differentiate settlement clusters spatially and investigate their internal structures. A two-tier hierarchy was identifiable in some clusters. LYS1 was the largest in the area at this time. It expanded rapidly to 24.8 ha from two small occupations in the previous phase (Figure 5.17). LYS13 was included in Yanggang system, consolidating the two-tier settlement hierarchy in this area. LYS13 was 0.5 ha in area, located about 700 m to the north of LYS1. This occupation is less than 150 m from the Guan River to the east and much closer to the river than LYS1, 2 and 3. The space around LYS13 as well as between LYS1 and 13 is largely covered by flood sediments from 2010. Only 1-2 sherds are scattered here. Two small hamlets of 0.25 ha in size, LYS2 and 3, were positioned on terraces about 200 m to the east and north of

LYS1. LYS2, 3, and 13 have relatively low artifact density compared to LYS1 (Figure 5.18), suggesting that the occupation at LYS1 is highly nucleated.

Settlement hierarchy was also identified in the tributary settlement systems. Another prominent settlement cluster is at Majiaying near the Xiaobei River, consisting of LYS9, 10, 11 and 12 (Figure 5.19). It featured a two-, if not three-tiered settlement system. One hundred and fifty meters to the west of the other two, the 8.8 ha center, LYS9, was the second largest settlement during this period. By contrast, the eastern occupation, LYS10, was only 1.1 ha. Two hamlets, LYS11 and 12, were located at the other side of Xiaobei River.

Other than the excavation on part of LYS9 which has not been published yet, post-depositional processes have not extensively influenced the formation of this intriguing settlement cluster. The collection shows that the LYS9's core area lay on the small mound of its northern section, where adobes and sherds are densest. High sherd density may be largely due to excavation. In comparison, the occupation on the lower lying land near the river, which is separated from the mound by a modern village, is also convincing. The sherd density on the near the river is similar, or even higher compared to the density on the southern edge of mound; the occupation carried on into historic period on the lowland, which is absent on the mound.

No sherd of this period was found in the blank area between LYS9 and 10, an open space that was occupied in later periods. The area between LYS9 and 10 is flat farmland with excellent visibility. Also, sherd density is similarly high: the lowland of LYS9 is 60 sherd/ha, and the collection unit in LYS 10 that is nearest to LYS9, C269, has a density of 40 sherd/ha. Although it is uncertain if this blank area was unoccupied during the Late Yangshao period, it is more likely that the space was used or deposited in processes that are different from LYS9 and 10.

Across the river from the center, the location of LYS11 and 12 indicates diverse residential patterns for resource using. Nowadays the Xiaobei River is only 5-10 m wide. The alluvial plains on both sides of the river are narrow and restricted by small hills, which also kept the river from dramatically changing its course. The current channel is shallow and eroded severely. According to local villagers, the area was not affected by flood in 2010. Their observations are supported by the lack of flood sediments on the settlements. Though rivers have paramount forces on the landscape throughout the region, it seems that the fluvial pattern of the Xiaobei River near the Majiaying settlements has been quite stable, which rules out the alluvial processes led to the formation of LYS11 and 12.

The size and location of LYS11 and 12 imply that they may have been occupied seasonally, in contrast to the LYS9, which was likely a more permanent occupation. The higher elevation of LYS9 protected the site from floods and hazards. LYS10, 11, and 12 may have been used for subsistence activities. Since LYS10, 11 and 12 were on alluvial plains close to the river, I suspect that irrigated farming and water-resource acquisition were the major concern for lowland occupation. Taken this into consideration, LYS11 and 12 may be occupied especially for alternative farming when the farmland at LYS10 was in fallow or inundated by flood.

A similar occupation pattern is also found at the settlements near the Badie River (Figure 5.20). The largest settlement near this tributary, LYS17 is 2.3 ha in size and located on the ridge top of a valley that is at least 30 m above ground-level and 400 m from the edge of the Badie River. Although a small stream flows beneath LYS17, a steep slope makes the narrow stream hard to access for people on the hilltop. To the north of LYS17 is mostly hilly terrain, while the broad Badie alluvial plain expands to the east and south, forming some of the best farmland of all in the survey area. Yet occupations on the alluvial plain are small and scattered. The 0.5 ha site LYS18 is 450 m to the south of LYS17 on the flat floodplain on the other side of Badie River. LYS15 and 16 were two similarly small occupations, .25 ha each, 500-700 m further to the east and west of LYS17 and 18.

The occupation of the Badie River was not limited to LYS17 and its neighbors on the floodplain of the middle reach. LYS14 was situated at the upper stream of the Badie River, where the river flows out of mountains and has formed long, narrow-bench terraces less than 100 m wide on one side of the river. LYS23 was 2 km downstream of LYS17, easily accessible for residents of LYS17 by water or land. The formation of LYS23 is ambiguous compared to LYS17. Only one diagnostic sherd, the foot of a Ding tripod (the heaviest part of any Late Yangshao vessel), was found at this location. The weight of such feet increases their transportation difficulty by regular colluvial process, which likely explains the sherd's rare presence at a non-site location.

The occupation of Xiaoshui started from this period (Figure 5.21). The largest one was LYS6, measuring 1.05 ha, while LYS7 and LYS8 which are 350 m to the west, are both 0.25 ha. Surprisingly, the LYS6 is on the current river bank, closer to the river than all later occupations, which gradually moved inland in the later period. Nowadays, the river bank is largely covered by fluvial sediments, wild grass, and trees, creating low visibility for the surveyors, which may have, to some extent, minimized the occupation area. However, in the more open area with good visibility, the sherd density is low, indicating that the occupations were sparse compared to their counterparts at the lower reach of the Guan River, a pattern inherited by later occupants at Xiaoshui as well.

In contrast to the rise of large centers in some areas, the occupations at the Guzhuang River do not differ much in size (Figure 5.21). All occupations here were 0.25 ha in size. LYS19, 20, 21 and 22 were located on top of a series of river terraces of the Guzhuang River, less than 200 m apart from each other. About 800 m to the east, LYS19 was on a higher terrace where the Guhuang River curves and creates a delta-shaped floodplain.

In general, all Late Yangshao settlements were in close proximity to a watercourse. The clustering settlement pattern was another prominent feature. Settlement clusters were compact and often consist of 4-5 settlements. The settlement hierarchy was no more than moderate in most of the clusters. Centers were evident. Small settlements were nearby, all within less than a 1 km radius. The settlement tier was weak, although size differences do exists among non-center settlements. The location of center/non-center settlements is intriguing; the centers occupied elevated, but naturally bounded localities, while the hamlets were positioned on the alluvial plain. The areas between clusters, despite being of the highest quality farmland in the region, have no evidence of human occupation.

5.3 Longshan Period (LS): 2900-1900 B.C.

The artifacts of the Longshan are difficult to identify in the study area. An array of Late Qujialing, Shijiahe and Longshan artifacts are all found in the Guan Valley. The chronologies of these ceramic styles overlap and certain ceramic styles existed across periods. Mixed ceramics made site dating difficult. The team grouped collections into Early Longshan, Late Longshan, Longshan, and Yangshao to Longshan periods based on the best available knowledge. These phases are not as clear-cut as we would have hoped; the last two categories, in particular, are ambiguous. Longshan ceramics are the ones that we cannot identify with either Early or Late Longshan phase. The Yangshao to Longshan category is comprised of ceramics that dated to a general period from Late Yangshao to Late Longshan (see Appendix 2).

Considering these technical difficulties, I will discuss the settlement patterns of the Early and Late Longshan independently and together as the whole Longshan period, including settlement data from the Early Longshan, Late Longshan, and the Longshan periods in one single data set. For the purpose of clarity, I omit the Yangshao to Longshan ceramics.

Early Longshan (ELS): 2900-2500 B.C.

A series of changes in settlement patterns took place during the Early Longshan period (Figure 5.3). The Early Longshan occupation was highly nucleated. A total of 872 sherds of this phase were found in 31 collection units, the highest sherd density across all periods. However, the settlement count decreased to 11, and the total occupation area shrank from 43.05 ha during the Late Yangshao to 16.35 ha. The regional site hierarchy compressed as well. The Yanggang settlement was still the largest, and the only first-tier settlement. Previous centers along the Guan River tributaries disappeared and remained only small hamlets of 0.25-0.5 ha.

The Yanggang settlement, now ELS1, dwindled to 13.6 ha from 24.8 ha in the previous phase. Compared to the previous phase, the occupation was still concentrated on the higher terraces and occupied a similar area. The collection units show that the occupation formed an “S” shape, leaving three blank blobs, minimizing the measurement of the occupation area (Figure 5.23). The sherd densities are exceptionally high in 80% of collection units, with a mean of 38.9/units and 60 sherd/ha. In the Yanggang settlement cluster, LYS2 and LYS13 disappeared in this phase, while the LYS3, now the ELS2 was the only hamlet at Yanggang. This hamlet was on the floodplain, about 300 m to the east of ELS1. Although the size was still 0.25 ha, it yields more sherds compared to the previous phase.

Other than the Yanggang settlements, occupations at all tributaries decreased in number and size, if they still existed. All occupations were 0.25 ha. Remaining settlements were still positioned along watercourses, but neither the compact clustering pattern nor the settlement hierarchy was identifiable. The Xiaobei river settlement system was reduced to two small river-separated occupations and another two occupations further down the stream. The Badie River occupation shrank to a single hamlet. The settlement system at the Guzhuang River was wiped out. The Xiaoshui settlements also diminished to two small occupations of 0.25 ha, further away from the river.

While the other settlements were shrinking and disappearing, a new occupation, ELS6, appeared at a location further inland, more than 500 m to the east of the Guan River, and 1 km to the south of the Xiaobei River. Six sherds were found at this location. The occupation was located on the fertile alluvial plain, the site of most irrigated farmland today, although this area may have been vulnerable to flood, as the Guan River curved to the side. Today, farmers here cultivate rice and lotus roots here, instead of wheat which is much more common.

Late Longshan (LLS): 2500-1900 B.C.

Similar to many other surveyed regions in China, the occupation went through a dramatic decline during the Late Longshan period (i.e. Underhill *et al.* 2008) (Figure 5.4). There are only three settlements dated to the Late Longshan period. LLS1, the Yanggang occupation, decreased to 1.6 ha, though the three collection units on the high terrace feature high ceramic densities. LLS2, the Xiaoshui settlement was 0.7 ha during this period. At the Guzhuang River basin, a small occupation, LLS3, reappeared after the area was abandoned in the previous phase. All of settlements are along the watercourse.

Longshan Period (LS): 2900-1900 B.C.

When all Longshan collection units are grouped together, a different settlement pattern emerges (Figure 5.5). The settlement count increased to 25. The total area of occupation remained smaller than the previous period, but a total of 36.65 ha makes the decrease much less drastic compared to the 43.05 ha in the Late Yangshao period (Figure 5.13). As shown from the map, the clustering pattern continued in some regions. In general, Nearest Neighbor Analysis results in 0.539 in the lower reach of Guan River (Figure 5.11), higher than the previous phase, indicating a more dispersed pattern than the Late Yangshao. The Ripley's K function shows that the settlement clusters are most bounded within 790 m (Figure 5.12), which is also larger than the Late Yangshao period, suggesting that settlement clusters occupied larger areas in this period. The regional settlement hierarchy was three tiers (Table 5.2), but varied from one to two tiers in settlement clusters. The distribution of settlements and clusters were more varied, although still mostly following the watercourse.

The Yanggang occupation was highly nucleated. The largest Yanggang settlement, LS1, was 23.9 ha in area, smaller but still located on the higher terrace as in the previous phase. However, as discussed in the Early Longshan section, LS1 produced 40 sherd/ha, higher than any other period (Figure 5.24). This exceptionally high sherd density indicates an intensive use of the limited area on the terrace. There was an open space close to 2 ha at the center of the occupation with nothing found from this period, dividing the occupation into two sectors (Figure 5.25). This open area shows no apparent geophysical difference from the occupied area; they have similar terrace structures, soil, and land cover. Although collection units with less than 10 sherds were mostly located at the boundary of the settlement (except C023, which is at the center), there are also units with high sherd counts at the boundary. High density units can be attributed to taphonomic process as well as site use. The distribution of high and low shred density units may suggest the change in settlement configuration in relation to spatial use. Other than LS1, only one hamlet, LS2, was in the Yanggang area.

As artifacts show no apparent difference between the two occupied sections at LS1, this spatial separation was less likely to be caused by social differentiation, as seen in large Longshan sites such as the spatial differentiation at Taosi site, where occupation spaces for elites and commoners were distinguished (Liu and Chen 2012). For the same reason, the spatial separation was also unlikely to be created by functional difference.

The separation within the settlement was similar to a type of dual-settlement organization in the Mid-Yangtze River region, where one walled settlement contains two separate living areas (Pei 2010). For example, the occupation at Taojiahu, a walled site in Yingcheng, Hubei, had two mounds that were occupied contemporaneously, with less-than-20 m of open, unoccupied area in between. This type of settlement always revealed high occupation density in some areas coupled with large unoccupied land outside the site, which served as farmland for rice cultivation (2010). The Yanggang settlements during the Longshan period resemble the dual-settlements structure, although there is no evidence of walls or moats in Yanggang.

In contrast to highly nucleated occupation at Yanggang, Xiaoshui developed quickly at this time in a more dispersed pattern (Figure 5.26). The occupations dotted the alluvial plain on the west side of the river, and appeared, for the first time, on the plain to the east of the river

(LS4). There was no center at this point; occupations were discontinuous, mostly distanced by 100-200 m, and small in size (mostly 0.25 ha). The sherd density was low across the area. Compared to the intensive occupation on terraces at the Yanggang, Xiaoshui shows a different pattern that emphasized extensive use of land, especially on the broad alluvial plain.

A similar extensive land use strategy was manifested in other settlements. Another prominent cluster during the Late Yangshao period, the Majiaying settlement cluster, continued into the Longshan period (Figure 5.27). But there were significant changes in settlement pattern. The previously divided settlements at the northern bank of the river were incorporated into a new center, LS18, with an area of 4.65 ha, only half of its previous size. The mound where LYS9 resided in the previous period was barely used in this phase, same as the west and north section of LYS9. The occupation was concentrated on the alluvial plain, especially the area that was unoccupied between previous LYS9 and 10. The two small occupations across the river were abandoned, and replaced by one larger occupation on the alluvial plain, LS19 (0.7 ha). Three hundred and fifty meters to the southwest of LS18, a new occupation similar to the size of LS19 appeared also on the alluvial plain, with an unexpectedly high sherd density. To the further east, LS14, 15, and 16 were all small hamlets on the broadest part of the Guan River alluvial plain. LS16 was 1 km away from both the Xiaobei and Guan River, making it the furthest from the watercourse.

LS14, 15 and 16 were beyond the 750 m radius of the Xiaobei settlement system. However, they were an important part of the settlement pattern of the Majiaying system in the Longshan period. In contrast to the emphasis on higher terraces and mound displayed during the

Late Yangshao period, the inhabitants of LS14, 15 and16 chose to situate their settlements on the alluvial plains, manifesting a general trend in location choice during the Longshan period.

Both LS14 and 16 were close to a modern irrigation canal. The settlement record of this survey shows that the area along this canal have been increasingly occupied, suggesting that this canal, though built within the last 100 years, may have incorporated an ancient river channel or ancient canal. If so, the earliest occupation around this channel was during the Longshan period.

The Badie River and the Guzhuang River were sparsely occupied. The largest settlement, LS25, was 1.1 ha, sat at the confluence of Badie River and Guzhu River. LYS17, inhabited during the Late Yangshao period, disappeared. The broad alluvial plain on both sides of the Badie River was unoccupied, except for LS21, a minor hamlet that is 1 km to the east of LS25. Interestingly, LYS16, the Late Yangshao occupation at the transition from mountains to alluvial plains continued into Longshan period, even though it was a single hamlet. The Guzhuang River occupation was almost completely abandoned as well, except for two small hamlets.

In sum, the Longshan settlements seem to be less nucleated than the Late Yangshao at the Lower reach of Guan River. Large centers, especially Yanggang, may have been used more intensively, as shown by the high sherd density. Secondary centers decreased in number and size. In the upper reach of the Guan River, Xiaoshui started to expand, although a settlement center was not yet formed. The most noticeable characteristic of Longshan occupation is the tendency to use broad alluvial plains, despite flood risks. During the Late Longshan period, settlements decreased significantly, and most of the valley was abandoned.

5.4 Shang to Western Zhou (SZ): 1900-771 B.C.

Shangzhou ceramics are the most difficult to identify in the study area. The team identified and divided the ceramics into Shang to Western Zhou, Western Zhou to Eastern Zhou, and Eastern Zhou, based on the best available knowledge (see Appendix 2). To avoid overlooking settlements, I use the practice as in previous section that excludes collection units with ambiguous dating—the Western Zhou to Eastern Zhou period. I will present the Shang to Western Zhou settlement pattern first.

As shown by many regional surveys beyond the Central Plain, the regional settlement system shows a dramatic occupation decline during the Shangzhou period (Figure 5.6 and 5.13). In contrast to the Late Longshan settlements discussed earlier, this decline took place during the Late Longshan period before the end of the Neolithic. In fact, the occupations increased from 3 to 9 from the Late Longshan to this period. The settlements were not differentiated much in size (Table 5.3). Yanggang remains as the largest settlement (0.8 ha), and has a relatively higher ceramic density (Figure 5.28). The rest of settlements were all small hamlets of 0.25 ha in size. The Xiaoshui occupation at the mountainous area of the upper reach shrank to only one hamlet, the same as the Xiaobei River occupation.

The only identifiable settlement cluster during this period was at the Guzhuang River, which consisted of SZ5, 6, 7 and 8 (Figure 5.29). This occupation grew into an upper-class cemetery and a second-tier settlement in the next phase.

Other than the Guzhuang River cluster, two new sites appeared 90-150 m from the east bank of the Guan River prosper during the next phase (SZ9 and 10).

It is unclear why occupation was scarce during this period. Ceramic style shows a strong signature of the typical Shang artifact style, first from Erlitou, then Yinxu. I suspect that the area was continuously under the control of central dynastic power, although the nature, strategy, and degree of dominance are uncertain. The historic records suggest that the study area belonged to a small state called “Ruo” during the Western Zhou, where the capital of the state was located near the Ding River, a western tributary of the Guan River (Xu 1987). A reconnaissance survey found a walled town 2 km away from the western boundary of the survey area dated to the “Western Zhou to Han period” (Xu 1987). No excavation has yet been made to confirm Xu’s dating. The regional settlement survey shows that this walled-town, if dated to the Western Zhou period, lacked a supporting settlement system and large population.

Although the Shangzhou settlements were scarce, many dramatic changes in regional settlement history may have traced back to this period. The explanation for this occupation gap is possibly due to the rises of early states on the other side of the Qinling Mountain Range, which will be discussed further in Chapter 8 and 9. In the next period, the clustering pattern, low regional occupation density, and reliance on river terraces of the Neolithic occupation were altered. The site-size distribution became more varied, and the land use more diverse.

5.5 Eastern Zhou (EZ): 770-221 B.C.

The settlement pattern of the Eastern Zhou reveals a significant population increase and new degree of social, economic, and political complexity (Figure 5.7). The settlement count increased to 41, and the total occupation area increased to 94 ha. Xiaoshui replaced Yanggang as the largest occupation. However, the administrative center was EZ41, which locates to the east of the Guan River. The clustering pattern still existed, but is different than the pattern of the Neolithic periods: Nearest Neighbor Analysis shows that the degree of clustering was higher than the Longshan period (0.601), while the Ripley's K shows that settlements clustering remained quite similar from 200 m to 1500 m (Figure 5.12). This pattern implies that the site-size distribution transformed from delineated and similar-size clusters to more varied clustering pattern. A four-tier settlement hierarchy was established: supra-tier, >20 ha; 1-tier, 10-20 ha; 2-tier, 1-10 ha, and 3-tier, <1 ha (Table 5.4). Second-tier settlements increased rapidly. Site situation varied as more of them were at platform mounds or on higher river terraces, no longer restrained by waterways. The settlements along the Guan River itself increased significantly in number and area.

The rapid expansion of the Xiaoshui occupation is noteworthy considering its geographic configuration, which suggests an increasing exploitation of mountainous region (Figure 5.30). The Eastern Zhou artifacts are distributed across the alluvial plain, creating a supra-settlement that of 46.5 ha. Together with the two small hamlets nearby (0.25 ha), Xiaoshui had a two-tier hierarchy with very concentrated occupation on the west bank of the Guan River. Occupation was denser on the third and fourth terrace, further than previous occupations from the river. The piedmont was not in use during this period. Only one small hamlet is found at a higher elevation (EZ11). The ceramics from Xiaoshui are generally poorer in quality (thicker or uneven thickness, inconsistent in color, etc.) compared to other large occupations from this period. The crude ceramics may suggest that the pottery production was less specialized compared to the settlements at the lower stream.

The importance of Yanggang decreased in this period. The settlement cluster at Yanggang had a two-tier structure (Figure 5.31). The center, EZ1, was a secondary settlement with 3.4 ha in area, located at the western edge of the Neolithic occupation. The second largest, EZ2, was around 1 ha. There were five small hamlets of 0.25 ha each scattered around EZ1 within a 200-900 m radius. The broad and flat land to the west of Yanggang was occupied for the first time. The ceramic density is exceptionally high in a few collection units and relatively low in the rest. Ceramics were mostly household pottery with a few tiles. Since the area is close to the survey boundary, I suspect that more settlements would be found to the west or the northwest of the survey area along the Ding River area, near the town found by Xu (1987) as discussed in the section of Shangzhou settlement pattern.

Although Xiaoshui was the largest occupation of the time, the regional administrative center was another prominent settlement cluster centered on the debris of an Eastern Zhou walled-city, EZ41, which located to the east of the Guan Valley. Different from previous regional centers which locates to the west of the Guan River, this location may have facilitated regional administration and communication. This site was discovered in another reconnaissance survey:

> The city is in a square-shape. The best-preserved sections of the city debris are at the northwest and the northeast corner, and the east and the south part. The eastern city wall is about 700 m long, while the south about 500 m, the west 750 m, and the north 400 m. The east and west of the city are closed to mountain cliffs….the east, west, and south city gates are still visible (Xixia 2010:72)

The city was historically called "White Feather City" after an indigenous stork, which also gave name to the river. Today, the city debris is topped by a recreational park, without a trace of wall or city gates. The area is now part of the modern city, with buildings and roads surrounding the site. All sherds collected in this project were from open construction sites, open ditches, small pieces of farmland, or vegetable gardens—any visible land scattered between densely-populated neighborhoods.

Due to the poor preservation conditions, the survey collection only reflects a small portion of the occupation of this city and its neighboring area (Figure 5.32). Nevertheless, the data provide a glimpse to the occupation during the Eastern Zhou period. The survey shows that the city extended once about 17 ha, compared to the predicted area of 34 ha from the reconnaissance survey (Chinese 1991; Xixia 2010). A secondary occupation, EZ40 (3.04 ha), was located 225 m to the south. The artifacts of these two occupations are similar: a large number of tiles with only a few household pottery sherds. Because of the artifact similarities, we only collected a few tiles from each unit randomly, many more were not collected.

The large number of tiles and few daily utensils suggests a few possibilities. First a layer of tiles could have buried the daily utensils underneath after the city was abandoned. Second, the area could have been abandoned in an organized fashion, with household pottery taken away. Since the area continued into use until the Han dynasty, the abandonment may have happened during or after the Han dynasty. Third, the area could have been used for a specific purpose, in which domestic utensils were not needed. In order to investigate the possibility of each hypothesis, I will introduce the river bank sites first.

Two kilometers to the east of EZ41, a series of settlements, averaging 2.8 km apart, occupied the east bank of the Guan River (Figure 5.33). These include three secondary settlements, EZ7 (2.27 ha), EZ34 (2.28 ha), EZ36 (2.05 ha), and several surrounding hamlets, EZ12 (0.25 ha), EZ35 (0.25 ha), and EZ37 (0.25 ha). All of these are within 50 m of the current channel. The artifact collections are dense, concentrated and continuous, contraindicating taphonomic site formation.

Other than EZ7, all the river bank occupations were found in modern construction sites, open garbage disposal areas, or small vegetable gardens between the neighborhoods. Nowadays, the river bank area is highly urbanized and is the most expensive residential area in the local real estate market. Many of the ongoing construction projects expose previously unknown sites, yet the understanding of the size of these sites is limited by the area of exposure.

The artifacts of these occupations differ from each other. EZ7 was located 50 m to the south of a highway. The site is partly covered by weedy grass. Construction garbage from the highway, nearby houses, and the reengineering of the Xiaobei River largely covers the surrounding area. Some sectors were plowed just before our survey, and the visibility helped us to identify the settlement and the content. EZ7 has only yielded tiles, most of which are of better quality and preservation than tiles we found in any other location. The team did not find any sherd of household pottery. There are many calcite nodules scattered around as well. The whole survey area has abundant calcite nodules, but they are more common in the hills and rarely exist in large quantities on the alluvial plain where EZ7 is located. Since the Neolithic period, residents have used calcite nodules as a construction material.

Other than EZ7, all sites near the rivers have both tiles and household ceramics. Some collection units yield a complete household pottery assemblage typical of the State of Chu during the Eastern Zhou period, including li tripods, yu bowls, guan pitchers, and dou stem plate (Institute of Archaeology 2004). Compared to EZ40 and 41, the tiles from riverside occupations are comparatively poorer in quality. In my estimation, the household potteries appear of better quality than those found in Yanggang, and certainly better than the ceramics from Xiaoshui.

There are few open lands between the riverbank settlements and EZ40. The spatial arrangement and connection between EZ41 and the riverside sites is unknown, though the political center of gravity would certainly have attracted people for settlement. If I assume that the taphonomic processes have been similar between EZ41 (with EZ40) and riverside settlements (EZ7 excluded), the previous predictions about EZ41 can be reevaluated.

The assumption that the daily utensils were burial underneath the tiles is plausible, if the architecture at EZ40 and 41 used much larger quantities of tiles, as shown in the excavation of the palatial structure at Longwan, Hubei Province (Wang 2013). Although most of domestic wares were found outside of the palatial structure, few sherds from containers and pitchers were buried under piles of tiles.

However, based on current evidence, the most convincing interpretation would be that EZ40 and 41 were used for non-domestic functions, such as administration. It is because the functional and zonal difference led to the contrast between the artifacts assemblage at EZ40 and 41, and the riverside settlements. EZ40 and 41 are likely to be sections of administrative zone, while the riverside was primarily residential. Though occupants abandoned the riverside settlement by the end of Eastern Zhou, the administrative zone continued to be used into the next period. EZ7 due to its small size, it could be a specialized structure, such as a summer palace desirable for its proximity to the Guan River. However, considering the rapid expansion of Xiaoshui in the mountainous area, and EZ17's proximity to EZ18, (a site strategically nestled between the mountains and alluvial plains), EZ17 was more likely an administrative gateway for riverine transportation or military control of the Guan River region (see Chapter 7).

The zonal differentiation is further supported by the occupation at the Guzhuang River, where bronze burial vessels were found in the 1960s (Figure 5.34). EZ28, a 7.3 ha center, was a secondary settlement. There were six hamlets distributed along the Guzhuang River within 1 km distance to EZ28 (10 hamlets if in 2 km distance), forming a two-tier settlement system. Although the bronze vessels might suggest an upper-class cemetery in the area, the ceramics show it was more likely to be a residential zone. Similar to the riverside settlements, most artifacts are domestic along with a few tiles. Unlike riverside residences on the alluvial plain, the Guzhuang River occupations were located on high platform terraces surrounded by hills, a setting resembling EZ40 and 41. There was no occupation on the other side of the river where the alluvial plains are much broader.

The increasing exploitation of the mountains starts in the Eastern Zhou period. The occupation at Xiaoshui expanded tremendously and started to move further inland. EZ40 and 41 are more than 4 km away from the river. EZ21 was located on the valley floor, bounded by hills. EZ22 is an Eastern Zhou cemetery located near the mountain top. There were also three small occupations at the upper reach of Guzhuang River, where the river flows out of the mountains.

In sum, the settlement pattern of the Eastern Zhou suggests different level of complexity. A more integrated regional settlement system was formed with a four-tier regional settlement hierarchy. For the first time, the system was centered on a walled-city (EZ41) to the east of the Guan River, where most occupations locate. This location may have facilitated regional administration, communication, and movement of goods, labor and information between center and peripheries. Secondary settlements were home to a large population along the Guan River and its tributaries. Hamlets and small villages increased and expanded in number into previously unoccupied landscapes. The functional differences between settlement clusters become visible, with administrative and residential areas separated. The rapid expansion of Xiaoshui at the upper reach, the mountainous area of the Guan River, the thriving of near-river occupations, and the special nature of EZ17 all indicate that the watercourse became significant for transport connecting the mountains with the alluvial plains of the lower reach. Thus resources from mountains could be exploited, administered, and transported to lower stream, implying organized, systematic, and specialized macroregional economic activities. In addition, considering these sites' location at the boundary of two powerful states, Qin and Chu, their economic activities could have been influenced or managed for macro-political/military purposes. In particular, it is likely that the city of EZ41 was built for regional control. I will return to this point in Chapter 8 and 9.

5.6 Qinhan Period (QH): 220 B.C. to A.D. 220

Qinhan period refers to the archaeological period that overlaps with Qin and Han dynasties. Occupation reached its peak both in number and total area during the Qinhan period (Figure 5.12). However, the average ceramic density is the lowest in history (Figure 5.13). This contrast indicates a dramatic change in occupation pattern. The settlement maps show that most Eastern Zhou occupations continued into this phase (Figure 5.8). Nearest Neighbor Index is 0.52, suggesting that the degree of clustering was slightly higher than the Eastern Zhou's. The Ripley's K graph does not show any peak, which suggests that the variation in the size of the clusters was far from consolidated. The four-tier settlement hierarchy maintained but with a decrease in second-tier settlements and a significant increase in third-tier settlements (Table 5.5; Figure 5.16).

The only supra-settlement was QH14, which reached 63.6 ha at Xiaoshui (Figure 5.35). The poor quality of the ceramics suggests that in spite of its paramount size, thus remained a farming village without much socioeconomic differentiation. The further expansion towards the piedmont reflects an increase in the regional population as well as an elevated emphasis on montane resource exploitation. The slight increase in roof tiles suggests that the use of tiles was becoming increasingly common.

The regional administrative center was the walled city QH51, which expanded from 17 ha to 20 ha (Figure 5.36). Artifacts show that the "White Feather City" was still used for administrative rather than residential purpose, the same as in the previous period. To the south of the city, there might be a large cemetery for both elites and commoners, although there are few traces of it left on the surface. There were reports that efforts to flatten the farmland during the 1960s and 70s may have destroyed burial sites. We also found several looting holes with broken ceramic vessels. One of them had a small bronze piece, indicative of a bronze vessel from an elite burial. According to local villagers, the looting activities have always been severe here.

The largest second-tier settlement is Yanggang. The center was 7.5 ha, surrounded by small hamlets of 0.25-0.5 ha. The occupation expanded further northward that close to the mountains (Figure 5.37). The alluvial plain is much narrower here, and terraces are cut into small, uneven pieces by a complex drainage system. This system may have contributed considerably to the post-depositional process. The artifact assemblage suggests that drainage canals divided the cemetery and residential zones. Many burial stones and bricks were found in the local modern villages, in use as building materials for the retaining walls of farming terraces.

In general, second-tier settlements of 1 to 10 ha decreased in number. In contrast, the Figure 5.8 shows that hamlets and small villages of 0.25 ha increased rapidly, representing the most noteworthy feature of this period. Small occupations expanded into what was previously a remote area of valley floors and piedmont. The Badie River area, unpopulated in the previous period, was repopulated during this phase with nine hamlets.

Although artifact distribution seems to be sporadic, the Qinhan occupations may have been denser. Artifact distribution is continuous in many locations but remains at low density, with 1 to 2 sherds scattered over the valley floors. According to the project's site identification principle that a site is defined as more than 3 sherds within 100 m distance, these locations are not defined as sites. This means that the estimate for Han occupation is underestimated to some extent. The excavation at the Sanyangzhuang, a Han village in east Henan Province, reveals that the households were separated by 50-100 m intervals, which contradicts the previous assumption that the villages consisted of quite compact, adjacent households as they do in the present (Liu 2010). This dispersed occupation pattern may have also existed in the Guan Valley, which would account for the low artifact density and scattered distribution pattern.

The four-tier settlement system was strengthened with an expansion of settlements of the lowest-rank. These small villages increased rapidly and covered diverse environmental settings, supporting an increasing farming population and a new regional socioeconomic system. The disappearance of settlement clusters indicates that the settlement system is structured differently from any previous period.

5.7 Tangsong and Post-Tangsong Period (TS and PTS): A.D. 221-1911

As discussed in Chapter 4, the Tangsong period is an archaeological period that beyond the historic period of Tang and Song dynasties. This is because that porcelain and glazed pottery replaced plain pottery as the main ceramic material since the Tangsong period. Little is known about the domestic ceramic assemblage and styles of the Tangsong and Post-Tangsong periods, because excavations have focused on large burials and cities. Although the team collected sherds dating to Tangsong and Post-Tangsong periods according to standard survey methods, the sherds are easy to confuse with modern ceramics, which were not collected. Consequently, the fieldwork overlooked a large quantity of porcelain and glazed ceramics and left a large number of late occupations undocumented. Historical documents for this period do not have detailed, accurate records for this area. Future researchers should assume that our records and analysis for the late periods are incomplete and under-represented on the full extent of the occupation in these later periods.

The team identified 33 occupations dated to the Tangsong and 13 to the Post-tangsong period (Figure 5.9 and 5.10; Table 5.6 and 5.7). The artifact densities are higher than Qinhan in both periods. The survey shows that the occupation continued decreasing from the Tangsong. Most settlements were occupied in previous phases. Although few new settlements emerged, the total occupation area was 1/9 of the Qinhan, shrinking to 3.75 ha during the Post-Tangsong. No major center was identified. Other than Yanggang (TS2), no occupation exceeds 1 ha, including Xiaoshui. The Yanggang area has the highest occupation density. Similar to the previous phase, the most dispersed occupations were found to the north of Yanggang, where the landscape is more diverse. Other than Yanggang, most occupations spread out along waterways.

5.8 Conclusion

The full-coverage survey reveals a lot that is new about the history of regional settlement patterns at the Guan River valley. No site dates to earlier than the Middle Yangshao period—possibly due to either taphonomic processes or socioeconomic factors. The earliest occupation began in the Middle Yangshao period on top of the Yanggang terraces. These dotted occupation quickly expanded in the Late Yangshao to all tributaries of the Guan River. A regional center and secondary centers were formed, manifesting in a highly clustered settlement system at each tributary. Most settlements were close to watercourses. The centers often occupied elevated terraces or mounds, while the hamlets were positioned on lower ground.

For the majority of the Longshan period, the settlement system was maintained, but with some variations. Settlements situated more on the alluvial plain, and slightly less nucleated than the Late Yangshao period. The secondary centers decreased. The occupation at upper reach mountainous region began. The occupation intensity, however, differed between the upper reach and lower reach settlements—settlements at lower reach were occupied more intensively, especially at centers; in contrast, the upper reach mountain occupations were less intense and more dispersed. It is very likely that by the Late Longshan period, occupation decreased dramatically to only three locations.

In the Shang to Western Zhou, the occupation remained at a low level. Settlement clusters at all river tributaries shrank or disappeared. Settlements were not differentiated much in size. The largest site, Yanggang, shrank to 0.8 ha from 23.9 ha in previous period.

During the Eastern Zhou, the regional complexity of settlement system developed dramatically. Despite a rapid increase in settlement number and area, a four-tier hierarchy with a supra-center was formed. The functional differences between settlements became visible. The supra-center, which locates at upper reach mountainous region, was mostly residential. A walled city at the lower reach was the administrative center, exerting sociopolitical control over the region. Hamlets and villages increased in number and expanded into previously unoccupied areas. Watercourse, especially the Guan River, became significant for transportation, connecting the mountains with alluvial plains of the lower reach.

In the Qinhan period, the four-tier hierarchy maintained, and small villages further dotted the Guan Valley. Settlement number and size reached historic peak. However, the ceramic density is the lowest, indicating a dramatic change in occupation pattern. The supra-center expanded to over 60 ha, three times larger than the administrative center in the lower reach. After the Qinhan period, the occupation at the Guan Valley decreased both in number and size in Tangsong and deteriorated in the Post-Tangsong period.

The regional settlement history reveals temporal changes in the scale and regional organization of human occupations at the Guan River valley. This discussion of settlement pattern is rather descriptive and not conducive for quantitative evaluation and comparative studies. The next chapter will compliment this descriptive approach with estimations on the regional population based on settlement data and artifacts.

Table 5.1 Settlement size and rank for the Late Yangshao period.

Number	Size(ha)	Tier
LYS1	24.8	1
LYS9	8.8	2
LYS17	2.3	2
LYS10	1.1	2
LYS6	1.05	2
LYS13	0.5	3
LYS18	0.5	3
LYS2	0.25	3
LYS3	0.25	3
LYS4	0.25	3
LYS5	0.25	3
LYS7	0.25	3
LYS8	0.25	3

LYS11	0.25	3
LYS12	0.25	3
LYS14	0.25	3
LYS15	0.25	3
LYS16	0.25	3
LYS19	0.25	3
LYS20	0.25	3
LYS21	0.25	3
LYS22	0.25	3
LYS23	0.25	3

Table 5.2 Settlement size and rank for the Longshan period.

Number	Size(ha)	Tier
LS1	23.9	1
LS18	4.65	2
LS25	1.1	2
LS13	0.7	3
LS19	0.7	3
LS17	0.6	3
LS9	0.5	3
LS2	0.25	3

LS3	0.25	3
LS4	0.25	3
LS5	0.25	3
LS6	0.25	3
LS7	0.25	3
LS8	0.25	3
LS10	0.25	3
LS11	0.25	3
LS12	0.25	3
LS14	0.25	3
LS15	0.25	3
LS16	0.25	3
LS20	0.25	3
LS21	0.25	3
LS22	0.25	3
LS23	0.25	3
LS24	0.25	3

Table 5.3 Settlement size and rank for the Shangzhou period.

Number	Size(ha)
SZ1	0.8
SZ2	0.25
SZ3	0.25
SZ4	0.25
SZ5	0.25
SZ6	0.25
SZ7	0.25
SZ8	0.25
SZ9	0.25
SZ10	0.25
SZ11	0.25

Table 5.4 Settlement size and rank for the Eastern Zhou period.

Number	Size(ha)	Tier
EZ10	47.37	Supra
EZ41	17	1
EZ28	7.3	2
EZ1	3.4	2
EZ40	3.04	2

EZ34	2.28	2
EZ7	2.27	2
EZ36	2.05	2
EZ2	0.89	3
EZ25	0.87	3
EZ3	0.25	3
EZ4	0.25	3
EZ5	0.25	3
EZ6	0.25	3
EZ8	0.25	3
EZ9	0.25	3
EZ11	0.25	3
EZ12	0.25	3
EZ13	0.25	3
EZ14	0.25	3
EZ15	0.25	3
EZ16	0.25	3
EZ17	0.25	3
EZ18	0.25	3
EZ19	0.25	3
EZ20	0.25	3
EZ21	0.25	3
EZ22	0.25	3
EZ23	0.25	3
EZ24	0.25	3
EZ26	0.25	3
EZ27	0.25	3
EZ29	0.25	3
EZ30	0.25	3
EZ31	0.25	3
EZ32	0.25	3
EZ33	0.25	3
EZ35	0.25	3
EZ37	0.25	3
EZ38	0.25	3
EZ39	0.25	3

Table 5.5 Settlement size and rank for the Qinhan period.

Number	Size(ha)	Tier

QH14	63.61	Supra
QH51	20	1
QH1	7.5	2
QH47	3.1	2
QH24	1.23	2
QH28	0.88	3
QH3	0.82	3
QH16	0.7	3
QH6	0.5	3
QH18	0.5	3
QH19	0.5	3
QH26	0.5	3
QH29	0.5	3
QH39	0.5	3
QH43	0.5	3
QH2	0.25	3
QH4	0.25	3
QH5	0.25	3
QH7	0.25	3
QH8	0.25	3
QH9	0.25	3
QH10	0.25	3
QH11	0.25	3
QH12	0.25	3
QH13	0.25	3
QH15	0.25	3
QH17	0.25	3
QH20	0.25	3
QH21	0.25	3
QH22	0.25	3
QH23	0.25	3
QH25	0.25	3
QH27	0.25	3
QH30	0.25	3
QH31	0.25	3
QH32	0.25	3
QH33	0.25	3
QH34	0.25	3
QH35	0.25	3
QH36	0.25	3
QH37	0.25	3

Number	Size(ha)	Tier
QH38	0.25	3
QH40	0.25	3
QH41	0.25	3
QH42	0.25	3
QH44	0.25	3
QH45	0.25	3
QH46	0.25	3
QH48	0.25	3
QH49	0.25	3
QH50	0.25	3
QH52	0.25	3
QH53	0.25	3
QH54	0.25	3
QH55	0.25	3
QH56	0.25	3
QH57	0.25	3

Table 5.6 Settlement size and rank for the Tangsong period.

Number	Size(ha)	Tier
TS2	1.6	1
TS21	0.9	2
TS15	0.8	2
TS9	0.6	2
TS23	0.6	2
TS28	0.6	2
TS1	0.5	2
TS12	0.5	2
TS3	0.25	2
TS4	0.25	2
TS5	0.25	2
TS6	0.25	2
TS7	0.25	2
TS8	0.25	2
TS10	0.25	2
TS11	0.25	2
TS13	0.25	2
TS14	0.25	2
TS16	0.25	2
TS17	0.25	2
TS18	0.25	2
TS19	0.25	2
TS20	0.25	2
TS22	0.25	2
TS24	0.25	2
TS25	0.25	2
TS26	0.25	2
TS27	0.25	2
TS29	0.25	2
TS30	0.25	2
TS31	0.25	2

TS32	0.25	2
TS33	0.25	2

Table 5.7 Settlement size and rank for the Post-Tangsong period.

Number	Size(ha)
PTS1	0.5
PTS2	0.5
PTS3	0.25
PTS4	0.25
PTS5	0.25
PTS6	0.25
PTS7	0.25
PTS8	0.25
PTS9	0.25
PTS10	0.25
PTS11	0.25
PTS12	0.25
PTS13	0.25

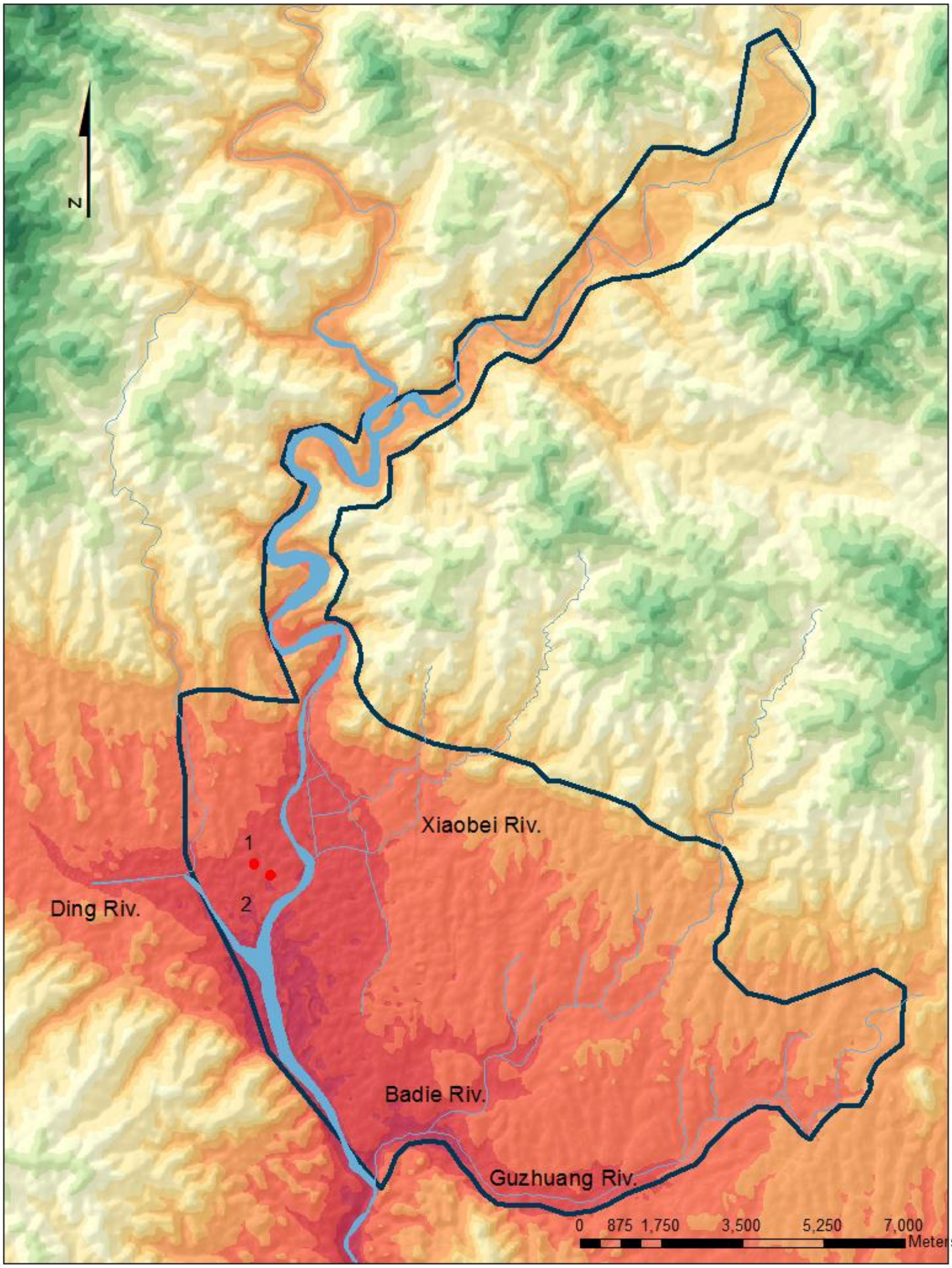
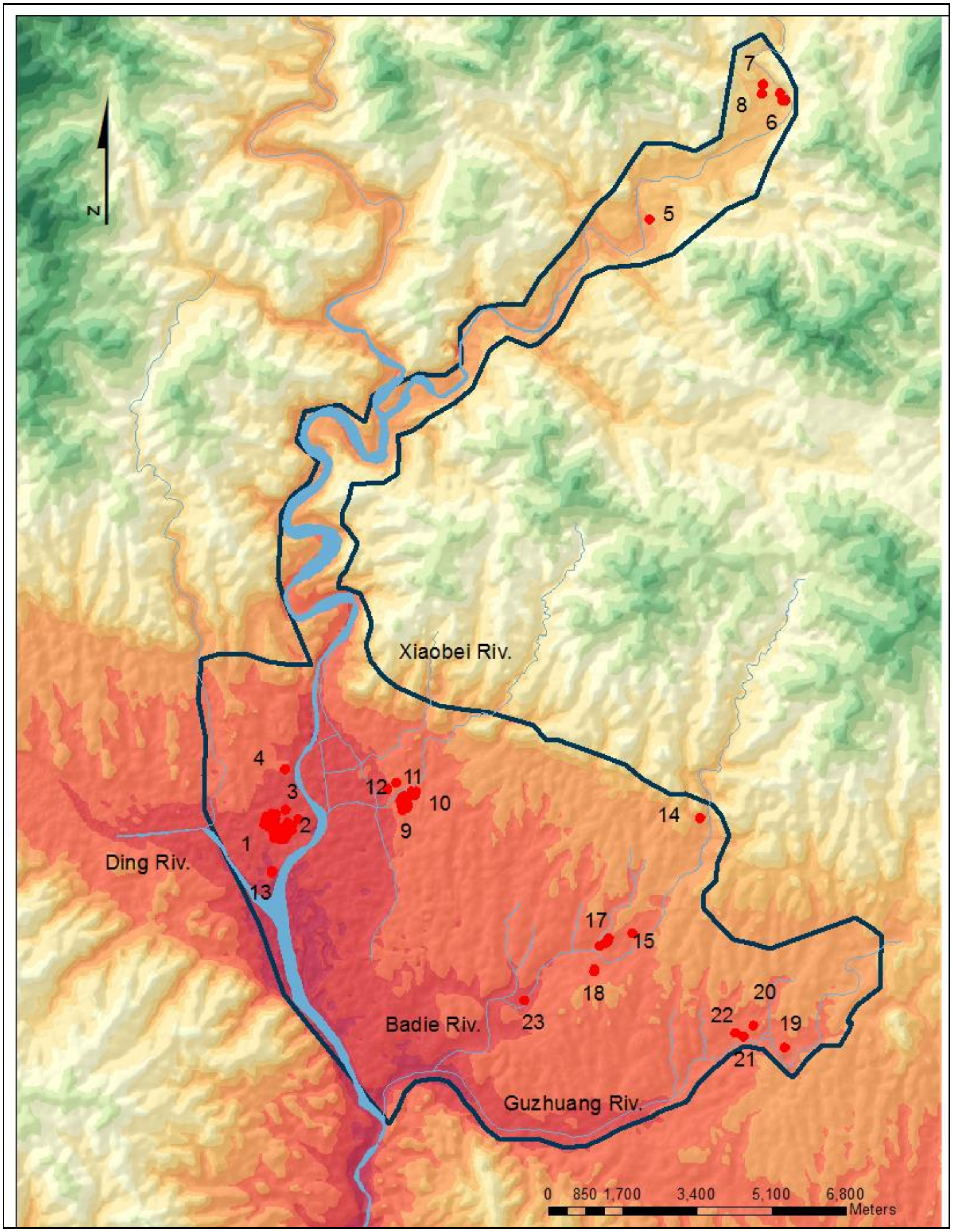

N
Xiaobei Riv.
1
2
Ding Riv.
Badie Riv.
Guzhuang Riv.
0 875 1,750 3,500 5,250 7,000
Meters

Figure 5.1 Middle Yangshao Settlement Map


N
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8
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Xiaobei Riv.
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12
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14
Ding Riv.
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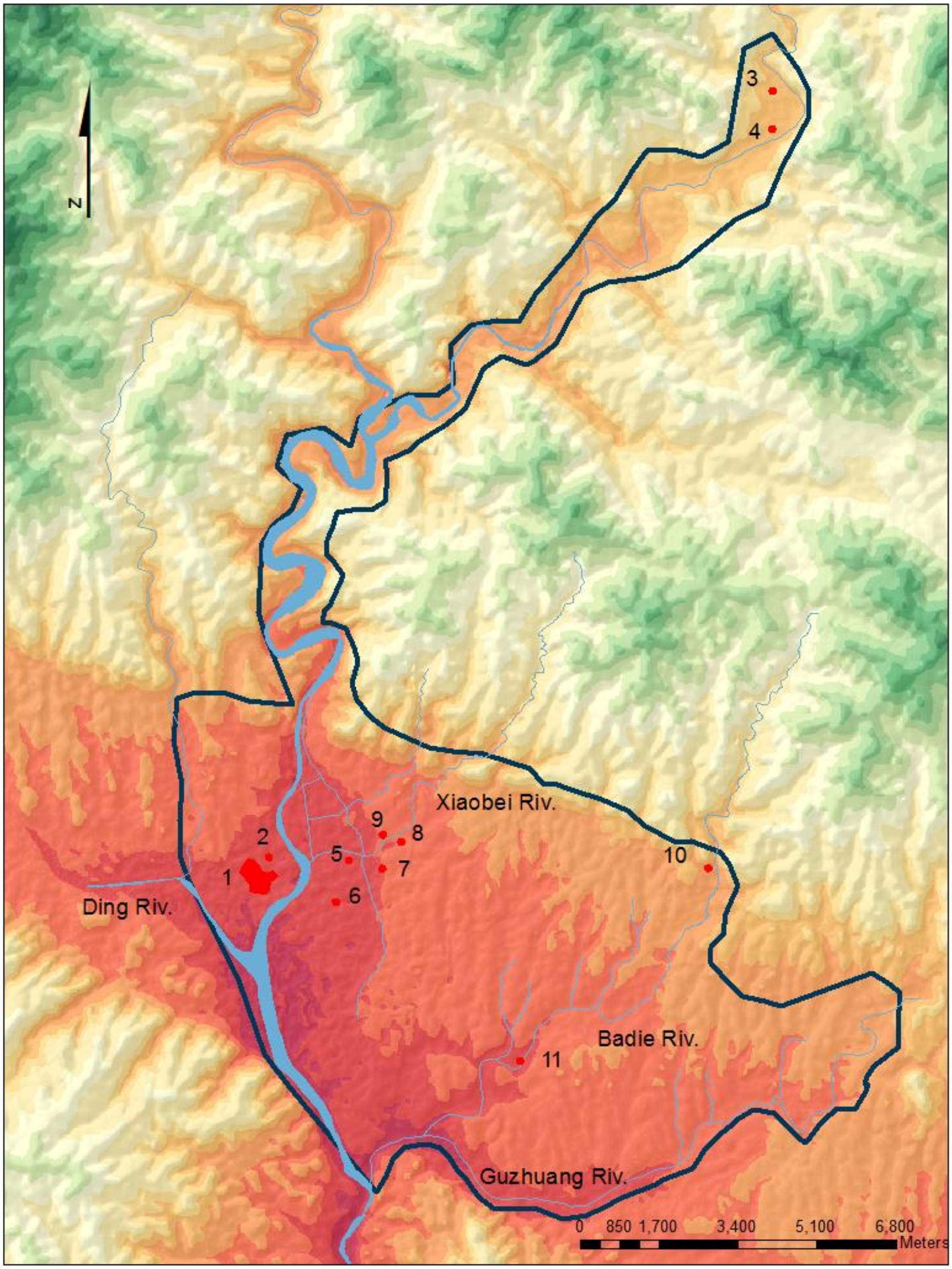
17
15
18
23
Badie Riv.
20
22
19
21
Guzhuang Riv.
0 850 1,700 3,400 5,100 6,800
Meters

Figure 5.2 Late Yangshao Settlement Map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Xiaobei Riv.
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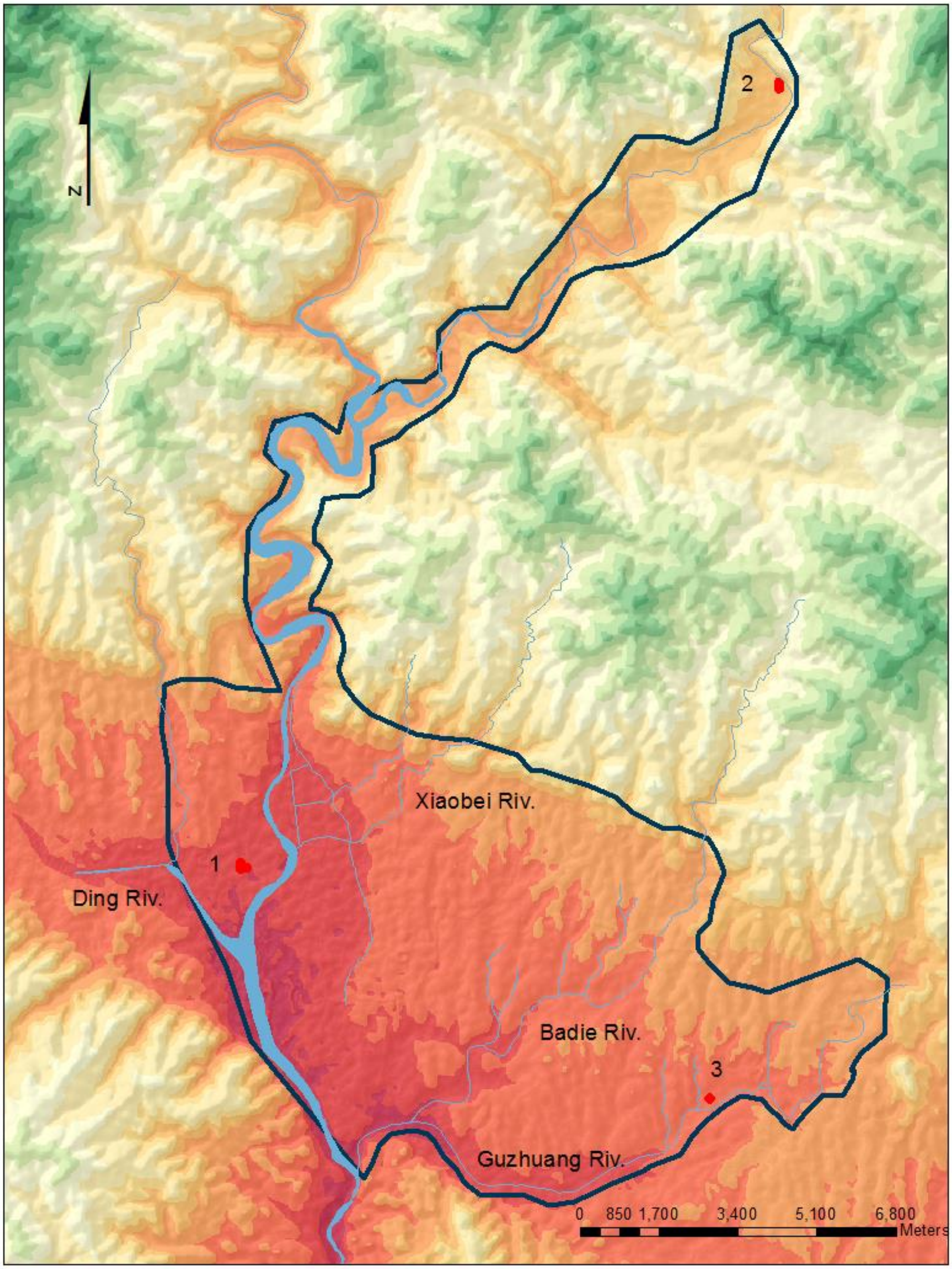
Ding Riv.
Badie Riv.
11
Guzhuang Riv.
0 850 1,700 3,400 5,100 6,800
Meters

Figure 5.3 Early Longshan Settlement Map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Xiaobei Riv.
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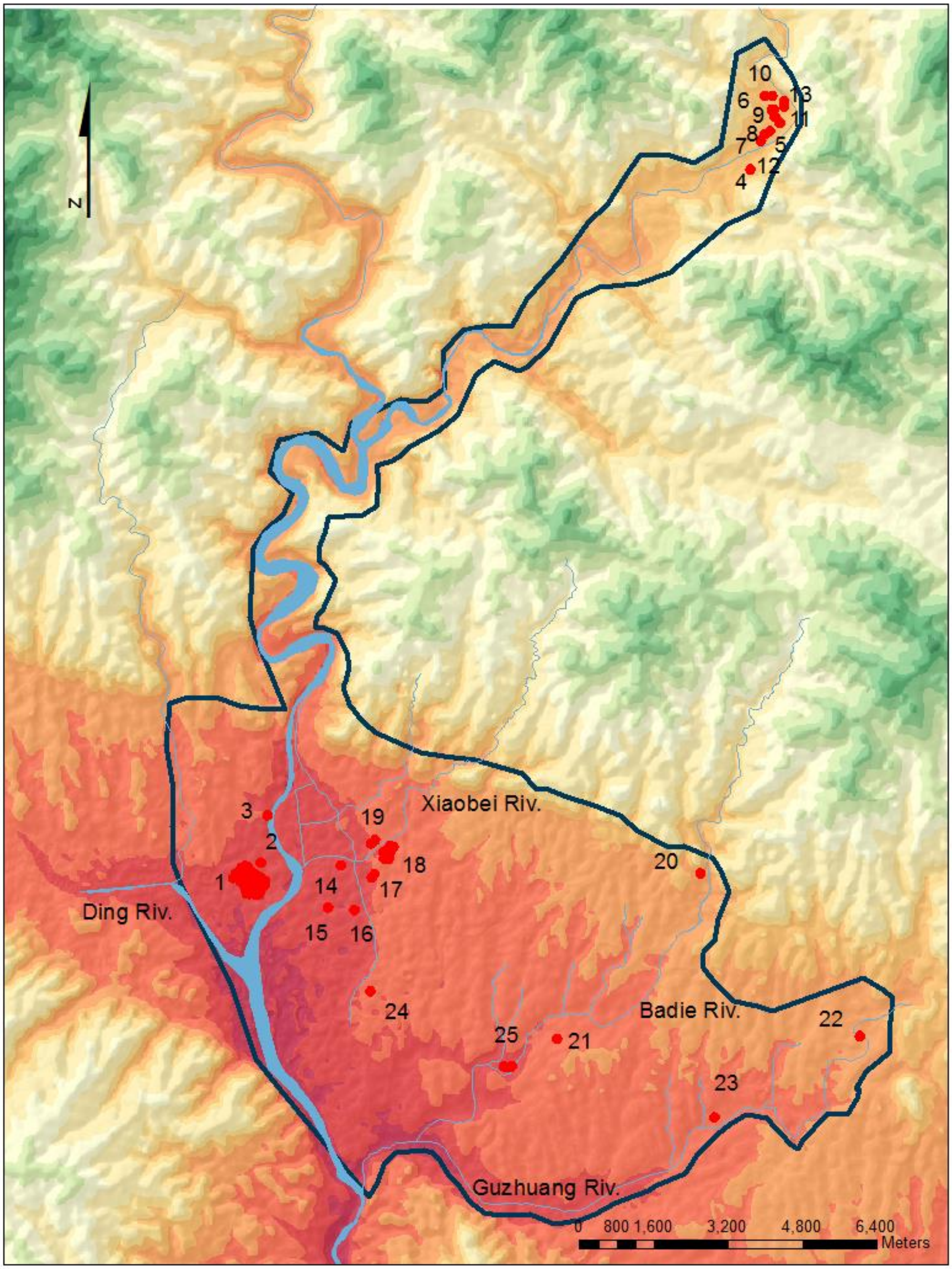
Ding Riv.
Badie Riv.
3
Guzhuang Riv.
0 850 1,700 3,400 5,100 6,800
Meters

Figure 5.4   Late Longshan Settlement Map


N
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Xiaobei Riv.
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Ding Riv.
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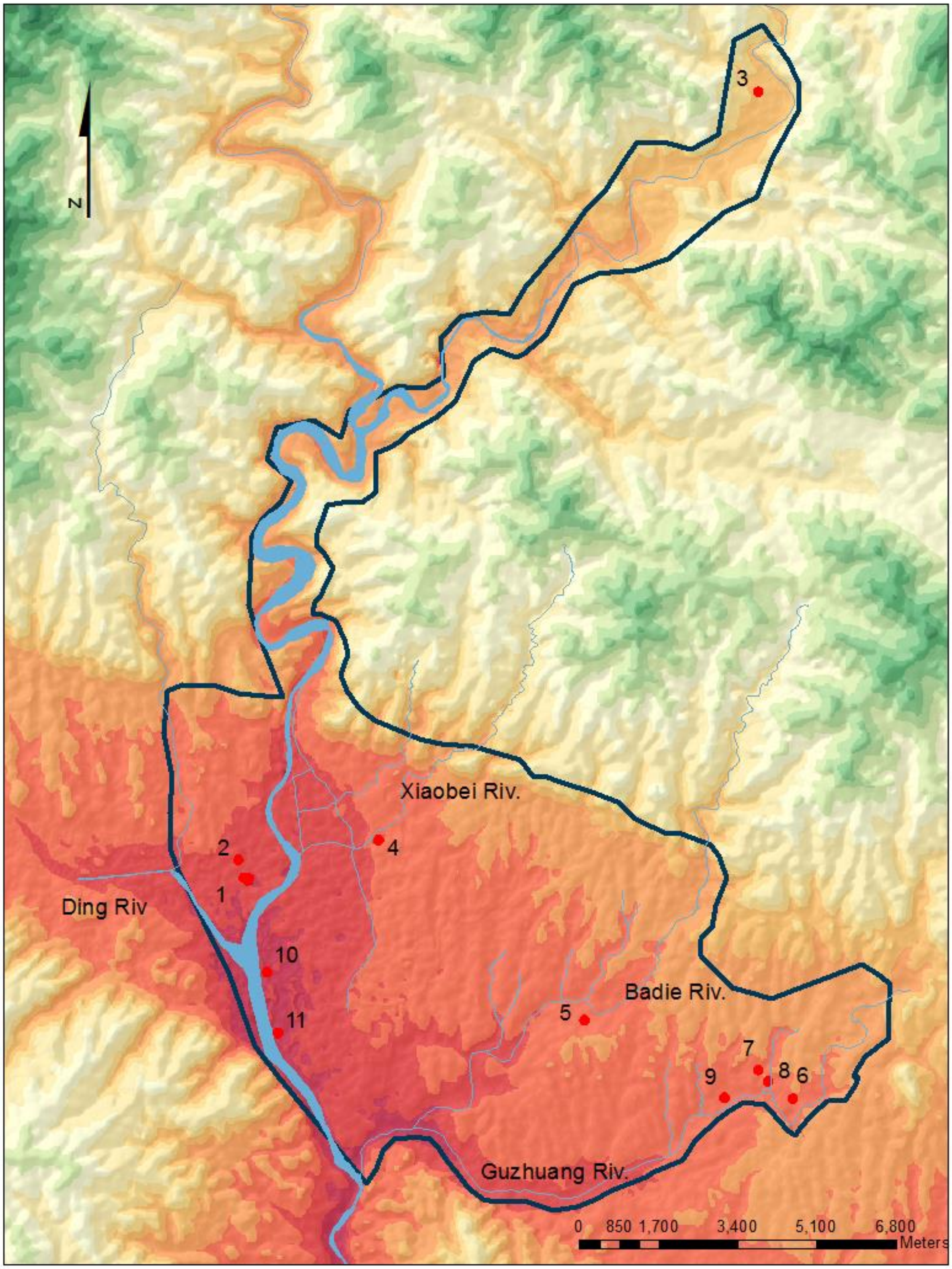
24
Badie Riv.
22
25
21
23
Guzhuang Riv.
0 800 1,600 3,200 4,800 6,400
Meters

Figure 5.5 Longshan Settlement Map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3
Xiaobei Riv.
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Ding Riv
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Badie Riv.
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8
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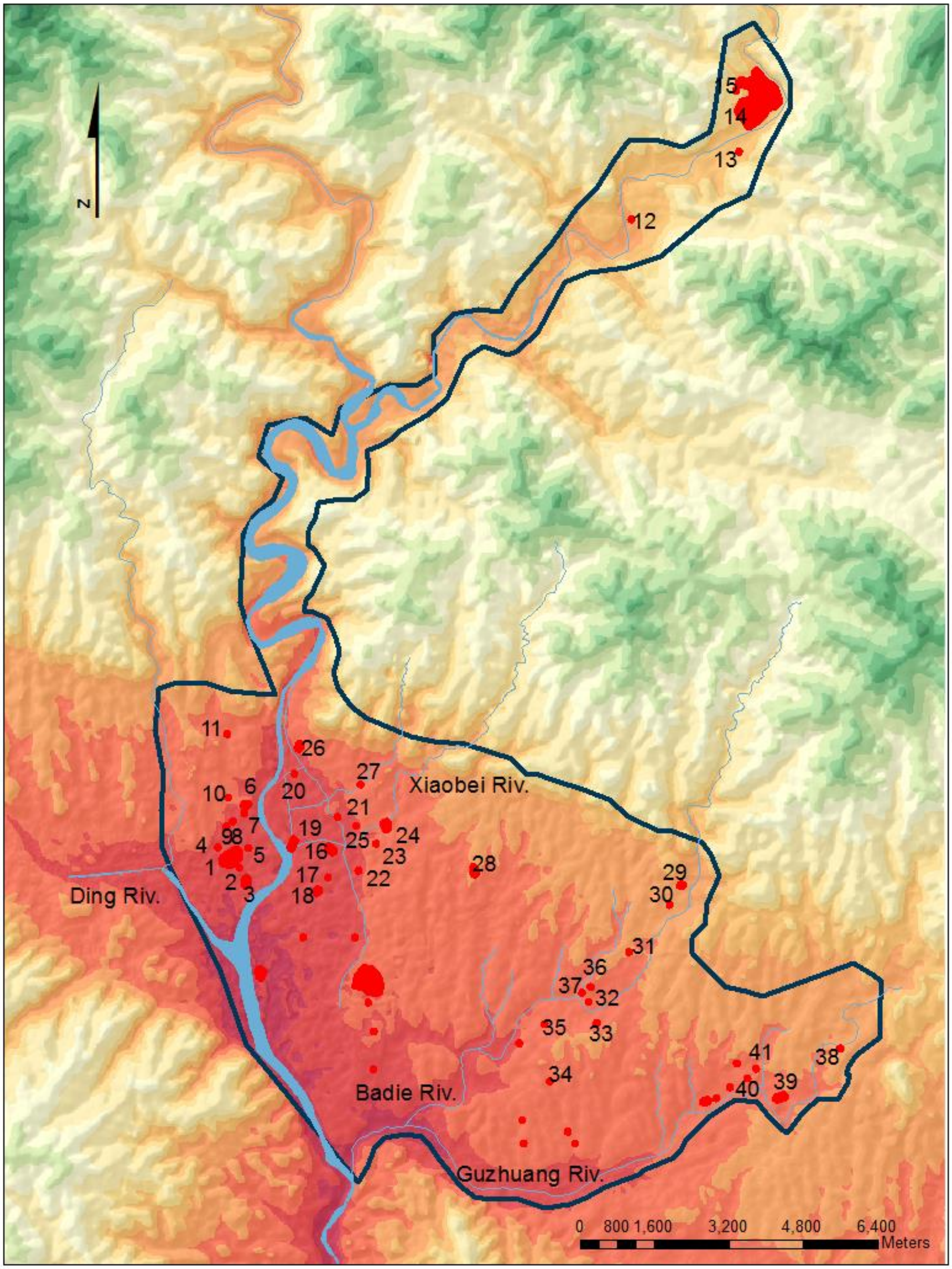
Guzhuang Riv.
0 850 1,700 3,400 5,100 6,800
Meters

Figure 5.6 Shangzhou Settlement Map



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26
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Xiaobei Riv.
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28
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Ding Riv.
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Badie Riv.
Guzhuang Riv.
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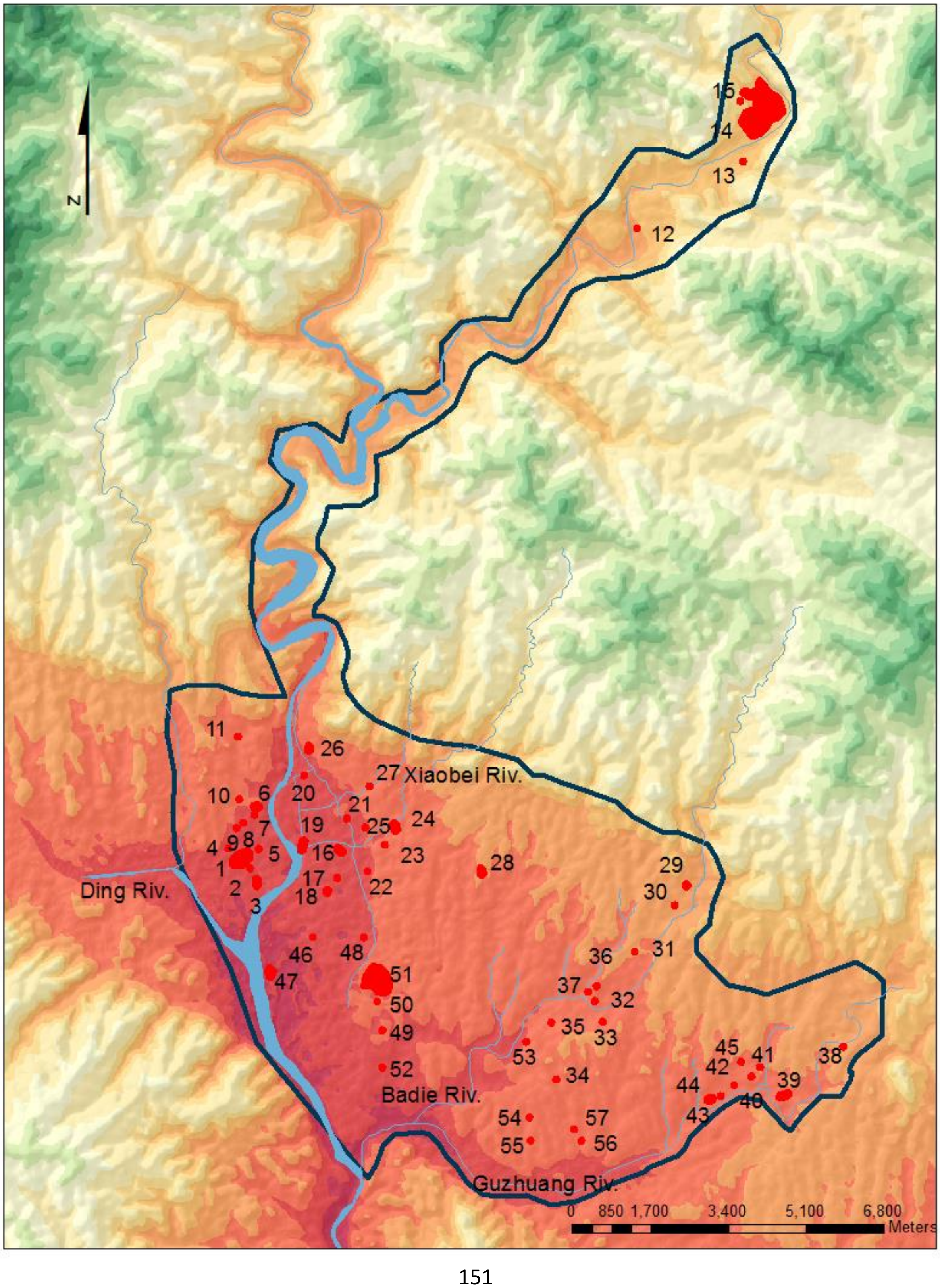
6,400
Meters

Figure 5.7 Eastern Zhou Settlement Map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Xiaobei Riv.
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23
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29
Ding Riv.
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46
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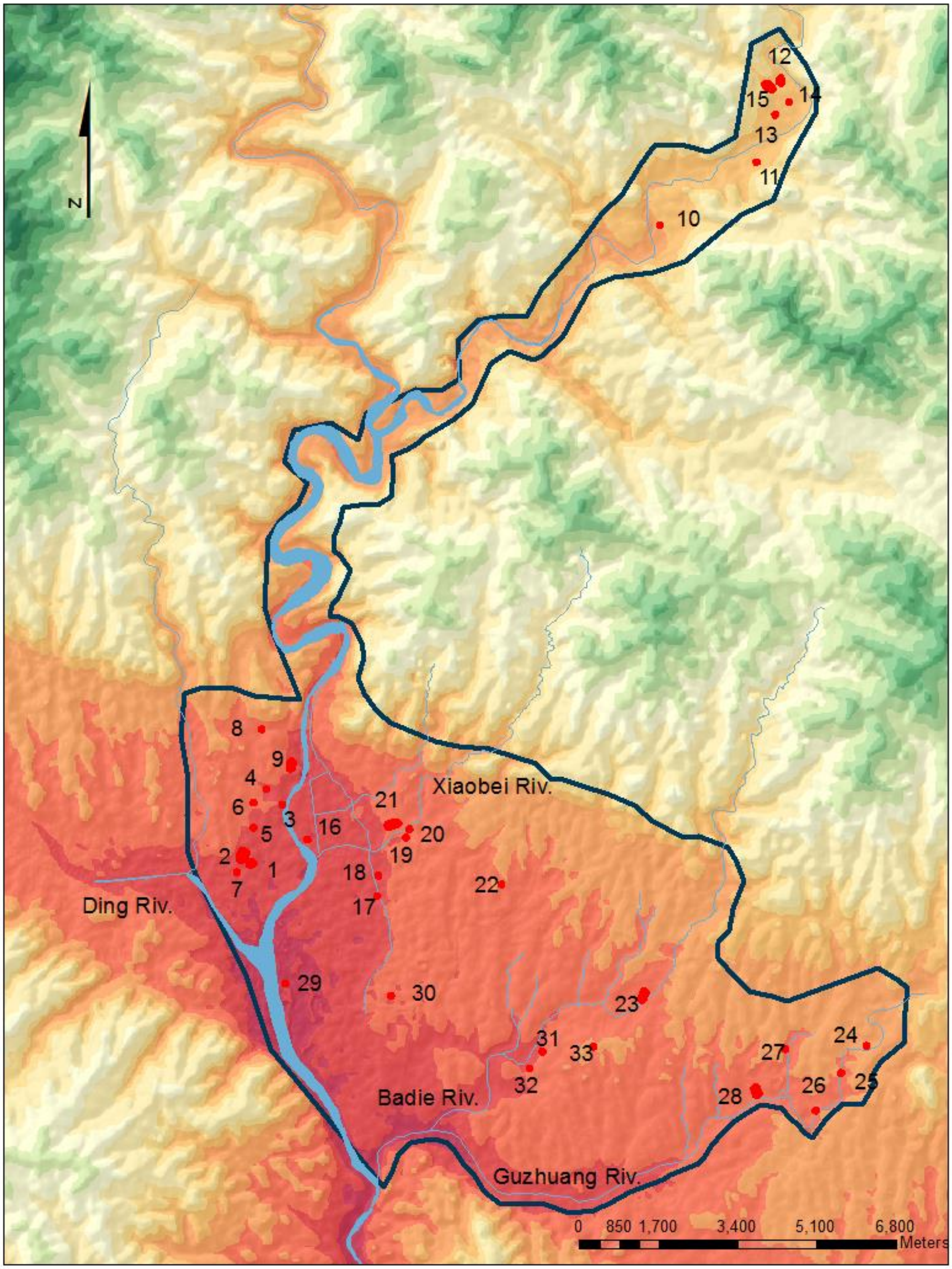
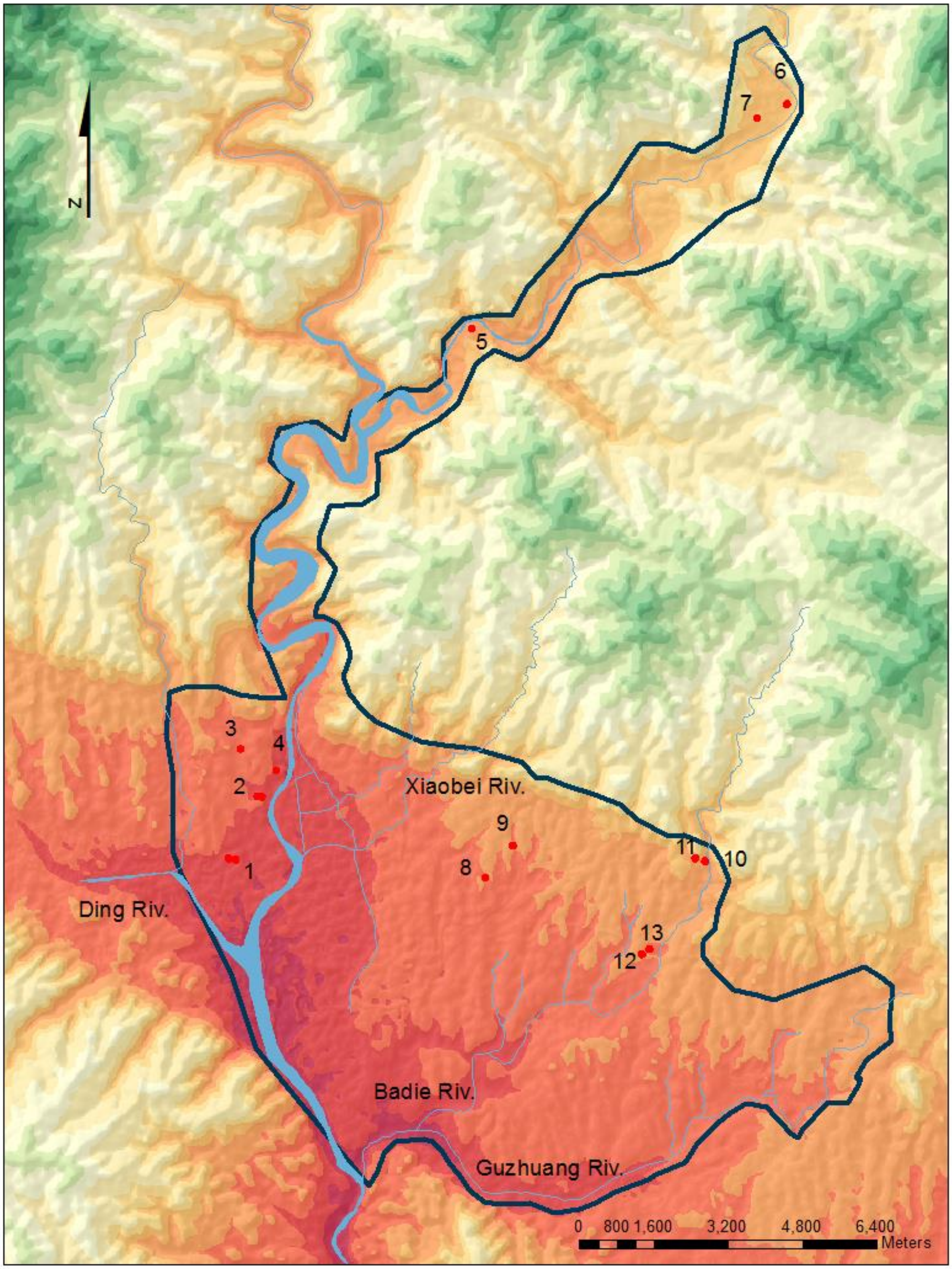
33
49
53
45
41
38
42
52
34
44
39
Badie Riv.
40
43
54
57
55
56
Guzhuang Riv.
0
850
1,700
3,400
5,100
6,800
Meters

Figure 5.8   Qinhan Settlement Map



Xiaobei Riv.
Ding Riv.
Badie Riv.
Guzhuang Riv.
0 850 1,700 3,400 5,100 6,800
Meters

Figure 5.9 Tangsong Settlement Map


N
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2
Xiaobei Riv.
9
11
10
1
8
Ding Riv.
13
12
Badie Riv.
Guzhuang Riv.
0 800 1,600 3,200 4,800 6,400
Meters

Figure 5.10 Post-Tangsong Settlement Map

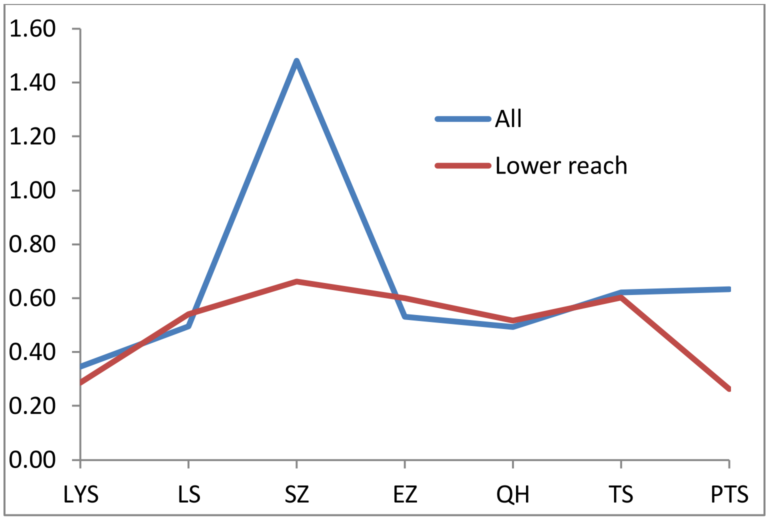
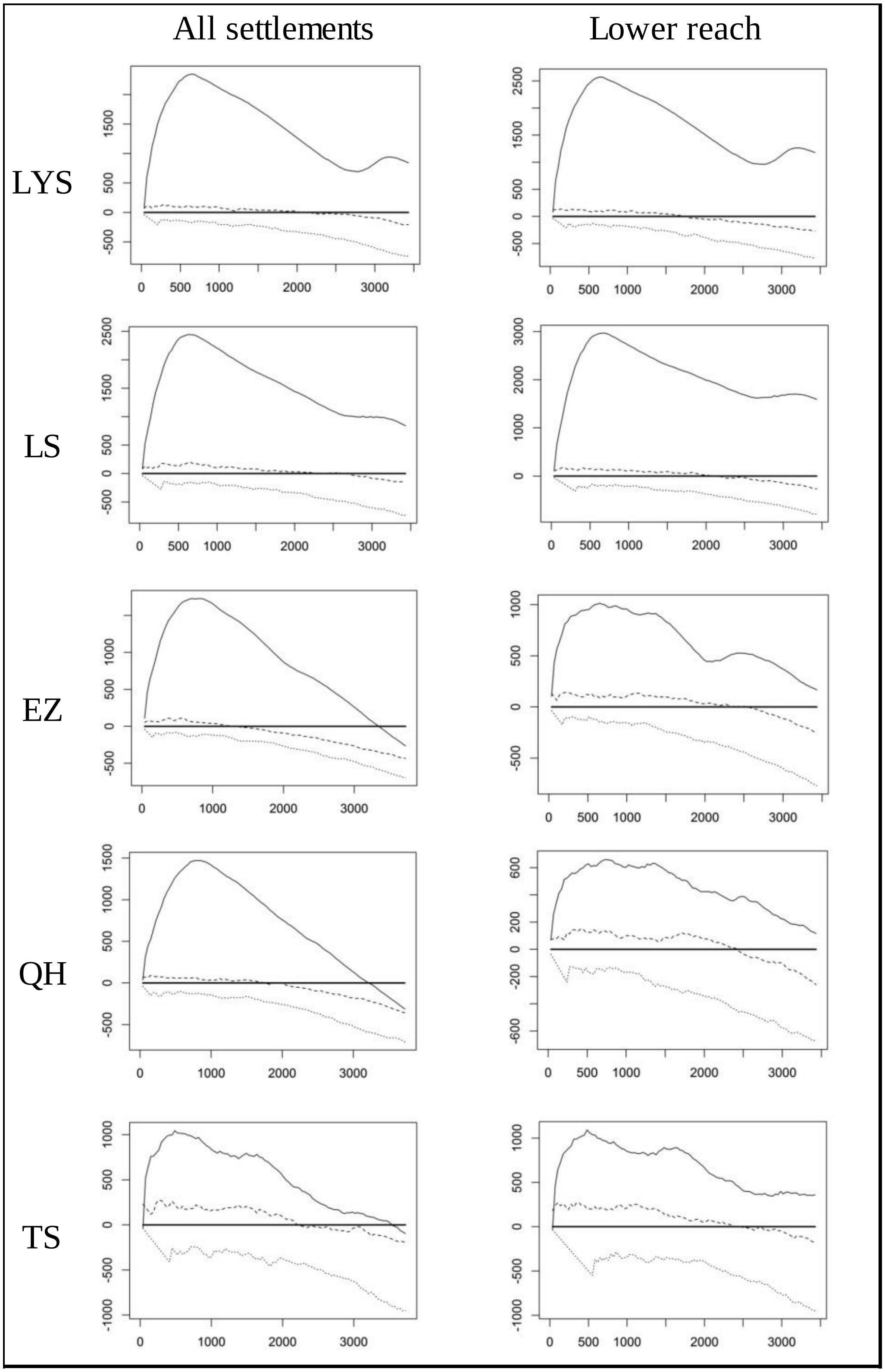


Figure 5.11 The Nearest Neighbor Analysis (NAA) results of all sites and lower reach sites of each period. Blue line indicates NAA include all sites of each period. Red line shows results of sites at the lower reach .



All settlements
Lower reach
LYS
LS
EZ
QH
TS

Figure 5.12 Ripley's K analysis showing clustering pattern at different spatial scales of each phase (Area: 135 km^2; no edge correction).

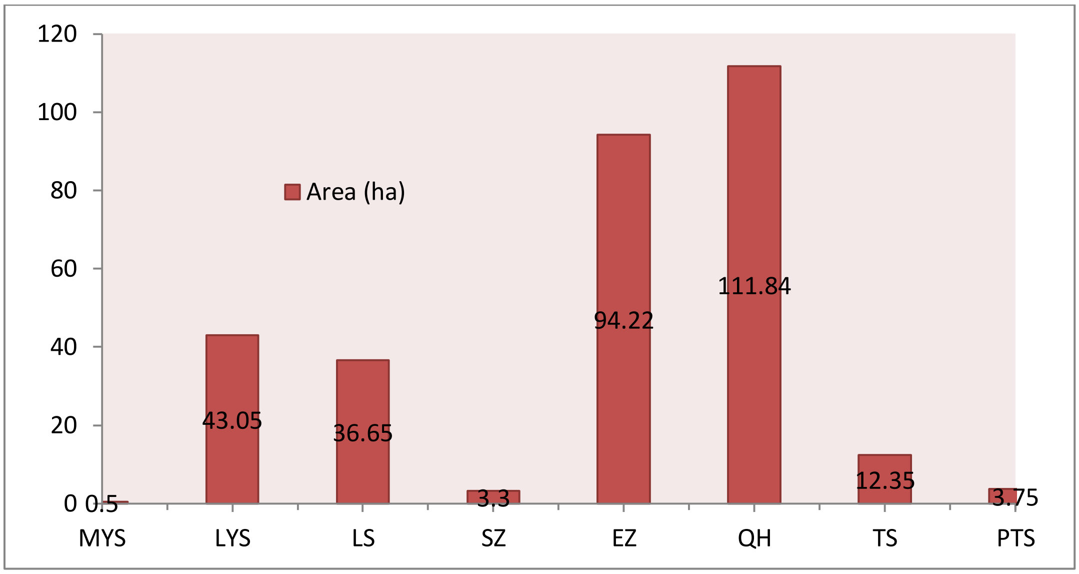


Figure 5.13 Total occupation area of all periods (ha)

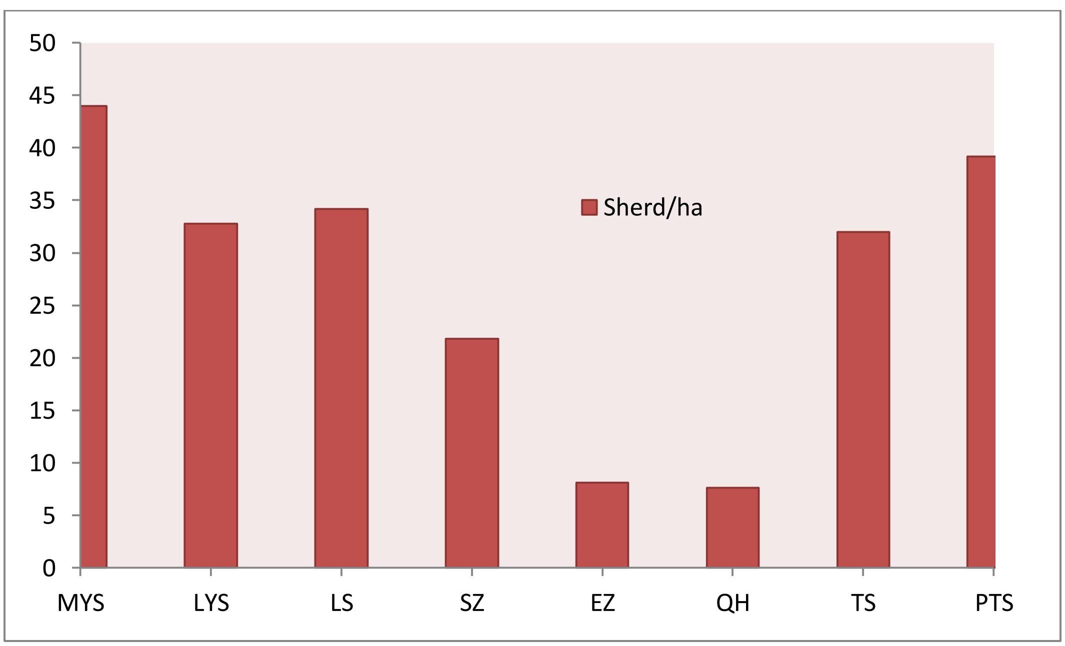


Figure 5.14 Ceramic density of all periods (sherd/ha)

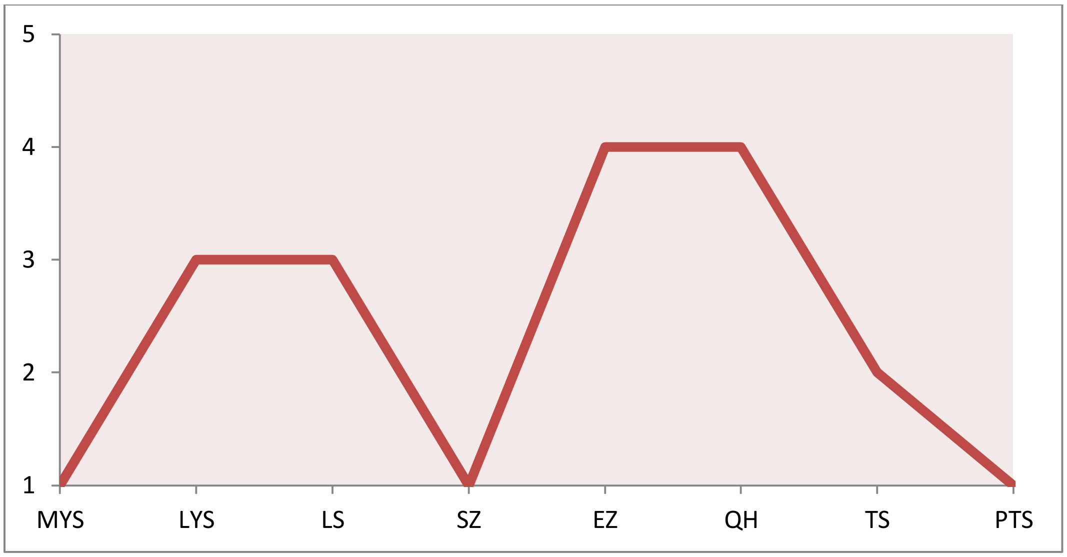


Figure 5.15 The tiers of settlements in each period.

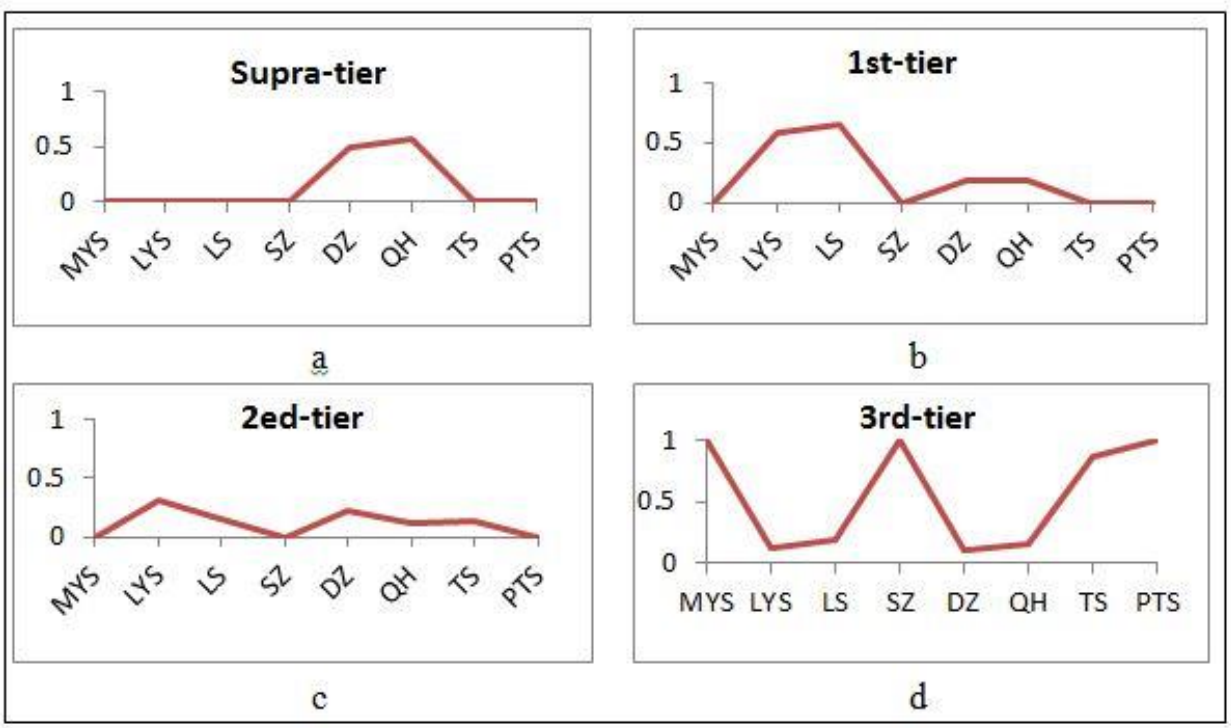


Figure 5.16 The ratio of occupation area of each tier to total occupation area.

Figure 5.17 Settlement cluster at Yanggang: LYS1-3 (need to add LYS13)

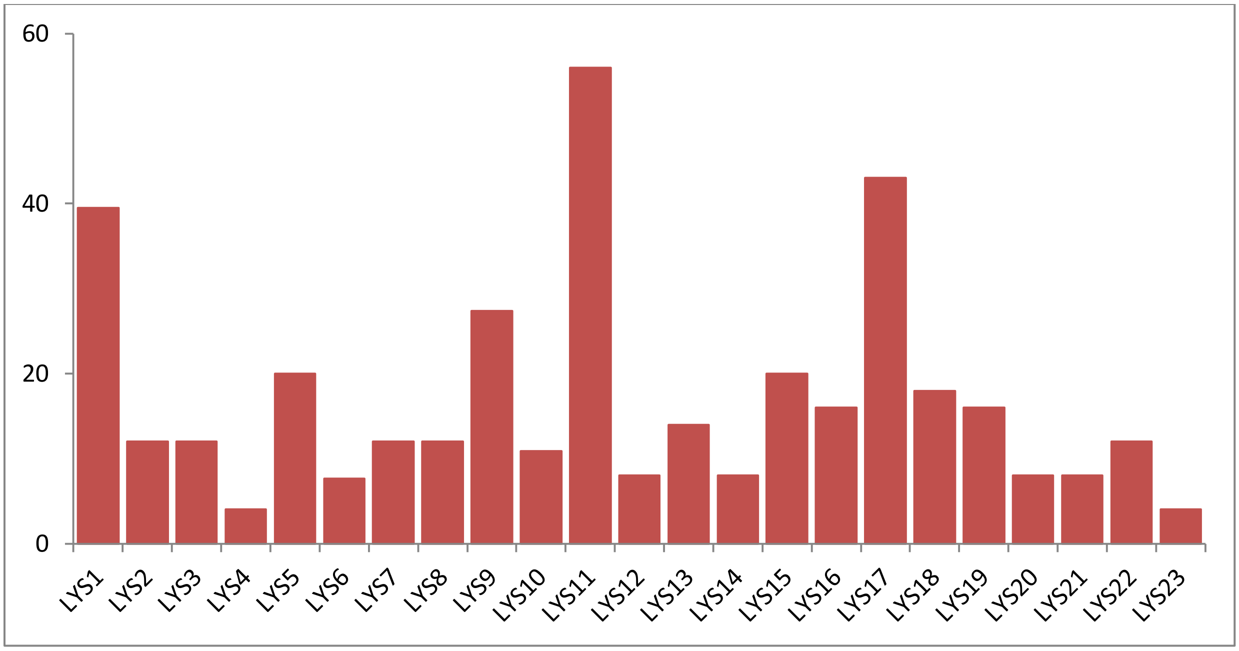


Figure 5.18 Artifact density of the Late Yangshao settlements (sherd/ha)

Figure 5.19 Settlement cluster at Majiaying during the Late Yangshao period: LYS9-12

Figure 5.20 Settlement cluster at Badie River during the Late Yangshao period: LYS15-18

Figure 5.21 Settlement cluster at Xiaoshui during the Late Yangshao period: LYS6-8

Figure 5.22 Settlement cluster at the Guzhuang River during the Late Yangshao period: LYS19-22

Figure 5.23 Distribution of collection units of Early Longshan artifacts at Yanggang.

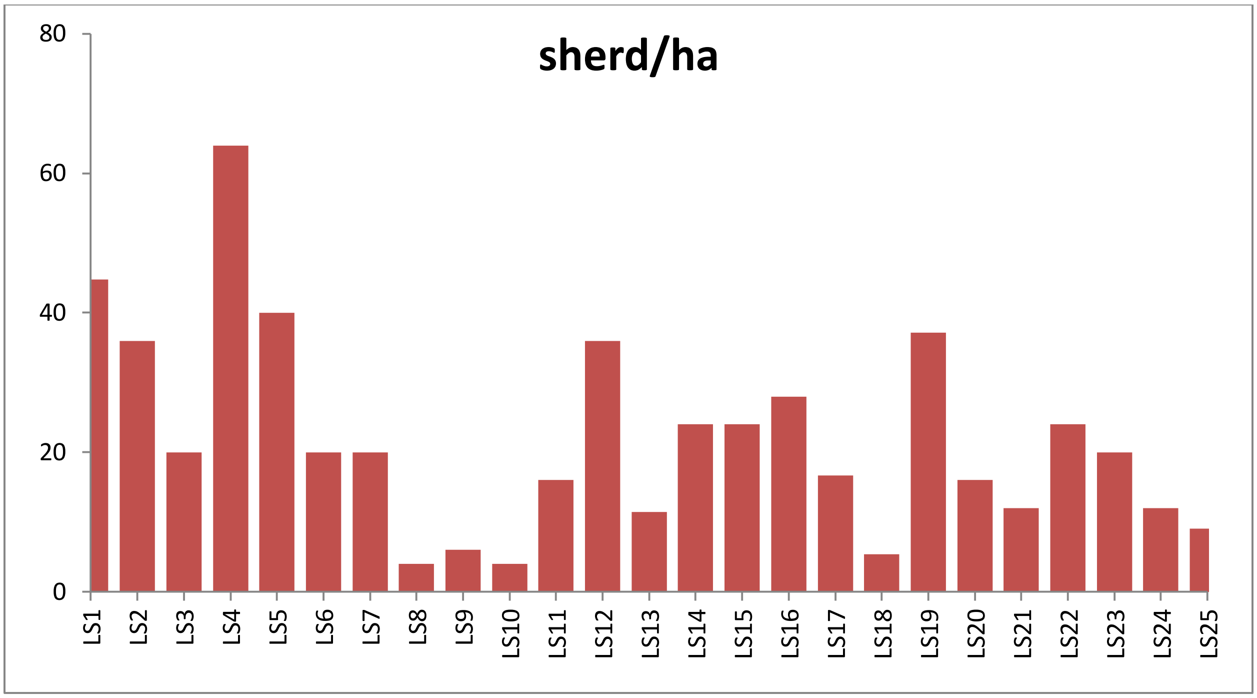


Figure 5.24 Artifact density of the Longshan settlements.

Figure 5.25 Distribution of collection units of the Longshan artifacts at Yanggang.

Figure 5.26 Settlement cluster at the Xiaoshui during the Longshan period: LS5-13.

Figure 5.27 Settlement cluster at the Majiaying during the Longshan period: LS14-19.

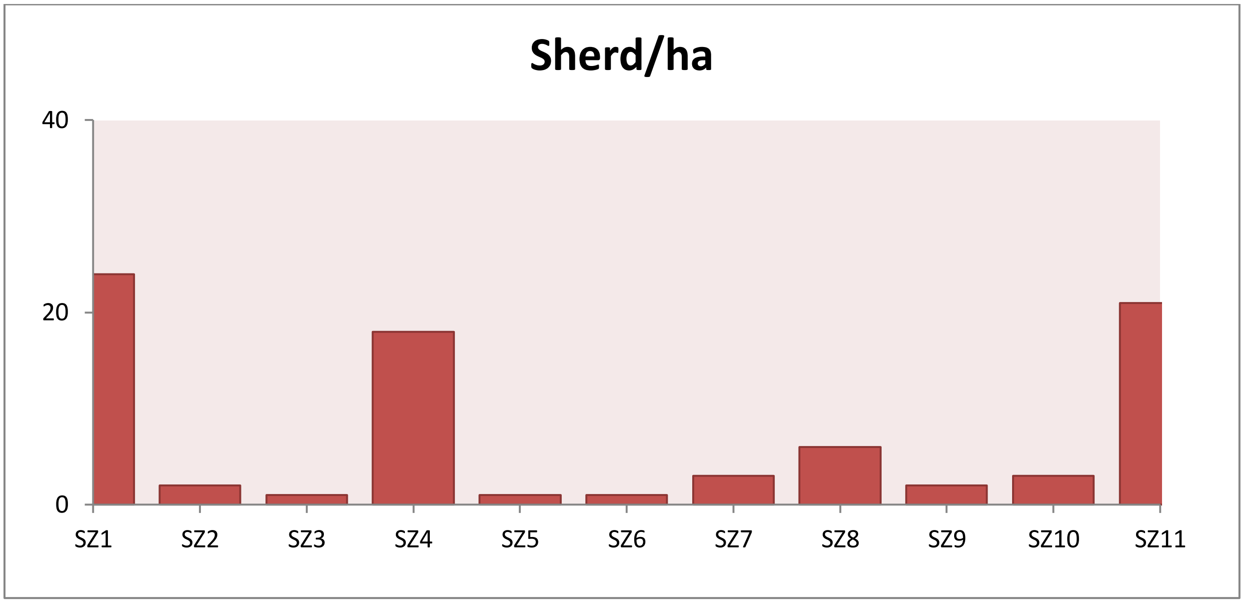


Figure 5.28 Artifact density of the Shangzhou settlements.

Figure 5.29 Settlement cluster at the Guzhuang River during the Shangzhou period: SZ5-8.

Figure 5.30 Settlement cluster at the Xiaoshui during the Eastern Zhou period: EZ10-11.

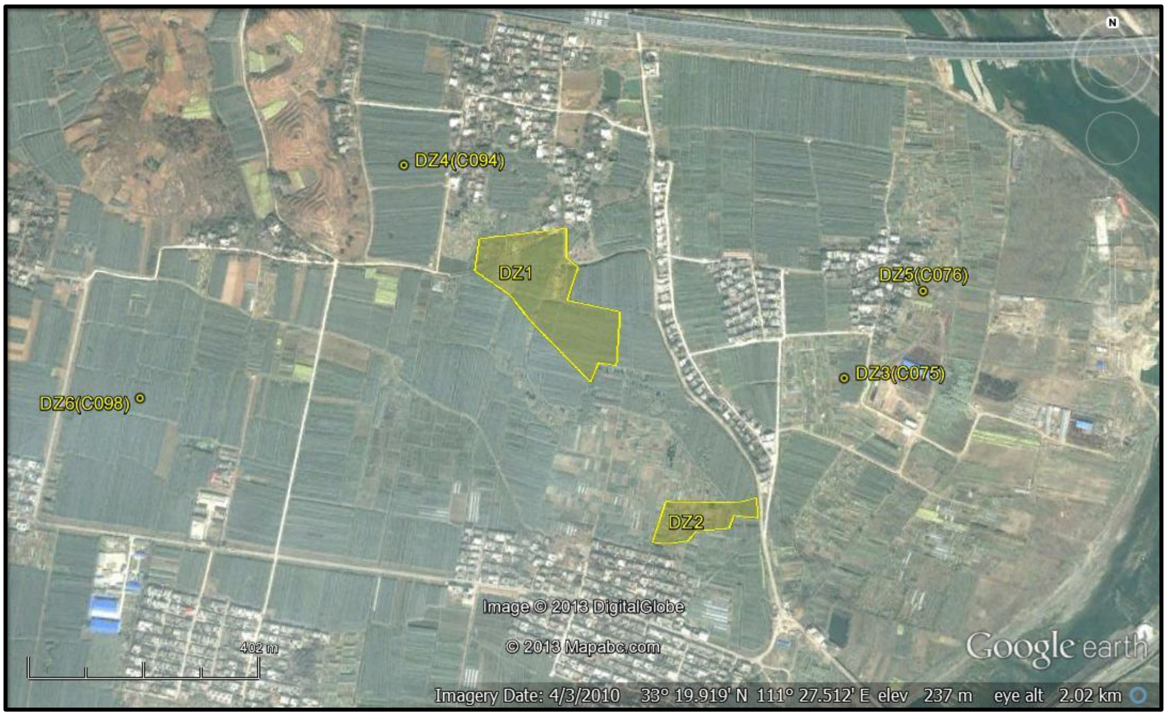


Figure 5.31 Settlement cluster at the Yanggang during the Eastern Zhou period: EZ1-6

Figure 5.32 Settlement cluster at the "White Feather City" during the Eastern Zhou period: EZ38-41.

Figure 5.33 Settlements along the Guan River bank during the Eastern Zhou period: EZ12, 27, 34, 35, 36, 37, and EZ1 in comparison.

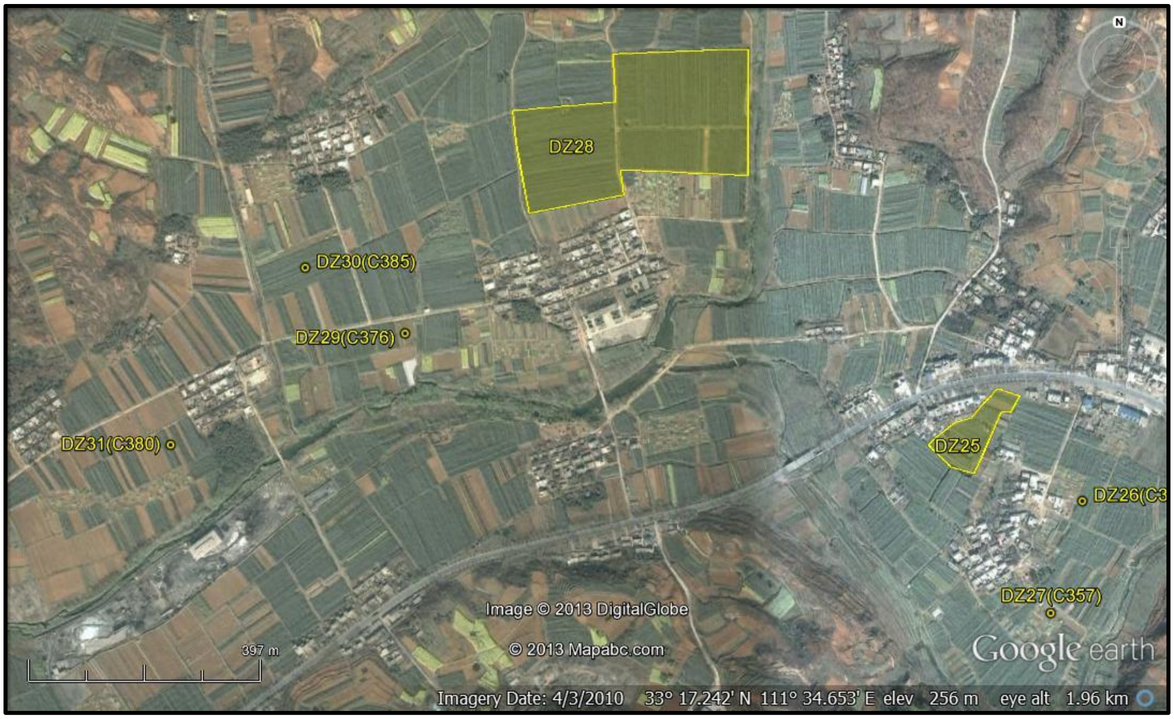


Figure 5.34 Settlements at the Guzhuang River during the Eastern Zhou period: EZ25-31.

Figure 5.35 Settlement cluster at the Xiaoshui during the Qin and Han period: QH14-15.

Figure 5.36 Settlements at the “White Feather City” during the Qin and Han period: QH50-51.

Figure 5.37 Settlements at the Yanggang area during the Qinhan period: QH1-10.

CHAPTER 6

REGIONAL POPULATION HISTORY

In the last chapter, I discussed the history of regional settlement patterns. The settlement patterns, as manifested by the distribution, size and structure of occupations, varied dramatically from one period to another, exhibiting no sign of single evolutionary direction. In order to make the variation in settlement patterns more comparable to one another, I will estimate a population scale for each period based on the survey data.

Regional archaeological survey methods provide meaningful estimates of regional demographic history (Blanton et al. 1982). Settlement patterns illustrate how communities are distributed across the landscape through time. Though surveys use artifact density and other evidence as proxies for population prediction, the relationship between settlements, artifacts, and population is far from direct. Occupation intensity, deposition conditions, length of occupation, demographic indices (birth rate, death rate, and life expectancy), and other variables vary spatially and temporally within and across past communities. Little evidence was left to detect or estimate population size from material culture. Thus some archaeologists are reluctant to make population estimates, especially in China, where academics are especially cautious about speculation. In order to investigate the mechanisms behind social and political change at the regional or macroregional scale, one must have some idea of the population size of area under investigation. Furthermore, population is one of the most important indices for cross-cultural comparison.

Several models for population estimation are based on ethnographic studies and settlement archaeology (e. g. Cook 1972; Kolb et al. 1985; Kramer 1978). The precision of the estimate largely depends on refined chronologies and excavation data of well-preserved settlements. Regional survey archaeologists tend to favor some approaches over others (e.g. Adams 1965; Sanders, Parson and Santley 1979; Blanton et al. 1982). In general, five models are most widely cited (Cook 1972; Kolb et al. 1985; Kramer 1978; Qiao 2010):

1. Population = people/house × number of houses;

2. Population = Total occupation area / occupation area per person;

3. Population = Average number of people per ha × total population area;

4. Population is in proportion to the number of sherds of a certain house ware, such as food containers or cooking pots; and more rarely,

5. The number of cooking vessel use per capita year per household and the total amount of potteries.

Most population models are based on local residential architecture counts, which are well preserved in regions such as Mesoamerica and Mesopotamia. In China, the preservation tends to be much poorer because of most buildings were constructed of wood. Chinese archaeologists rely on only a few sites with well-preserved residential architecture as the baseline for settlement or regional population estimation. For example, Qiao (2010) uses residential density of Jiangzhai and Yuchisi, two Neolithic villages with well-preserved house structures, to estimate the regional population of Yiluo River region (Jiangzhai: 120 houses of different size; Yuchisi: 73 rooms in 18 groups of houses). Qiao arrives at the estimate for the regional population of Yiluo River Valley is by multiplying the population density (57 people/ha) by the total occupation area for each phase.

Since this approach overlooks the regional and temporal differences of occupation history, it provides an incomplete reconstruction of population. The Chifeng project (CICARP 2003) uses a different approach for regional-scale population estimation that includes both the area and density of surface scatters (Drennan and Dai 2010). They calculate the sherd count of phase X/ Total sherd count and then multiply that figure by the sherd density in each collection unit. The outcomes are then combined to generate the relative population index for Phase X. The relative estimate is then converted into absolute estimates by excavation data, which is also produced from the Jiangzhai excavation (2010).

The Rizhao Project (Fang et al. 2004) uses a relatively simple approach to estimate populations by multiplying modern population density (72.2 people/ha) by the total occupation area of each phase. This method reflects general trends of population change in a survey area. Although the result is three times larger than the historic record on regional population of Han dynasty, the authors attributed such an overestimation to the spatial variation in resource availability, in which some areas with more resources supported larger populations than other, marginal areas.

In comparison, Qiao's estimate uses one arbitrary index for the whole Yiluo Valley. Chifeng's approach relies heavily on the somewhat arbitrary characteristic of ceramic density. The Rizhao project, on the other hand, bases its estimates only on modern population density. To achieve a more rigorous and balanced estimate, I will apply all three of these methods to the Guan River valley, comparing and justifying the results to achieve the most accurate estimates for the study area.

Population Estimates Based on Residential Architecture of Excavation Data

Qiao (2010) first provided the estimates of the Yuchisi and Jiangzhai site, basing the estimates on the premise that there was an average of 3-4 individuals for each room larger than 10 m^2. Since there are 58 such rooms at Yuchisi and taken preservation into consideration, the estimate for Yuchisi occupation is at least 280 people. A similar calculation is also taken for Jiangzhai after reevaluating the functions of some large constructions. On average, the population density for both sites is 56-57 people/ha.

There might be a better example of predicting Neolithic population density in the Guan Valley. The site of Xiawanggang is 50 km to the south of the Guan Valley. Xiawanggang is a multi-component site that was occupied continuously from the Early Yangshao to at least the Western Zhou period (Zhongguo 1989). Excavated in 1970s, the site yielded a large amount of information especially concerning the Late Yangshao occupation. A long house, consisting of 20 apartments and 32 rooms, was excavated. The apartments take three forms: 1 outer room and 2 inner rooms (12 sets); 1 inner room and 2 outer rooms (5 sets); and 1 outer room and 1 inner room (3 sets).

The excavators believe that each apartment was occupied by one nuclear family (Zhongguo 1989: 335). The family size differs in terms of the size and number of inner rooms. From Qiao's model, a room larger than 10 m^2 should contain 3-4 people (Qiao 2010). In Xiawanggang's case, the two-inner room apartments range from 15.35-38.85 m^2, enough to accommodate a household of 6-8 people. Like those at the Yuchisi site, the 1-inner room apartments each contain 3-4 people as do the 1-outer-room-1-inner-room apartments. The total number of occupants of the long house are, thus, 96-128 people, with a mean of 112 people. The excavated area of the site is 2309 m^2. Excavators claim that the site occupied around 0.66 ha, including only the core zones of the site. Based on this figure, the population density of Xiawanggang is 169.69 people/ha.

When this population density approach is applied to the occupation area of each period in the Guan River valley, the population estimates for the Guan Valley come to those shown in Table 6.1.

Population Estimates Based on Modern Population Density

The modern population density varies significantly in Xixia. As there is no demographic information on village, I use census data from district, which consists of several villages. The survey area belongs to four different administrative districts, Chengguan, Wuliaoqiao, Shuanglong, and Huiche. The modern population densities of these four districts are indicated in Table 6.2. However, the population density and distribution varies between and within these districts. Contemporary buildings cover the landscape of Chengguan, while the other three districts contain large areas of uninhabited mountains, hills, or fallow lands. Since all sites for this project were found in farmland, I recalculate the modern population density based on the amount of farmland in each district (Xixia 2010). The corrected population densities of these four districts are also shown in the Table 6.2.

To apply modern population densities to the study area, I first assign all the settlements to modern administrative districts (for example, see Figure 6.1 for Eastern Zhou settlements). The next step is to apply the corrected modern population density to total occupation area of certain districts in each period (Table 6.3). The estimates for the Guan Valley by using this approach are listed in Table 1.

Although no ancient documents recorded the population of the study area directly, it is recorded that the survey area was a part of Hongnong District during the Han dynasty. Ge's

(2002:494; see Table 6.9-3) estimates that the population of Hongnong District at 2 AD, during the Han dynasty, was 199,113. The population density was thus 9.14 people/ km^2. To make this estimation comparable to the corrected modern population density, I adjust this number based on the area of farmland instead of total area. The area of farmland was possibly much smaller in extent two thousand years ago. Here, I arbitrarily assume that the exploited farmland was approximately 1/3 of what it was at 2 AD. This makes the farmland ratio 0.078% of total land. Hence, the population density of farmland during the Han dynasty is adjusted to 3.47 people/ha. In the Qinhan period, the estimated population is 388 people for the entire study area. Compared to the estimates based on modern population density, this estimate accounts for less than 0.03% in the Qinhan period.

Population Estimates Based On Ceramic Density

The Chifeng project uses the "density-area per century index" to estimate population (CICARP 2003). The greatest strength of this approach is the balance between the area of and the artifact density of the collection unit. The area of collection unit serves the same functions that the population index does for the previous two approaches. The sole reliance on settlement area overlooks the variation in artifact densities across the settlement, which can be an indication for the intensity and length of occupation. Yet the approach used in Chifeng's estimate is based on the notion that artifact density has important implications for population reconstruction. The Chifeng researchers describe their methods as the following:

> The first step in combining information on areas of collection units and surface artifact densities into a period-by-period demographic index is to calculate the percentage of the identified sherds from each collection unit that pertain to each period. This percentage is multiplied by the surface sherd density for the collection unit to arrive at a surface sherd density for each period for that collection unit. And this surface sherd density is multiplied by the total area of the collection unit to arrive at an area-density measure for that collection unit for each period (CICARP 2003:157).

Most of the collection units in the Guan River surveys are $50\times50m^2$. However, there are some systematic collection units (collection circles of 6 m in diameter), which are around 28 m^2 in area. The artifact density of these units must be distinguished from the calculations of the normal collection units. After following procedures described above, the population indices for each period are shown in Table 6.4.

The next step is to convert the relative population index into absolute population estimates. Drennan et al. (2003) used Jiangzhai as the basis of this derivation, generating a population density of 158-283 people/ha, a number much larger than Liu and Chen's estimate of 53.5 people/ha. There are two reasons behind this difference. The first is that Drennan et al. consider all houses at Jiangzhai to be contemporaneous, while Liu takes into consideration both house and cemetery data since the village was occupied for longer time. Second, Drennan et al. (2003) include only residential area, while Liu and Chen (2012) include total settlement area to calculate the population density.

The site of Xiawanggang is much closer to the study area than Jiangzhai. In addition, the population density of Xiawanggang is similar to Drennan et al.'s (2003) estimate for Jiangzhai. Therefore the Xiawanggang data is a better proxy for the study area. The Late Yangshao occupation density at Xiawanggang is 169.69 people/ha. The highest ceramic density of the Late Yangshao collection units at the Guan Valley is 0.41 sherd/m^2 per century. With this method, the 0.41 sherd density indicates a residential density of 169 people and yields a relative population index of 2.99 (see Table 6.4). According to Drennan et al.'s (2003) approach, the final population estimate is 413.88 times the population index for the Late Yangshao time, which makes it 1235 people in the study area. The estimates for other periods are also shown in Table 6.4.

Discussion

The population estimates from three different approaches vary considerably (see Figure 6.2). The Yiluo approach suggests that occupation area indicates population size, which is more likely to be more accurate in agricultural zones with more homogeneous environments. The Rizhao approach points out the importance of modern population distribution, especially in regions as environmentally diverse as Shandong. The Chifeng approach incorporates surface ceramic density, which is an important, yet often overlooked parameter. When applied to the study area, Yiluo and Rizhao's approaches, though differing in outcome, show a similar trend, which include two population peaks during the Eastern Zhou and Qin and Han periods. Chifeng's approach, however, shows that the highest population during the Neolithic period. This approach indicates a much more gradual population change than the other two methods suggest.

The main reason for the variation between approaches lies in the surface artifact density of each period. Two factors may lower artifact densities in some periods than others (Chifeng et al. 2003). First, the consumption and disposal rate may vary from one phase to another. Second, the production techniques of some pottery may produce larger and fewer pieces than others. In the Guan Valley, the low artifact density of the Qin and Han settlements are noticeable and likely to be due to both factors—causing the low population estimate achieved with the Chifeng approach.

Despite these differences, all the evidence indicates a population increase during the Eastern Zhou to Han dynasty. Therefore, I choose to use the mean value of three estimates to arrive at more balanced population estimate for the Guan Valley. I believe this measure will even out the extreme values associated with the weakness of each approach, and present a more coherent and acceptable picture of population change in the region (see Table 6.1 and Figure 6.2). Nevertheless, these estimates must be considered preliminary, providing only an idea of relative change over time. Both a refined chronology and a more sophisticated model of population estimation would help improve accuracy of the estimate.

The final estimates shows that the most dramatic population increases in succeeding periods took place at the Middle to Late Yangshao period with 6 times, and 34 times from the Shangzhou to Eastern Zhou period. On the other hand, the Shangzhou occupation is 1/9, and the Tangsong population is 1/13 of their previous period. This contrast reveals that the demographic history was not lineal and continuous, instead, it undulated dramatically.

Conclusion

In this chapter, I discuss several approaches for estimating regional population. These three approaches are widely used in the comparative studies of regional archaeology in China and throughout the world. I test all three approaches for estimating population at the Guan Valley. Although the outcomes vary dramatically, all of the outcomes show significant fluctuation from one period to another, and point to two population peaks, one at the Late Yangshao and the other at the Qinhan period. In order to balance the measurements, I use the mean values of the three predictions as the final population estimate for the Guan Valley.

As population increased and decreased dramatically in some periods, the carrying capacity of available natural resources has to be investigated to evaluate the sustainability of communities at the Guan Valley. In next chapter, I will explore the relationship between settlement pattern, population, agricultural productivity and environmental variables. The correlations between these parameters will elucidate ecological preference and land use pattern of ancient communities.

Table 6.1 The Population estimates of each period by using different approaches (Green column is the final population estimates at the Guan Valley).

	Yiluo	Rizhao	Chifeng	Guan Valley
MYS	85	9	44	46
LYS	7275	768	1238	3094
LS	6194	795	1089	2693
SZ	558	300	1	286
EZ	15923	13290	191	9801
QH	18901	14387	318	11202
TS	2087	478	10	858
PTS	634	72	35	247

Table 6.2 The adjusted population density based on modern and historic population densities and area of each district in the study area.

	Population	Area (sq.km)	Density (people/ha)	Farmland(ha)	Adjusted density (people/ha)
Chengguan	47503	10	48	95	500
Wuliqiao	44531	222	2	2533	17.58
Shuanglong	22585	294	1	800	28.23
Huiche	34936	187	2	2200	15.88

Table 6.3 The occupation area and population in the four districts of each period.

	Chengguan (ha)	Population	Wuliqiao (ha)	Population	Shuanglong (ha)	Population	Huiche(Area in ha)	Population	Historic Population	Total Population
MYS	0	0	0.5	9	0	0	0	0		9
LYS	0	0	36.45	641	1.8	51	4.8	76		768
LS	0.25	125	31.1	547	3.2	90	2.1	33		795
SZ	0.5	250	1.3	23	0.25	7	1.25	20		300
EZ	23.09	11545	12.79	225	48.12	1358	10.17	161		13290
QH	24.35	12175	16.84	296	64.36	1817	6.25	99	388	14387
TS	0.5	250	6.6	116	2.3	65	2.95	47		478
PTS	0	0	2	35	0.75	21	1	16		72

Table 6.4 The population estimates by using Chifeng's approach.

Period	No. of Settlements	No. of collecti-on units	Area of collection (ha)	No. of sherds	Length of period (Centuries)	No. of sherds/century	Density-Area Index (m2)	Density-Area per Century Index (m2)	Maxi-mum Sherd density	Xiawang-gang population density	Sherd-Popula-tion Index	Abosulte Estimates with Excavation Data
MYS	2	2	0.25	22	5	4.40	0.53	0.11				44
LYS	23	80	16.79	1412	6	235.33	17.94	2.99	0.41	169.69	413.88	1238
LS	25	70	13.30	1253	10	125.30	26.31	2.63				1089
SZ	11	13	3.25	90	12	7.50	0.03	0.00				1
EZ	41	117	28.01	764	5.5	138.91	2.54	0.46				191
QH	57	123	29.02	856	8	107.00	6.15	0.77				318
TS	33	47	11.75	395	6.6	59.85	0.16	0.02				10
PTS	13	15	3.75	123	6.3	19.52	0.53	0.08				35

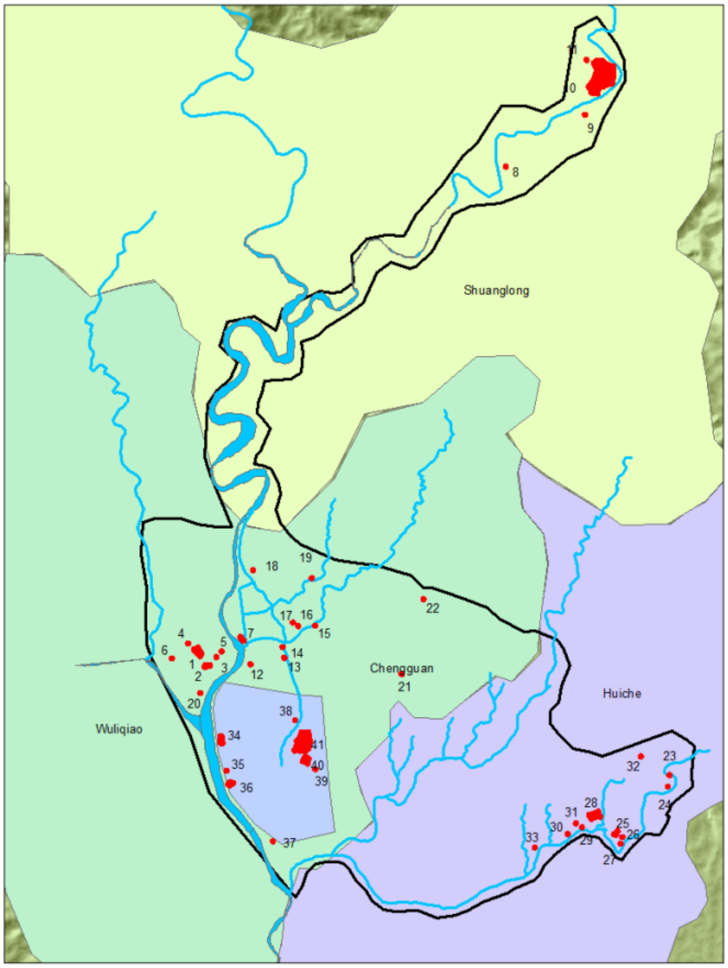


Figure 6.1 The distribution of Eastern Zhou settlement in four districts.

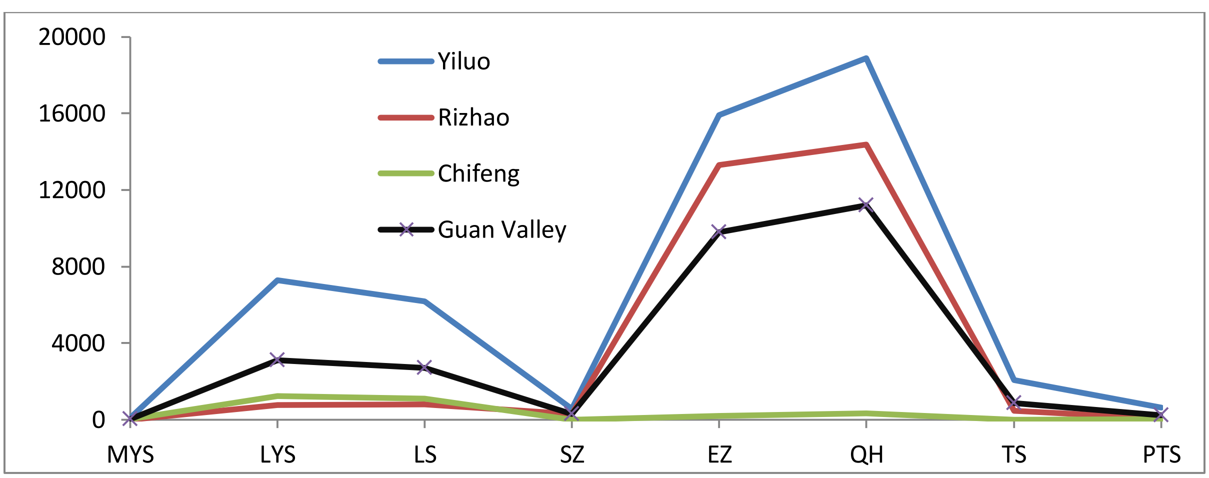


Figure 6.2 The comparison of all population estimates.

CHAPTER 7

THE LANDSCAPE HISTORY OF AGRICULTURE IN THE GUAN RIVER VALLEY

The natural condition for agriculture may not have been favorable for by ancient farmers at Guan Valley. The modern city of Xixia, where the Guan Valley locates, has one of the worst geomorphological conditions for farming in the Henan Province. Largely covered by mountains, only 6.9% of lands at Xixia are currently used for farming, 34.6% lower than average cultivation rate in the Henan province. Among all farmland, 29% has slope steepness above 6°, which make the land prone to erosion and water and fertility loss (Xixia 1990). In spite of this condition, the settlement history shows that the region supported large and centralized population in some periods. How did ancient people, especially farmers, adapt to the ecological constrains and what were their strategies? And how did human occupations in the valley incorporate farmer's concerns and choices on their physical surrounding? The answers to these questions are essential to understand the occupation history at the Guan Valley. In this chapter, I will approach these questions by reconstructing the agricultural landscape of the ancient Guan people.

The agricultural landscape encompasses farmers' perceptions and use of their environment, as well as the ways in which beliefs and practices shaped and are shaped by social and economic organization (Barton et al. 2010; Fisher and Feinman 2005; Ian 1998). This agricultural landscape represents a complex and dynamic overlay of socioecological systems over time (Fisher and Feinman 2005). In this chapter, I will explore how socioeconomic practices influenced the contours of the agricultural landscape. By modeling past occupation and environmental conditions, I will explore the diversity in the land-use patterns of farming societies in the Guan Valley. The results suggest that, from the Late Yangshao period to the Qinhan period, land use practices changed from time to time, reflecting different economic concern and social conditions. As patchy as ecological condition is at the Guan Valley, farmers adapted to the environmental restraints through various ways. Over time, this socioecological dynamic history has transformed the agricultural landscape dispersed with farming communities and various economic resources.

7.1 The Ecodynamics Model

In this chapter, I will weave together three strands of data on environmental variables, settlement patterns, and agricultural capacity to construct a model of the agricultural landscape. Van West (1994) and Lock and Harris' (2006) work integrating location, landscape and culture underpins the methodological framework for this chapter's modeling and quantitative assessment. Though many such models have been applied to the land-use studies (reviewed by Kosiba and Bauer 2013), only a few studies are have explored the relationship between settlement pattern, site location, and economic resources in China (Zhang et al 2010; Qiao 2010). Despite the prevalence of such models, their results should be treated with caution. The overall analytical utility of these models is limited due to the highly generalized units of analysis; the conceptualization of the environment is reduced to economic values, and the continuity in the landscape is accounted for by only to a few points (Kosiba and Bauer 2013).

Before modeling the conditions in the Guan Valley, it is important to note several assumptions and constraints. First, this study does not consider the distribution of wild food resources as a part of agricultural landscape, though wild food collection was central to the settlement pattern, subsistence activities, and movement of people especially in the prehistoric period. Second, the availability of agricultural resources near settlements will be used as major index for agricultural productivity. These resources are assumed to be more or less stable in the last few thousand years. Third, according to archaeobotanical and dietary studies in other regions, agricultural practices may differ between contemporaneous settlements as farming techniques, knowledge, and social traditions vary from one settlement to another. I will, however, consider this variation to be relatively insignificant, considering the spatial scale of this study. Four, I am not able to account for major technological advances in the history of agricultural development, such as the use of sickle and plough, and the fallow system in the Longshan period, and irrigation, metal tools, and new crops in the Eastern Zhou to Han dynasties. Current data does not allow us to quantify the contribution of these techniques in this study.

I address these limitations in the discussion section to add nuance to the modeling results. Some important environmental variables, such as precipitation and evaporation rates, are similar across the study area and, thus excluded from the analysis. I use ArcGIS to construct a spatial framework, spatial analysis, and data acquisition. The software package allows me to exploit environmental coverage and to examine spatial relationships with ever increasing efficiency in terms of time and cost. I then use R, the statistical package, to explore the relationships between variables. I conclude with the data preparation and methods for conducting site catchment analysis.

Data Preparation

1. *Basemap*

The basemap is a 30 m digital elevation model (DEM) of the Guan River valley that was extracted from the ASTER GDEM satellite image (International Scientific Data Service Platform 2013). The 30 m resolution means that any terrain variation of a size less than $30 \times 30\ m^2$ is not differentiated on the map. Several secondary datasets used in this study were produced from the

DEM dataset, including settlement maps, catchment maps, slope map, aspect map, soil map, agricultural landform map, and surface flow map. The surface flow map was generated through the Flow Accumulation module of ArcGIS 10. An agricultural geomorphology map was extracted from a 1:1,500,000 Henan Province Agricultural Resource GIS Dataset (Earth Science Database Project 2006). The soil map was extracted from the 1:200,000 Henan Province Soil Map Dataset (2006). Similar to the basemap, the map scales limited their representations that belie spatial heterogeneity of the landscape.

2. Settlement data

The settlement maps (shown in the settlement pattern chapter) were generated from the distribution of collection units. The location of each unit is represented by the geographic coordinates of its center. According to my site identification rule, if two units are less than 100 m distant from each other, they are considered as one site. Thus, all units are buffered for 75 m (each unit is 25×25 m^2 in size, plus 100 m between two points) in diameter and projected on DEM map. If two or more buffered points overlap, they are treated as one site. If the units are contemporaneous, they are considered one settlement.

Since many modules and tools in the ArcGIS modeling in this study are point-based (such as cost surface analysis), the patchy settlements are reduced to points here, and just for this purpose, often represented by the center or near-center of the collection unit (see Figure 7.1 for difference). This procedure leads to a problem—the shrinkage of catchment areas particularly in large settlements. It also reduces the intra-settlement variation in the measurement of environmental variables.

3a. Environmental variables: Agricultural catchment

Agricultural catchment, which indicates the area of farmland available to an occupation, is a critical feature of the local agrarian economy. Thus it is one of the most important environmental variables to evaluate land use strategies. The modeling of agricultural catchment uses cost surface analysis to identify the maximum radius that people may take from the site in a defined travel time by adopting the "optimal path"—cost surface analysis assumes that human agents travel with economical rationality, minimizing their energy expenditure and transportation cost (Kosiba and Bauer 2013). Some recent software tools, such as the r.walk module in GRASSGIS and cost distance module of ArcGIS 10, allow researchers to combine the effects of anisotropic influences on travel time such as steepness of slope and river crossing, as well as isotropic costs such as land cover (Fera 2007). Researchers have utilized cost surface to predict shortest traveling paths (Anderson and Gillam 2000) and territorial boundaries (Hare 2004). More recently, it has been used to evaluate population pressure and agricultural productivity (Varien *et al.* 2007). This approach has to be used cautiously, since cost surface models are based on current landscape and human movement speed.

Here, I use the impact of slope of terrain and added different time for river crossing to construct the cost surface of each settlement. Slope and river crossings seem to be the two factors that most strongly affect the travel patterns and division of land parcels in the Guan Valley. Hills and waterways are often used as the natural boundaries between villages and serve as boundaries for farmland parcels between villages. Rarely farmers will travel across hills or waterways to their land on daily basis.

The rasterized slope map is generated from the DEM by using slope analysis. The degree of steepness is then re-classified by the time cost in seconds (Figure 7.2). The time cost for passing up/down the slope is based on our field experiments. A slope steepness over 30 degrees is given a large value (5000), lowering the probability of traversing such steep slope (Table 7.1). Land cover and existing paths may create different passing times across the terrain, yet modern land cover and most paths were formed recently. A vector file with rivers is extracted from Google Earth. The crossing time for the Guan River is also given the high value of 9999, making it extremely costly to surpass. The time cost for other rivers are 30 minutes (1800 in value), regardless the variations in width or depth. The re-classified slope and river maps are overlaid by simply sum the values. The example of such a cost surface is shown in Figure 7.3.

The cost surfaces generate the “cost distance” from any settlement to any point on the map, thus allowing us to propose which parts of the surrounding landscape should be allocated to each contemporaneous settlement, based on the shortest travel time. There are, of course, many other factors affecting the organization of agricultural resources at village scale (social, economic, environmental, etc.), but travel time is often an important factor. Several studies have emphasized that a one hour round-trip to the fields represents a cross-cultural threshold (Zhang 2010). For local villages in the Guan Valley today, the cultivated fields are normally located within a one-hour return trip distance, except for newly exploited lands or those on steep slopes. No village owns land on the other side of almost any watercourse). Also, since the input/output ratio of farming was lower in the past, a two-hour walking distance was often preferred in later period of Chinese history. Here I adopt a two-hour return trip to mark the agricultural catchment for each settlement. First, I allocate each part of the landscape to the nearest settlement in terms of travel time, and then crop these allocations to a maximum travel time of one hour as the settlement catchment in the unit of square meters (see Figure 7.4 for example). The catchment area of each settlement is measured for further statistical analysis.

3b. Environmental variables: Others

In order to investigate whether differences in surrounding environments might explain some of the variation in the settlement pattern and population, I list a range of environmental variables (other than catchment) and extract their values in the catchment of each settlement from the database. These variables include soil type (Figure 7.5), landform (Figure 7.6), slope, aspect, distance to nearest waterways, and the catchment area measured in the previous stage. These variables are crucial determinants of agricultural yields, especially in the early stage of agriculture when technologies and inputs were limited. In addition, inferring from the discussion of settlement patterns, there are other strategic concerns in location choice, such as securing against floods or military threats, access to montane and hill resources, and waterway transportation.

There are six types of soils in the study area (Henan Province Soil Map Dataset 2006). Spread along the banks of the Guan River, the grey fluvo-aquic soil, also called rice soil in China, is one of the most fertile soils for wheat and rice cultivation. Cinnamon soils are formed through humification and present good drainage conditions in the semi-humid sub-tropical zone. This type of soil is one of the most widely distributed soils used for dry farming crops throughout Central China. Purple soil is more common in Southern China for dry farming crops than neutral skeletal soil, a highly eroded soil type that contains a large proportion of sand. Skeletal soil is found mostly along the base of the mountains and is unsuitable for farming (Pan 2004; Table 7.2).

Based on elevation and slopes, landforms can be divided into large and medium erosional mountains, corrosional mountains, corrosional high hills, erosional hills, and alluvial plains (Earth Science Database Project 2006). Although farming is practiced on the slopes and tops of a few medium-height mountains, the cultivations are seasonal and the lands are left fallow for most of the year. The large mountains to the north of the study area are rarely occupied by humans today.

The direction of wind and sunshine have made the southern and southeastern areas of the valley most desirable and the northern and northwestern areas the least desirable. In the spring, lands that face south and southeast absorb more sunlight and rainfall, brought the moist airflow from the ocean, and are protected from the cold, dry continental winds during the winter. Considering that dry farming was prevalent in the Guan Valley for most of the period under consideration, I include distance to nearest waterway and flow accumulation as variables. Flow accumulation measures volume of surface water flow according to surrounding topographical elevation, an important condition especially for dry farming with insufficient irrigation support. Although water table is a better indicator here, such data are unavailable. Surface water flow is thus used instead as an indicator to evaluate dry farming conditions.

Slope and aspect maps are generated from ArcGIS 10, while soil and landform maps are extracted from other datasets at different scales, creating inconsistencies between sources and scales. Flow accumulation is generated from the DEM through the flow accumulation module of ArcGIS 10. Though precipitation and evaporation are also crucial to farming, both factors are constant throughout the study area (precipitation: 800 mm; evaporation: 1600 mm). Other variables, such as underground water depth, soil nutrient, geological elements with proper scales are absent from the database. They should be included in future studies once they are available.

Data Analysis

1. *Date normalization*

The variables are extracted from the database for their values in each individual catchment. The formats contain both numeric and string data. Numeric data, including catchment size, slope, orientation, flow accumulation, and distance to nearest waterway are normalized to align datasets of different scales to a common scale. For example, the standard deviation of slope degree of the Late Yangshao settlements is 2.32, while the standard deviation of catchment areas is 509,926. This contrast will enlarge the weight of larger variation datasets in the correlation models. Normalization is applied to eliminate the effects of gross influence. Common procedures for normalization include logarithmic, quantile normalization, etc. For this study, I use the normalization function provided by the statistical package R for most of variables—each value is divided by variance.

The only numeric value that requires additional normalization is aspect as they need to be converted into ordinal data. The values of aspect are in degree, and reclassified using a new value based on preference in farming practice. As discussed earlier, the most preferred aspect is southeast and south. Therefore aspects are adjusted in the following reclassification:

0-90° [North to East]:-1~0.5;

90-180° [East to South]: 0.5~1;

180-270° [South to West]:1~-0.5;

270-360° [West to North]: -0.5~-1.

The soil types and landforms are string data. They are also given a numeric value based on agricultural resource evaluation (Pan 2004; see Table 7.2). Of all environmental variables, these two have been the most significantly transformed by human activity, especially farming practices.

2. Environmental preferences: Principal Component Analysis (PCA)

Using quantitative and spatial information on settlement patterns and environmental variables, I explore the existence and nature of Guan Valley residents' environmental preferences. Inferences based on these data are discussed in the Chapter 5. For example, from the settlement maps, it seems that the Neolithic occupations were closer to waterways than in any other period. However, location choice is complex and entails multiple cultural and ecological concerns. Statistical analysis of observed patterns in light of other environmental variables is essential for understanding the complexity of location choice.

I approach this issue first by investigating the recurring trends in environmental variables appearing together during each period, as some of the variability in settlement location might be explained by spatial correlation with more than one environmental variable. For example, if better soil and closer proximity to water sources always appear together, it suggests that a combination of these conditions of some significance to the productivity of dry farming were preferred. If these two variables account for most of the variation in all variables, it suggests that these two variables are prioritized. Thus, the questions to be addressed are: 1) how do environmental variables correlate to each other and how significant are these correlations in each period?; and 2) how do correlations change through time? To answer these questions, I use Principal Component Analysis (PCA) to analyze the summary values of catchment area, soil type, distance to waterways, landform type, slope, flow accumulation and aspect for settlements in each period.

Principal Component Analysis is a common multivariate technique (Joffille 2005). It explores patterns of interaction between variables to reduce the dimensionality of existing variables, so as to distinguish few more heavily weighted, linearly uncorrelated explanatory variables that account for most of the variance in the dataset. The calculation generates several components ranked by explanatory significance, each representing a different combination of multiple variables. The first component accounts for much of the variability. In this study, PCA helps to identify the interactions between variables and related patterns. A general form of formula by using PCA is (Joffille 2005):

$$PC1 = \beta_{11}\chi_1 + \beta_{12}\chi_2 + \ldots + \beta_{1P}\chi_P$$

Where:

PC1 = the subject's value on principal component 1 (the first component extracted).

β_{1P} = the regression coefficient (or weight) for observed variables p, as used in creating principal component 1.

χ_P = the subject's value on observed variable p.

Here, I use the function *prcomp* with the implementation of *Vegan* in the statistical package R (version 2.15.3) for PCA analysis. The package also includes a standard method for normalizing variables other than aspect. The threshold is set at 85%, which means that components with cumulative variance above 85% are not considered statistically significant. The PCA results for each period are listed in Table 7.3-7.

In Table 7.3-7, the results consist of two parts: 1) the upper section explains the accounted variation of each principal component; and 2) the lower section represents the variables and their weights in each component. The results in Table 7.3-7 suggest that the first five PCA factors (PC1-5) account for about 90% of the variance. There is no single component or variable that accounts for more than 35% of variance, suggesting that the interaction between environmental variables are more complex (Figure 7.7). This complexity is also implied by different variables in PC1-5 from period to period. Nevertheless, there are a few recurring trends that enable some speculation on environmental preferences.

For the Late Yangshao settlement, PC1 is negatively correlated with distance to rivers, catchment, and landform. PC2 is correlated negatively with soil and flow accumulation. This relationship may relate to the concerns of dry farming, as flow accumulation is an important index to evaluate dry farming condition. PC3 correlates with slope and landform in two opposite directions—one positive and one negative, reflecting similar trends in terrain relief. PC4 correlates with soil and aspect, which relate to farming productivity. Similarly with respect to farming productivity, PC5 correlates negatively with flow accumulation and aspect (Table 7.3).

In the Longshan period, PC1 correlates positively with catchment, distance to water and slope, the opposite of the Late Yangshao period. PC2 correlates positively with aspect, but still negatively with flow accumulation. PC3 correlates positively with flow accumulation and aspect, different from the previous period's PC3, but similar to PC5, though correlating in a different direction. PC4 correlates positively with slope and flow accumulation, both relating to terrain relief. PC5 correlates with soil and flow accumulation, which are both connected to farming productivity (Table 7.4).

In the Shangzhou period, PC1 correlates negatively with catchment, distance to rivers, and landforms. PC2 correlates negatively with soil and flow accumulation. Both components are similar to those in the Late Yangshao period. PC3 correlates positively with slope and aspect, and negatively with distance to the river, trends which seem to be related to exploitation of the hills and mountains. PC4 correlates with flow accumulation and aspect in a different direction. PC5 correlates with catchment and soil in different direction as well (Table 7.5).

In the Eastern Zhou period, PC1 correlates positively with flow accumulation, but negatively with soil and landform, which may be associated with dry farming conditions. PC2 correlates positively with catchment, distance to waterways, and slope. PC3 correlates negatively with catchment and positively with slope, pointing to the use of mountain resources. PC4 correlates positively with aspect and negatively with slope, which is connected to farming productivity. PC5 correlates positively with soil and accumulation, which are also clearly associated with agricultural productivity (Table 7.6).

In the Qinhan period, PC1 correlates negatively with catchment and distance to rivers. PC2 correlates positively with slope and flow accumulation, and negatively with landform, traits that may be associated with the practice of dry farming in the mountainous area. PC3 correlates with slope and flow accumulation as well, but in different directions. PC4 correlates with landform and aspect in different directions. PC5 shows a strong positive correlation with soil (Table 7.7).

In general, there are four classes of components that may imply four land-use concerns (Table 7.8). PC1 is the most and only consistent component. It generally associates with catchment, distance to river and landforms, except in the Eastern Zhou period, when these variables are associated with PC2. These three variables, though, differ from one period to another in terms of correlation direction, direction of change over time—either both correlate negatively or both positively with PC1. This implies that these three variables may represent a consistent preference in location, manifested especially by catchment size and distance to the river. The weights of these two variables differ from one period to another, but generally are quite similar. These two variables change in same direction, implying that larger catchments often accompany further distance to the river.

The association between catchment and distance to river is quite plausible considering the risk of flood that poses a greater risk to larger catchments. It also matches the observation on settlement pattern that some of the best floodplains for agriculture were not occupied for long time (see Chapter 5). Along the Guan River mainstream, the lack of sufficient drainage would keep the floodplain marshy for a year or two after a major flood event. These marshy conditions may have been another reason that ancient people avoided occupying floodplains that close to rivers. However, PC1 never exceeds 0.32 in proportion of variance. This suggests that the location concern PC1 represents, as long-standing as it has been, never dominate the location choice.

PC2-5 vary from time to time. Some components reflects identifiable trends leaning toward farming conditions, including PC2, 4 and 5 of the Late Yangshao settlements, PC3 of the Longshan settlement, PC2 of the Shangzhou period, PC4 and 5 of the Eastern Zhou period, and PC5 of the Qinhan period. All of these components contain two or more variables that values change in same directions that are advantageous to farming. For example, PC2 of the Late Yangshao period correlates negatively with soil and flow accumulation, suggesting that soil quality and flow accumulation change in the same direction. Therefore, better soil and higher flow accumulation appear together more often than other variables.

Some components that contain slope and landform seem to indicate the use of hilly or mountainous area. These components include PC3 of the Late Yangshao period, PC4 of the Longshan period, PC3 of the Shangzhou period, PC3 of the Eastern Zhou period, and PC2 and 3 of the Qinhan period. In some cases, such as PC2 in the Qinhan period, landform and slope account for most of the variability in this component, while they change in different directions, implying the coexistence of larger slope with unfavorable landform conditions. Although this observation needs further evaluation, the increasing importance of the slope variable in Qinhan matches the visual observations discussed in Chapter 5, which shows an increasing use of hilly landscape.

The rest of the components seem to contain variables that conflict with each other and with the above three groups of component. However, most of these unknown components accounts for little variation. These components include PC2 and 5 of the Longshan period, PC4 and 5 of the Shangzhou period, PC1 of the Eastern Zhou period, and PC4 of the Qinhan period. Taking PC1 of the Eastern Zhou period as an example, soil and flow accumulation change in opposite directions, which contradicts the assumption that these two variables should change in same direction to provide better farming conditions.

Although PCA provides a simplistic model of the environmental conditions of ancient occupations, the results show that environmental preferences changed from one period to another. The most consistent concern relates to catchment size and distance to waterways, which implies a continuous concern with flood threat or disuse of marshland, especially for settlements with large catchments. Still, this concern has never dominated location choice, as shown by the proportion of PC1. Ideal farming conditions were also important throughout time. But the ways in which this concern manifested varied over time. The use of hills and mountains was also a quite consistent component throughout, but increased in the Qinhan period.

3. *Relationships between settlement patterns and environmental variables*

After investigating the environmental preferences of settlements in each period, the next step is to explore the connections between environmental variables and settlement pattern characteristics. To achieve this goal, I apply pair-wise linear regression to environmental variables and settlement pattern categories, including settlement area and hierarchy, to identify whether settlement size correlates with environmental variables, or if environmental variables correlate with settlements when they reach certain thresholds in size. In order to account for the site use intensity and site formation, I also include total sherd count—the total number of sherds collected in one settlement. As discussed in the last chapter, surface sherd density is an indicator of occupation intensity as well as deposit taphonomy.

In addition, I also apply pair-wise linear regression to environmental variables and the principal components generated from PCA. Environmental variables may be correlated and covary with one another, impairing the confidence of correlation results. PCA on the other hand, ensures that principal components are uncorrelated with one another, making it possible to proceed with pair-wise linear regression with greater confidence. Since principal components consist of correlated environmental variables, the regression results with principal components should reflect similar trends as results with environmental variables. Thus, the interpretation of regression results should incorporate both sets of results to balance their explanatory strength and significance.

In both regression models, the dependent variables consist of settlement information, including area, hierarchy, and total sherd count of all settlements in one period. Different from the hierarchy described in the settlement pattern discussion, the hierarchy is ranked from 1-4: 1 is the hamlets with an area of 0.25 ha; 2 is settlements between 1-10 ha; 3 is settlements between 10-20 ha, and 4 represents the supra-settlements that are above 20 ha (Chapter 5). It should be noted that the dependent variables are correlated internally. That is, the larger the settlement, the higher the hierarchy and more sherds in general. Yet the correlation between dependent variables does not affect the correlation results.

The independent variables are different in the two models. In the first model, the independent variables are environmental, including catchment, soil, distance to waterways, landform, slope, flow accumulation, and aspect. In the second model, the independent variables are PC1-PC4, generated with PCA. The structures of PC1-4 in each period are listed in Table 7.3. Both regression models are applied individually to each period.

The lineal regression results of environmental variables and components are presented in Table 7.9-13. The values of the coefficient of determination (R^2), the p-value (p) and the coefficient parameter (Coef) are listed to show the strength and direction of correlation analyses. A high R^2 value with a small p-value indicates a strong correlation between independent and dependent variables. Numbers in bold and red have high R^2 values and p-values lower than 0.05 (a common value for measuring significance level), suggesting stronger correlation with greater significance between dependent and independent variables in each category. The numbers in bold and black are highest in coefficient of determination (R^2), highlighting better fit correlations to a less significance extent.

Since the R^2 value, which is the indicator of the fitness of the correlation model, are all below 0.4, the results suggest that, in general, there is no strong linear correlation between the dependent and independent variables. However, some stronger correlations, as well as general trends reflected by both sets of regression results, imply changing behavioral patterns that can be partly attributed to some environmental variables. Thus, I will justify these correlations period-to-period. For the convenience of discussion, I will refer to regression with environmental variables as EVR, and regression with principal components as PCR.

During the Late Yangshao period, PC1 correlates negatively with settlement area and sherd counts and, to a lesser significant extent, with hierarchy. Compared to PC1, PC2, 3 and 4 correlate to settlement area in a much lesser extent of significance. PC1 is composed of catchment and distance to waterways. EVR results also show that settlement area and hierarchy correlate with the distance to rivers most significantly, less with catchment, and even lesser with landform. This means that larger settlements tend to be further away from river and possibly larger catchment. Other than these three variables, the correlation significances with other environmental variables are weak (Table 7.9).

In the Longshan period, PC1, which still associate with distance to waterways and catchment, also correlates most positively and significantly with area and sherd counts and less significantly with hierarchy. However, compared to the Late Yangshao period, the significance decreases in all three correlations. EVR results indicate that settlement area and sherd count correlate significantly with both catchment and distance to rivers instead of only one variable in the previous period, which imply that the larger settlements are likely to accompany with further distance to river and larger catchment. In addition, the hierarchy correlates with landform most strongly and significantly and less with distance to rivers and catchment. The difference correlation between settlement area and settlement hierarchy seem to suggests that favorable landform, which is alluvial plain, plays an important role in the location of centers (Table 7.10).

In the Shangzhou period, both EVR and PCR do not show significant correlations. In general, PC1, the distance to waterways and catchment size, still correlates most significantly with settlement area. Sherd counts correlate more significantly with PC4, which associate with flow accumulation, aspect, and catchment. However, EVR shows that settlement area correlates more significantly with landform, and less with distance to waterways or catchment. This difference between EVR and PCR results may be caused by too much variability in a small dataset. The changes in environmental variables or principal components do not associate with changes in settlement hierarchy during this period (Table 7.11).

In the Eastern Zhou period, PCR does not show significant correlations. Settlement area and sherd counts still correlate more significantly with PC1, although PC1 associates with flow accumulation, soil and landform. Consistent with EVR observations, landforms play a stronger role in the changes of settlement area and sherd count. As correlation is negative, this suggests that larger settlement tend to associate with unfavorable landforms, including hills and mountains. Settlement hierarchy, on the other hand, correlates more significantly with PC3, which entails slope, catchment, and aspect. Though EVR shows that settlement hierarchy correlates with soil more significantly (Table 7.12).

During the Qinhan period, settlement area correlates negatively with PC4 most significantly, associating with aspect, landform, and flow. This correlation with area coincides with EVR result, which shows that landform is the only significant variable that correlates with settlement area. Sherd count and settlement hierarchy correlate negatively with PC3, which associates with slope, flow accumulation, and aspect. EVR results show that soil correlate more significantly with sherd count, and sherd correlates with settlement hierarchy. This contradiction between PCR and EVR on settlement hierarchy and sherd count is likely to be caused by large variation in the dataset (Table 7.13).

Table 7.14 presents the direction of change with dependent and independent variables generated from PCR. Combined with EVR results, several observations need to be emphasized:

1) The significance of correlation between principal components and settlement variables is stronger during the Late Yangshao and Longshan period, and decreases in extent since the

Shangzhou period. This correlation implies that environmental variables may have played a more important role in both the area and hierarchical position during the Neolithic period and to a lesser degree in the later period.

2) Flood may have been the greatest concern in the formation of settlement centers before the Eastern Zhou period. PC1 shows an association between distance to rivers, catchment, and landform, which have been the most important independent variables from the Late Yangshao to Shangzhou period. These three variables change in the same directions with settlement area and sherd counts (except in the Shangzhou period, when shed correlates with PC4 more significantly). This correlation shows that larger settlements are more likely to be further from rivers, larger catchments, and sometimes more cultivable landforms, and vice versa. Among these variables, distance to rivers may play the most important role (however, not defining role) in differentiating the size of settlement. As discussed in the PCA section, PC1 seems to associate with concern for reducing flood risk or avoiding marshland near the rivers. This concern may have been a dominant factor for location choice, especially for large settlements and regional centers. At the same time, large catchments were also favored when other preferred farming conditions, such as soil quality or flow accumulation were not emphasized. This suggests that farmland availability was prioritized over other agricultural conditions for the Neolithic societies in the Guan Valley.

3) A tendency to the use of hills and mountains in the Eastern Zhou and Qinhan period can be demonstrated by both EVR and PCR, although environmental variables seem to play a much less significant role in differentiating settlement area and hierarchy. Landform is the only independent variable that significantly correlates with settlement area in the Eastern Zhou to Qinhan period. Since the correlations are negative, they imply that settlement size depends more on the use of hills and mountains during the historic period. Although it is different from the

location preference in the Neolithic period that balances flood risks and farmland availability, it also expresses a trend that emphasizes the quantity, not the quality of farmland.

4) Farming conditions may not have played a significant role in differentiating settlement area and hierarchy. As some principal components associate with preferable farming conditions, they do not correlate significantly with settlement area and hierarchy in any period. EVR suggests that catchment area, landform, and soil correlate with settlement area and hierarchy in one period or another. However, the extent of significance is poor, and the correlation is sometimes negative. The only exception is the correlation between catchment and settlement area in the Longshan period, although it is in the secondary importance after distance to rivers. This contradicts popular opinion that favorable farming conditions, such as soil and sunlight availability play an important role in the location choice of farming societies.

5) In most periods, the surface sherd count may have reflected occupation intensity rather than deposit typhonomic processes. Sherd counts change in the same direction and correlate with similar independent variables as settlement area in three out of five periods (Late Yangshao, Longshan, and Eastern Zhou), suggesting that similar processes led to larger settlement areas and created the deposition of more sherds on the surface.

6). From the Eastern Zhou period, settlement area and settlement hierarchy correlate with different principal components. In the Eastern Zhou, settlement area correlates with PC1, which associates with flow accumulation and soil. The settlement hierarchy, on the other hand, correlates with PC3, which connect catchment and slope. While settlement hierarchy depends on settlement size, their correlations with environmental variables are very different. This suggests the possibility that location choice between each tier of settlements may vary. This variation is different from the location choice variations between large and small settlements. As settlement tiers associate with functional, categorical difference rather than size difference between settlements, I suspect that location choice for certain types of settlements may have been more standardized or planned than earlier in order for the settlement to function better. This coincides with the observation on settlement pattern that the spatial arrangement of Eastern Zhou occupations were more planned (Chapter 5).

In summary, the concern for flood risk prevention may have factored more significantly in the location of large occupations in the Neolithic period, while in later periods the exploitation of more farmland was also important. The exploitation of farmland is expressed as catchment area in the Neolithic, while in the Eastern Zhou and Qinhan periods, use of mountains and hills were more significant to the large occupation locations. High-quality farming conditions were not a major concern with respect to large settlement location in any period. In general, environmental variables were more influential in settlement location in the earlier periods than later periods.

Agricultural Capacity

Archaeobotanists—at more than 50 sites—have found that Yangshao societies intensively relied on the consumption of domesticated plants (Lee et al. 2007). Other than archaeobotany and stable isotopic studies revealing the importance of domesticated plants in the diet, Fuller and Zhang (2007) also study paleobotanic evidence with artifacts and settlement data to illustrate varying food production behaviors at inter-site scale at the incipient stage of Yangshao agriculture.

By evaluating the agricultural environment available to local occupants, many models measure agricultural productivity and sustained population levels to explore the behavioral diversity of farming societies (e.g. Murtha 2009; Varien et al. 2007; Zhang et al. 2010). As productive as the results are, models vary from one another in variables as well as measurements. Here I will focus on the sustained population size, yield, and consumption rate of ancient farming communities. Lacking paleoenvironmental proxies and soil productivity information, Qiao (2010) provides an equation for measuring the required farmland of cereal-based population in the Yiluo region:

Farmland needed (in hectare) = farmland needed (per person)× population

Farmland needed (per person) = annual cereal consumption (per person) / cereal yield (per kilograms/per hectare)

There are several concerns regarding the measurement of agricultural productivity that must be addressed. As the Yiluo River region is proximate to the Guan River valley, I adopt same proxies as Qiao's study. The millet yield (per kg/per ha) applied to the Yangshao to Shang period is 315kg/ha (Qiao 2010), which is more conservative an estimate than other studies (both Zhao [2005] and Li and Yang [2009] estimate 1410/ha). The annual millet consumption per person, which is 258 kg/person is also conservative (Hsu [1980] suggests a higher consumption rate).

Qiao (2010) includes a one-year fallow period is also included in her calculation. By comparing farming tools, especially the ratio of cutting tools to digging tools, Wang (1998) speculates that the fallow system started as early as in the Longshan period in the semi-arid Middle Yellow River after a long history of slash-and-burn agriculture. Wang (1998) also cites oracle-bone inscriptions, which describe a three-year fallow system during the Shang dynasty. In addition, fallowing may have ceased and been replaced by alternative farming during the Eastern Zhou, especially in the populous areas around cities. Different from fallowing, a several year period of disuse of agricultural lands that allows them to recover moisture and fertility, such alternative farming methods focus on the preparation of land for next-year's cultivation like periodic weeding and plowing (Wang 1998). In the Han dynasty, as irrigation construction became common, alternative farming methods were widely used in agricultural zones with long traditions of farming and irrigation. In newly exploited areas, however, fallow or slash-and-burn was still practiced, as recorded in historic documents (Hsu 1980)

Crop selection represents another point requiring further justification. The Guan River valley is situated at the transitional zone of rice and millet agriculture. The cultivation of both crops has been dated to as early as the Yangshao period in this zone (i.e. Zhang et al. 2004). Gouwan at Xichuan, a site less than 100 km to the south of the Guan Valley, yielded an array of crops, including both rice and millet in the Late Yangshao period (Fu et al. 2010). Rice and millet have different yield and consumption rates. While few historic records mention rice yield in the early periods and modern rice yields depend more on labor input and seedling technology than millet yield, I will only use millet yield as the indicator for domesticated plant production. Other than rice, the growth of soybeans increased in the Shang period. Millet has remained in the major crop package until the Han dynasty, when the government promoted wheat. Its longevity of use makes millet the only stable proxy by which to estimate crop yield for such a long temporal scale.

There are also distinctive inter-settlement variations on the scale of crop exploitation and dietary composition within and between regions at the incipient stage of agriculture. Fuller and Zhang (2007) observe that crop harvesting and processing practices differ between sites and are also "opportunities for both innovation and information-sharing between people or communities" (Zhang et al. 2010: 1481). They propose that agriculture may have been organized on a smaller scale in more focused units of production, which means settlement, in the early stage of agriculture. Some behaviors, such as harvesting, were not shared at a regional scale at the time.

Taking all these factors into concern, I adopt Qiao's (2010) estimates of 315kg/ha as cereal yield and 258 kg/person as annual cereal consumption per person. These estimates suggest that 1.6 ha of farmland was needed per person, as at least 1.6 ha of land cropped with millet is required to feed one person per year.

When the number is applied to the estimated population in the Guan Valley, it is possible to estimate the amount of farmland needed for each settlement in each period. The ratio of farmland needed to the catchment area then represent the index of carrying capacity of agriculture of each settlement:

ACI (Agricultural capacity index) = farmland needed/catchment area

ACI increases in an opposite direction to agricultural capacity. The larger the index is, the smaller the agricultural capacity is, for each settlement. A ratio of 1 means that the catchment of a settlement is just enough to support its occupants. If ACI is above 1, the catchment is not enough to support the population with millet, which suggests either food shortage or supplemental subsistence activities.

In order to identify and compare agricultural productivity and sustainability in each period, Figure 7.8 and 7.9 present the average agricultural capacity and the percentage of settlements with agricultural capacities above 1 in each period. Some of the variation may be due to population density and catchment size of each period (shown in the Figure 7.10 and 11). The ACI drops almost by half from the Late Yangshao to Longshan period, suggesting a significant increase in the agricultural capacity. However, 12% of Longshan settlements were not able to produce enough cereal with the available catchment. During the Shangzhou period, all settlements were surrounded by abundant farmland that population could rely on only 30% of the catchment. The lowest population density may have also contributed to the low ACI value (Figure 7.10). During the Eastern Zhou period, the ACI value increases again, possibly due to high population density and a decrease in the average catchment. Nearly ¼ of settlements were not able to produce enough cereal in their catchments. The decline in ACI in the Qinhan period suggests that the shortage of farmland was relieved to a certain extent (ACI: 3.31 to 2.51). The population density was at the highest level during the Qinhan period. However, the size of the catchment area, the largest of all periods, made up for the population increase.

7.2 Discussion: Environmental Variables in the Agricultural Landscape

By using spatial analysis tools and statistical packages, the chapter demonstrates the history and variation in the land use practices and agricultural productivity of settlement locations in the Guan River valley. As long-term farming societies, the occupants of the Guan Valley faced various environmental challenges and opportunities. Modeling environmental variables provides visual representations of the distribution and scale of farming resources and risks. Modeling also quantifies environmental variables that are circumstantial in spatial data but essential to ecological decision-making. For example, agricultural catchment generated by ArcGIS, which measures the availability of farmlands near occupations, is one of the environmental variables that are associated the most with agricultural yields of communities. Yet it would require much more labor to measure the size of catchment of each site, which could be extremely time-consuming in the fieldwork.

Preferable environmental conditions vary from one period to another in terms of variables and statistical significance. The results of PCA reveal three categories of preferable environmental conditions. The first is the concern over flood risks and marshlands near rivers.

This concern has been more significant than other criteria in the influencing location choices in nearly all time periods. The second is the use of hills and mountainous landscapes, which increased over time. Finally, contrary to the expectation that quality farmlands are valued highly in farming societies, some environmental variables, including soil quality and aspect, have never been a paramount factor in settlement location in the Guan Valley. Instead, the land-use strategies seem more concerned with flood risk management than exploring hills and mountains.

Minimizing exposure to flood risks may have been a dominant influence in settlement location choice, especially for large settlements and regional centers in the Neolithic period. This concern is expressed as the distance to rivers played as the strongest variables correlate with settlement area and hierarchy. Since the Shangzhou period, the statistical significance of environmental variables in influencing settlement area is weakened. However, landforms that are not generally valued high in farming (i.e. hills and mountains) correlate more significantly with larger settlements. The occupation of hills and mountains in the historic period replaced the pursuit of larger catchments in the Neolithic period, providing an alternative economic strategy for settlement expansion and agricultural production.

Agricultural capacity analysis evaluates food availability of the Guan Valley people by comparing the required amount of farmlands to sustain local populations with the area of available farmlands. If required farmlands exceed available farmlands in an occupation, it implies risks of food shortage. The ACI model provides quantitative measurements of agricultural capacities of occupations for all periods. The results show that other than during the Shangzhou period, most periods likely experienced food shortage problems. The worst food shortage took place during the Eastern Zhou period and the Late Yangshao periods for different reasons—the former was caused by a rapid population increase in the region, while the later by a shortage of available farmland. This food production problem may have been mitigated through market system, which will be discussed in later chapters.

An analysis of the relationships between environmental variables, settlement data, and agricultural capacity reveals the long-term dynamics of various components of the agro-ecosystem. Over time, land use practices have shaped and altered the agricultural landscape. Meanwhile, the ecological assessment also reveals that the occupation history cannot be reduced to the interplay between subsistence farming and ecological variables alone. In the next chapter, I will discuss other socioeconomic processes that have shaped social structure at the regional scale.

Table 7.1 Re-classification of slope value for Cost Surface analysis.

Original	Re-classified
1-4°	4
5-9°	5
10-15°	6
16-20°	7
20-29°	8
>30°	5000

Table 7.2 Reclassification of soil and landform types.

Soil type	Rating	Value	Landform type	Rating	Value
Grey fluvo-aqvic soil	good	5	Alluvial plains	excellent	3
Cinnamon soil	better	4	Corrosional mountains:500-2500m	medium to poor	2
Neutral purple soil	medium	3	Corrosional high hills	medium to poor	2
Calcareous purple soil	medium to poor	2	Errosional valleys and terraces	medium to poor	2
Neutral skeletol soil	medium to poor	2	Erosional mountains:500-2500m	poor	1
Calcareous skeletol soil	poor	1	Erosional mounatins:500-1000m	poor	1

Table 7.3 PCA results of the Late Yangshao period: Pink values are the two-three highest correlated variables in each component. Components are also marked with different colors, as-- orange: components relate to flood and marshland concern; yellow: components relate to the hills and uplands use; blue: components relate to preferable faming condition; grey: components with unknown association. Table 7.4-7 has similar representations.

Late Yangshao							
	PC1	PC2	PC3	PC4	PC5	PC6	PC7
Standard Deviation	1.427	1.210	1.098	0.995	0.817	0.616	0.507
Proportion of Variance	0.291	0.209	0.172	0.141	0.095	0.054	0.037
Cumulative Variance	0.291	0.500	0.673	0.814	0.909	0.963	1.000
	PC1	PC2	PC3	PC4	PC5	PC6	PC7
Catchment	-0.529	0.029	-0.455	0.010	-0.216	-0.483	-0.482
Soil	-0.267	-0.508	-0.051	0.626	0.154	-0.204	0.459
Distance to rivers	-0.543	0.274	-0.185	-0.184	-0.344	0.419	0.518
Landform	-0.390	0.103	0.574	0.420	-0.053	0.366	-0.441
Slope	0.169	0.337	-0.600	0.443	0.353	0.396	-0.144
Flow accumulation	0.186	-0.645	-0.254	-0.025	-0.474	0.449	-0.241
Aspect	0.372	0.355	0.047	0.448	-0.678	-0.241	0.123

Table 7.4 PCA results of the Longshan period.

Longshan							
	PC1	PC2	PC3	PC4	PC5	PC6	PC7
Standard Deviation	1.483	1.161	1.086	1.025	0.871	0.508	0.455
Proportion of Variance	0.314	0.193	0.169	0.150	0.108	0.037	0.030
Cumulative Proportion	0.314	0.507	0.675	0.825	0.934	0.970	1.000
	PC1	PC2	PC3	PC4	PC5	PC6	PC7
Catchment	0.574	-0.093	0.124	0.094	0.427	-0.255	-0.625
Soil	-0.478	-0.244	-0.110	-0.160	0.638	0.474	-0.206
Distance to rivers	0.567	-0.159	0.284	-0.099	0.220	0.465	0.547
Landform	0.327	0.099	-0.730	0.051	-0.260	0.480	-0.225
Slope	-0.070	0.128	-0.110	0.919	0.274	0.006	0.218
Flow accumulation	-0.072	-0.636	0.339	0.325	-0.458	0.281	-0.283
Aspect	-0.062	0.689	0.482	0.056	-0.102	0.430	-0.301

Table 7.5 PCA results of the Shangzhou period.

Shangzhou							
	PC1	PC2	PC3	PC4	PC5	PC6	PC7
Standard Deviation	1.424	1.335	1.138	0.890	0.854	0.566	0.229
Proportion of Variance	0.290	0.255	0.185	0.113	0.104	0.046	0.007
Cumulative Proportion	0.290	0.544	0.729	0.842	0.947	0.993	1.000
	PC1	PC2	PC3	PC4	PC5	PC6	PC7
Catchment	-0.482	0.285	-0.145	0.383	0.457	0.513	-0.214
Soil	-0.231	-0.552	-0.132	0.209	-0.599	0.266	-0.390
Distance to rivers	-0.500	-0.328	-0.406	-0.282	0.079	-0.001	0.626
Landform	-0.404	0.429	-0.199	0.319	-0.337	-0.630	-0.042
Slope	-0.273	0.213	0.699	0.044	-0.368	0.291	0.413
Flow accumulation	0.018	-0.495	0.308	0.639	0.336	-0.315	0.199
Aspect	-0.475	-0.180	0.418	-0.467	0.255	-0.292	-0.446

Table 7.6 PCA results of the Eastern Zhou period.

Eastern Zhou							
	PC1	PC2	PC3	PC4	PC5	PC6	PC7
Standard Deviation	1.333	1.295	1.070	0.957	0.846	0.665	0.572
Proportion of Variance	0.254	0.240	0.164	0.131	0.102	0.063	0.047
Cumulative Proportion	0.254	0.493	0.657	0.788	0.890	0.953	1.000
	PC1	PC2	PC3	PC4	PC5	PC6	PC7
Catchment	-0.300	0.512	-0.472	0.090	0.007	-0.117	-0.635
Soil	-0.493	-0.196	0.258	-0.350	0.548	-0.473	-0.074
Distance to rivers	-0.272	0.629	-0.004	0.200	0.134	-0.079	0.683
Landform	-0.480	-0.293	-0.429	-0.159	0.149	0.651	0.169
Slope	-0.065	0.425	0.556	-0.489	-0.106	0.465	-0.197
Flow accumulation	0.511	0.152	-0.083	0.067	0.798	0.247	-0.084
Aspect	-0.311	-0.119	0.458	0.749	0.111	0.234	-0.225

Table 7.7 PCA results of the Qinhan period.

Qinhan							
	PC1	PC2	PC3	PC4	PC5	PC6	PC7
Standard Deviation	1.459	1.178	1.040	0.985	0.903	0.619	0.480
Proportion of Variance	0.304	0.198	0.155	0.139	0.117	0.055	0.033
Cumulative Proportion	0.304	0.503	0.657	0.796	0.912	0.967	1.000
	PC1	PC2	PC3	PC4	PC5	PC6	PC7
Catchment	-0.576	0.297	-0.070	0.109	-0.202	0.040	0.722
Soil	0.367	-0.062	-0.141	0.126	-0.904	0.081	0.029
Distance to rivers	-0.528	0.399	-0.095	0.064	-0.257	-0.200	-0.665
Landform	-0.322	-0.445	0.355	0.507	-0.043	0.537	-0.158
Slope	0.137	0.510	0.573	-0.393	-0.082	0.481	-0.035
Flow accumulation	0.241	0.434	-0.539	0.405	0.250	0.483	-0.056
Aspect	-0.271	-0.319	-0.470	-0.627	-0.065	0.447	-0.079

Table 7.8 Four classes of components.

	Flood/Marshland	Hills/Mountains	Farming	Unknow
LYS	PC1	PC3	PC2, 4, 5	
LS	PC1	PC4	PC3	PC2,5
SZ	PC1	PC3	PC2	PC4,5
EZ	PC2	PC3	PC4,5	PC1
QH	PC1	PC2, 3	PC5	PC4

Table 7.9 Pair-wise linear regression results for the Late Yangshao period data: Red colors are statistically significant correlations, with p value smaller than 0.05; bold color values are also significant correlations, but to less extent comparing to the red variables. Table 7.10-13 have similar representations.

Late Yangsho									
	Settlement Area			Sherd			Hierarchy		
	R^2	p	Coef	R^2	p	Coef	R^2	p	Coef
Catchment	0.136	0.084	0.000	0.136	0.083	0.000	0.023	0.491	0.000
Soil	0.016	0.567	0.588	0.013	0.603	20.830	0.002	0.850	0.020
Dist river	**0.379**	**0.002**	0.022	**0.380**	**0.002**	0.856	**0.219**	**0.024**	0.002
Landform	0.000	0.986	0.009	0.069	0.225	67.170	0.064	0.245	0.169
Slope	0.000	0.986	0.009	0.000	0.985	0.381	0.002	0.859	-0.009
Flow	0.009	0.669	-0.011	0.008	0.679	-0.416	0.010	0.642	-0.001
Aspect	0.008	0.690	-0.005	0.012	0.619	-0.224	0.029	0.440	-0.001
	Settlement Area			Sherd			Hierarchy		
	R^2	p	Coef	R^2	p	Coef	R^2	p	Coef
PC1	**0.255**	**0.014**	-1.881	**0.241**	**0.017**	-71.070	**0.132**	**0.089**	-0.137
PC2	0.020	0.521	0.620	0.024	0.477	26.650	0.014	0.587	0.053
PC3	0.011	0.629	-0.516	0.012	0.623	-20.400	0.001	0.899	0.014
PC4	0.002	0.846	0.230	0.003	0.814	10.770	0.001	0.911	-0.013

Table 7.10 Pair-wise linear regression results for the Longshan period data.

Longshan									
	Settlement Area			Sherd			Hierarchy		
	R^2	p	Coef	R^2	p	Coef	R^2	p	Coef
Catchment	**0.184**	**0.032**	0.000	**0.204**	**0.023**	0.000	0.036	0.367	0.000
Soil	0.000	0.959	-0.085	0.000	0.954	-4.272	0.001	0.913	-0.018
Dist rivers	**0.190**	**0.030**	0.012	**0.216**	**0.019**	0.564	0.074	0.187	0.001
Landform	0.055	0.261	1.114	0.040	0.337	42.760	**0.106**	**0.112**	0.154
Slope	0.000	0.965	-0.030	0.000	0.976	0.906	0.006	0.704	-0.026
Flow	0.003	0.780	-0.001	0.002	0.819	-0.020	0.005	0.740	0.000
Aspect	0.035	0.370	-0.009	0.051	0.278	-0.473	0.014	0.579	-0.001
	Settlement Area			Sherd			Hierarchy		
	R^2	p	Coef	R^2	p	Coef	R^2	p	Coef
PC1	**0.156**	**0.051**	1.266	**0.164**	**0.044**	58.070	**0.070**	**0.200**	0.085
PC2	0.009	0.645	-0.397	0.009	0.657	-17.110	0.000	0.929	-0.008
PC3	0.003	0.804	-0.229	0.000	0.977	-1.191	0.025	0.449	-0.069
PC4	0.000	0.919	-0.100	0.000	0.981	-1.037	0.007	0.684	-0.039

Table 7.11 Pair-wise linear regression results for the Shangzhou period data.

Shangzhou									
	Settlement Area			Sherd			Hierarchy		
	R^2	p	Coef	R^2	p	Coef	R^2	p	Coef
Catchment	0.071	0.429	0.000	0.287	0.090	0.000	0.000	1.000	0.000
Soil	0.001	0.916	-0.007	0.009	0.786	-1.039	0.000	1.000	0.000
Dist rivers	0.056	0.484	0.000	0.012	0.747	-0.004	0.000	1.000	0.000
Landform	**0.139**	**0.259**	0.096	**0.347**	**0.057**	8.478	0.000	1.000	0.000
Slope	0.055	0.489	0.020	0.272	0.100	2.483	0.000	1.000	0.000
Flow	0.018	0.692	-0.006	0.013	0.736	0.275	0.000	1.000	0.000
Aspect	0.022	0.662	0.000	0.042	0.545	0.019	0.000	1.000	0.000
	Settlement Area			Sherd			Hierarchy		
	R^2	p	Coef	R^2	p	Coef	R^2	p	Coef
PC1	**0.204**	**0.163**	-0.053	0.187	0.184	-2.831	0.000	1.000	0.000
PC2	0.028	0.623	0.021	0.155	0.231	2.745	0.000	1.000	0.000
PC3	0.005	0.830	0.011	0.075	0.414	2.245	0.000	1.000	0.000
PC4	0.017	0.705	-0.024	**0.250**	**0.117**	5.231	0.000	1.000	0.000

Table 7.12 Pair-wise linear regression results for the Eastern Zhou period data.

Eastern Zhou									
	Settlement Area			Sherd			Hierarchy		
	R^2	p	Coef	R^2	p	Coef	R^2	p	Coef
Catchment	0.001	0.841	0.000	0.001	0.826	0.000	0.006	0.628	0.000
Soil	0.036	0.238	-1.089	0.032	0.267	-6.060	**0.057**	**0.134**	-0.112
Dist rivers	0.000	0.913	0.000	0.008	0.577	0.012	0.000	0.890	0.000
Landform	**0.076**	**0.081**	-3.010	**0.096**	**0.048**	######	0.017	0.413	-0.117
Slope	0.024	0.331	-0.683	0.013	0.473	-2.985	0.037	0.226	-0.069
Flow	0.002	0.758	-0.001	0.004	0.680	-0.011	0.006	0.619	0.000
Aspect	0.001	0.859	0.003	0.011	0.518	0.059	0.013	0.473	-0.001
	Settlement Area			Sherd			Hierarchy		
	R^2	p	Coef	R^2	p	Coef	R^2	p	Coef
PC1	**0.047**	**0.174**	1.259	**0.025**	**0.322**	5.455	0.016	0.431	0.060
PC2	0.003	0.749	0.309	0.014	0.456	4.242	0.002	0.765	0.024
PC3	0.010	0.539	-0.716	0.002	0.806	-1.695	**0.039**	**0.216**	-0.117
PC4	0.000	0.965	0.058	0.010	0.529	4.846	0.010	0.542	0.065

Table 7.13 Pair-wise linear regression results for the Qinhan period data.

Qinhan	Settlement Area			Sherd			Hierarchy		
	R^2	p	Coef	R^2	p	Coef	R^2	p	Coef
Catchment	0.000	0.942	0.000	0.005	0.606	0.000	0.001	0.856	0.000
Soil	0.017	0.338	0.850	**0.029**	**0.203**	5.930	0.017	0.330	0.051
Dist rivers	0.000	0.980	0.000	0.003	0.670	0.007	0.000	0.916	0.000
Landform	**0.075**	**0.040**	-3.652	0.027	0.226	-11.465	**0.034**	**0.169**	-0.145
Slope	0.002	0.767	-0.247	0.009	0.479	-3.093	0.012	0.420	-0.039
Flow	0.001	0.791	-0.001	0.002	0.758	-0.008	0.003	0.701	0.000
Aspect	0.001	0.811	-0.004	0.000	0.975	-0.003	0.001	0.779	0.000
	Settlement Area			Sherd			Hierarchy		
	R^2	p	Coef	R^2	p	Coef	R^2	p	Coef
PC1	0.003	0.701	0.312	0.000	0.893	-0.576	0.000	0.934	0.004
PC2	0.000	0.912	0.112	0.000	0.912	-0.589	0.004	0.661	-0.026
PC3	0.039	0.143	-1.655	**0.040**	**0.136**	-8.870	**0.044**	**0.117**	-0.104
PC4	**0.057**	**0.072**	-2.133	0.020	0.291	-6.666	0.036	0.159	-0.099

Table 7.14 Linear relationships between principal components and settlement data as shown by PCR (Linear regression with principal components): Dependent variables include SA—settlement area, S—sherd count, and H—hierarchy. Independent variables are principal components that correlate most strongly with dependent variables. Each principal component contains three most correlated variables, listed top to bottom according to their weights in principal component. Arrows show the direction of change: blue shows decrease and red shows increase. If dependent and independent variable have same direction of arrow, they correlate positively. In addition, black arrows are linear correlation with p-value lower than 0.12.

Late Yangshao					Longshan					Shangzhou					
SA	S	H	PC1		SA	S	H	PC1		SA	PC1		S	PC4	
↓	↓	↓	Dist to Rivers	↓	↑	↑	↑	Dist to Rivers	↑	↓	Dist to Rivers	↓	↑	Flow	↑
			Catchment	↓				Catchment	↑		Catchment	↓		Aspect	↓
			Landform	↓				Landform	↑		Aspect	↓		Catchment	↑

Eastern Zhou							Qinhan						
SA	S	PC1		H	PC3		SA	PC4		S	H	PC3	
↑	↑	Flow	↑	↓	Slope	↑	↓	Aspect	↓	↓	↓	Slope	↑
		Soil	↓		Catchment	↓		Landform	↑			Flow	↓
		Landform	↓		Aspect	↑		Flow	↑			Aspect	↓

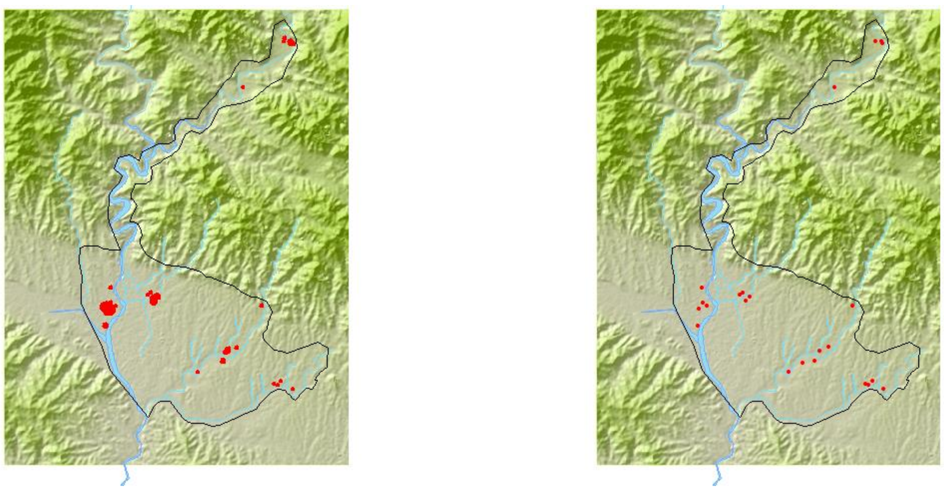


Figure 7.1 Original settlement map and adjusted settlement map of the Late Yangshao period.

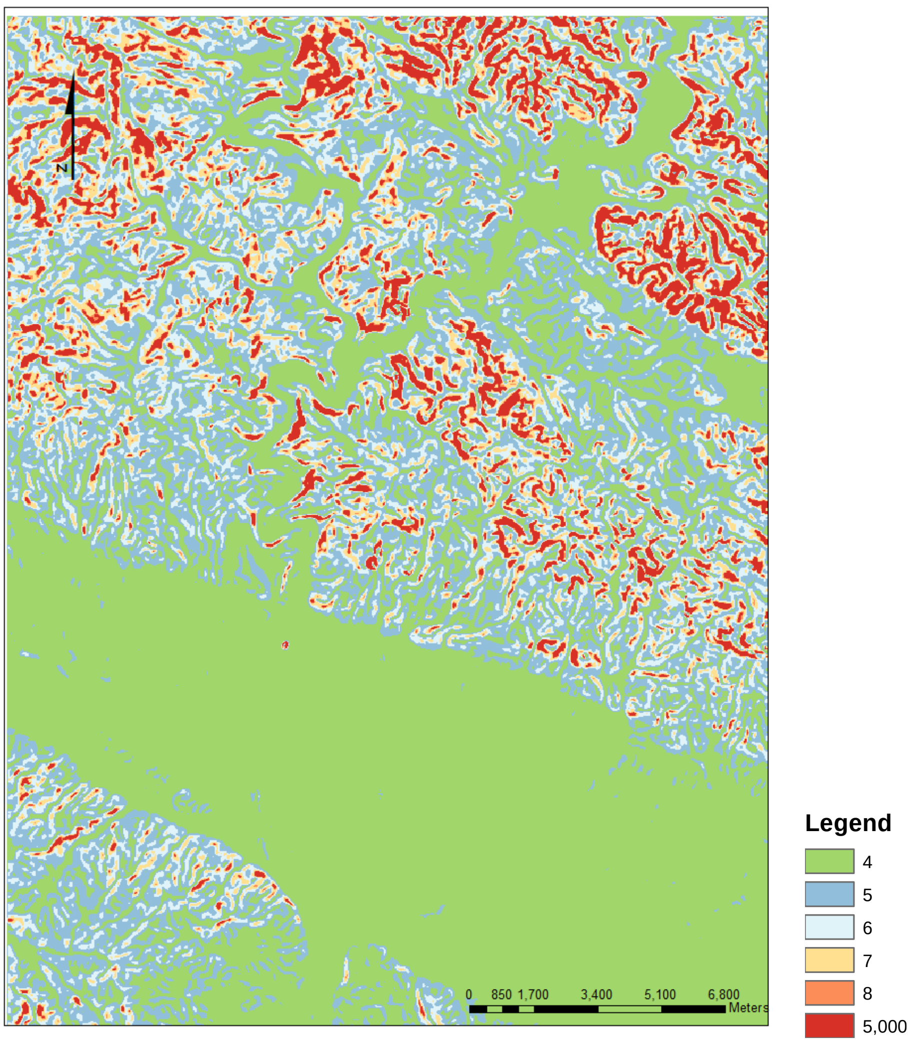


Figure 7.2 Reclassified Slope Map.

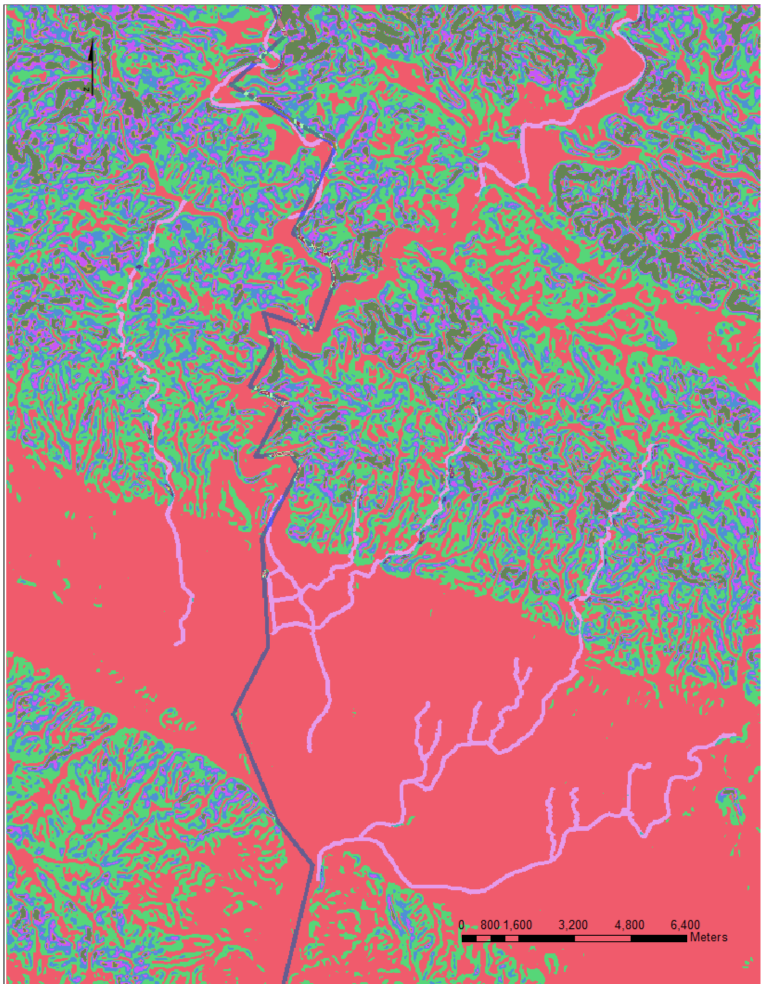


Figure 7.3 The cost surface based on slope and river crossing.

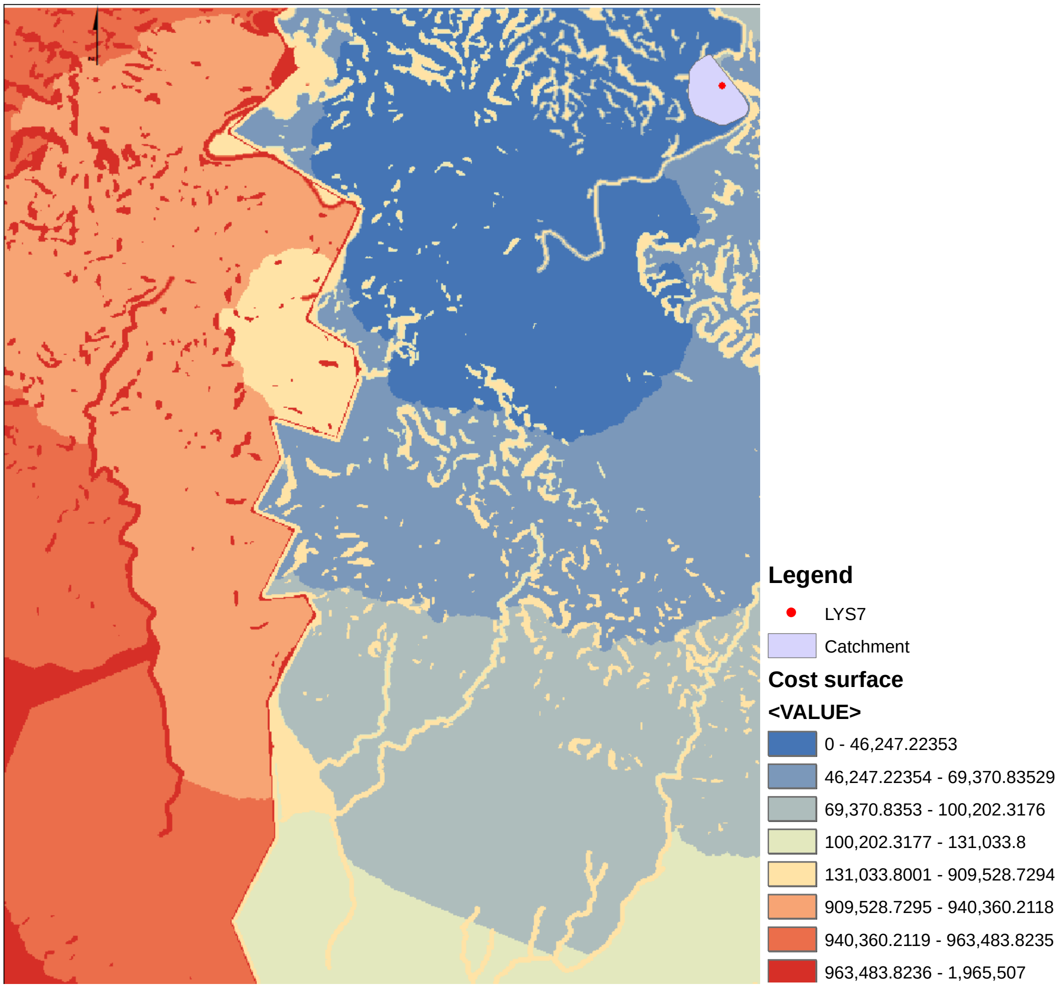


Figure 7.4 Cost distance and catchment of LYS7.

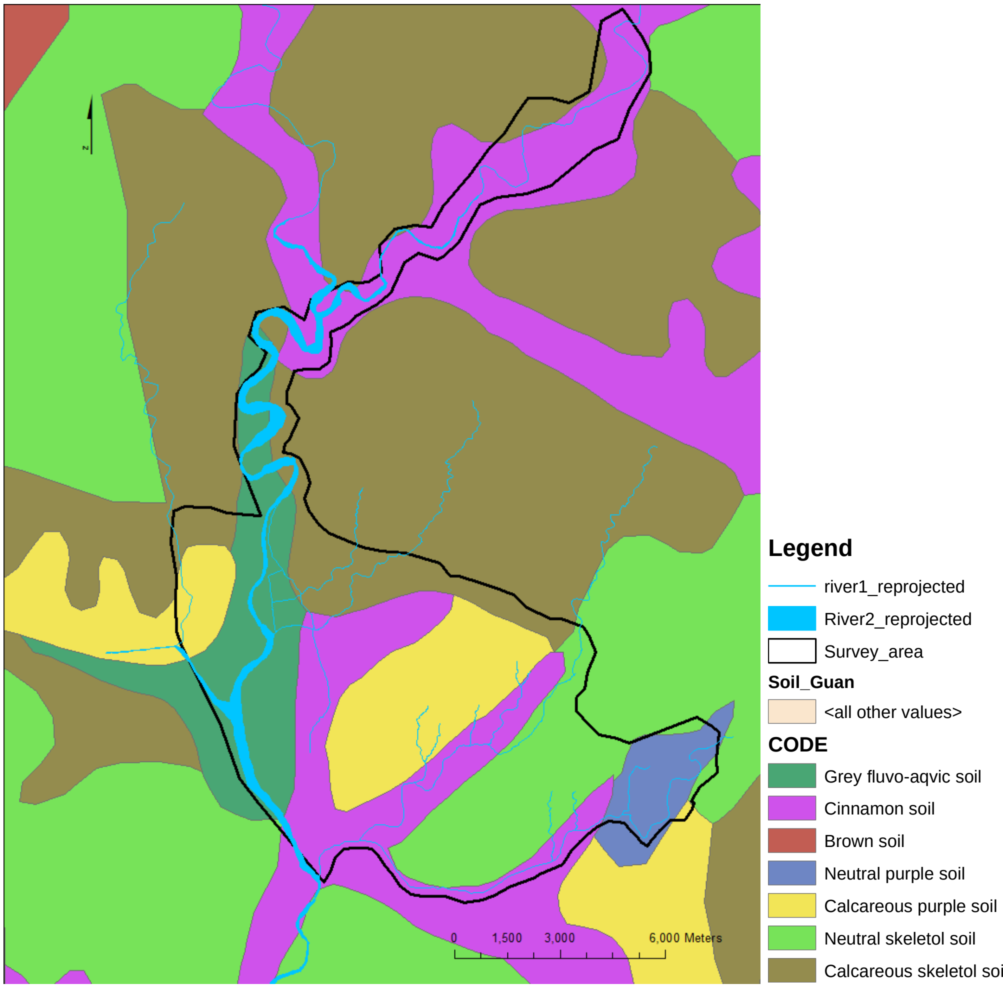


Figure 7.5 Soil types of the Guan Valley.

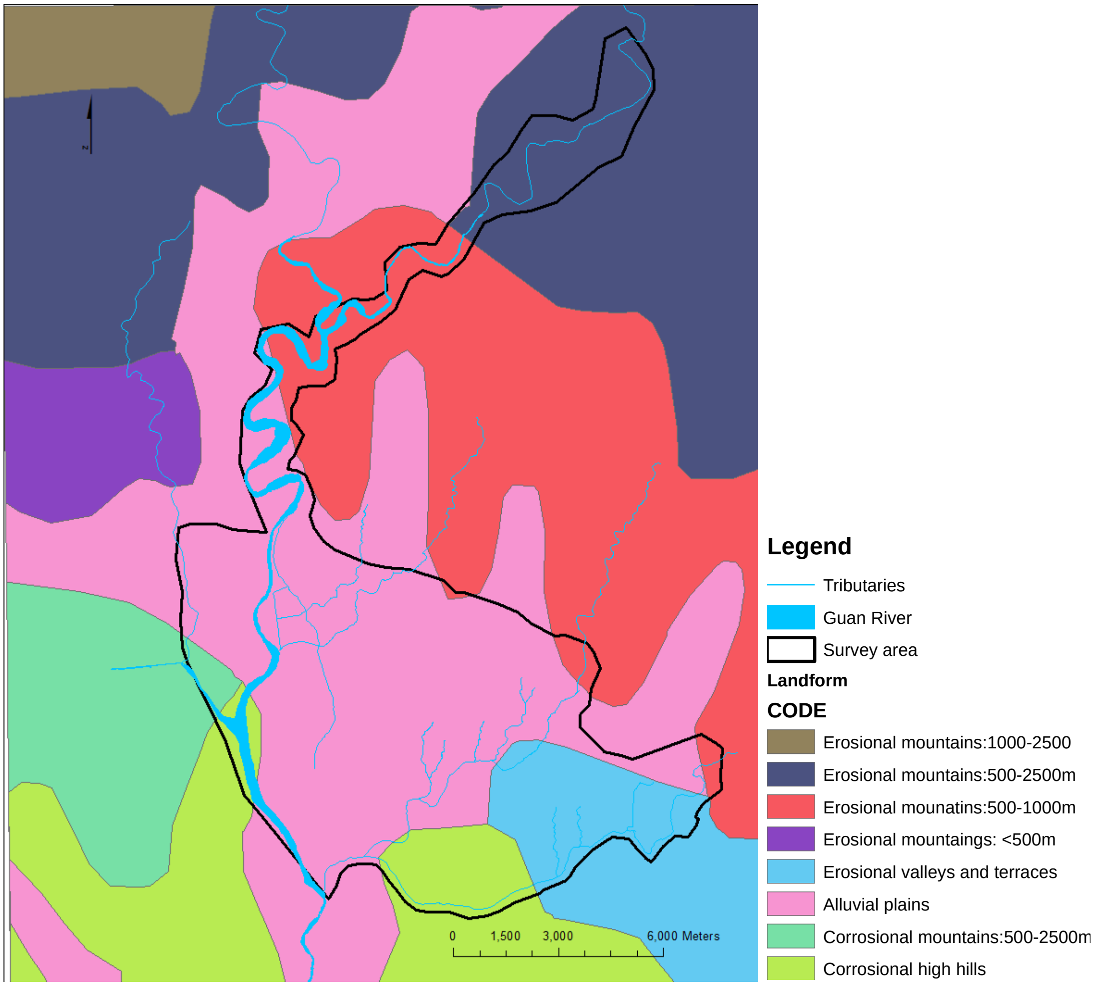


Figure 7.6 Landforms of the Guan Valley.

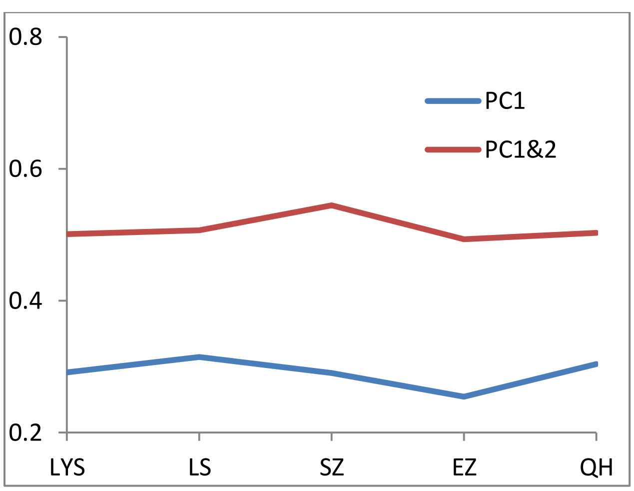


Figure 7.7 Proportion of variance of PC1 and PC1 and 2 in each period.

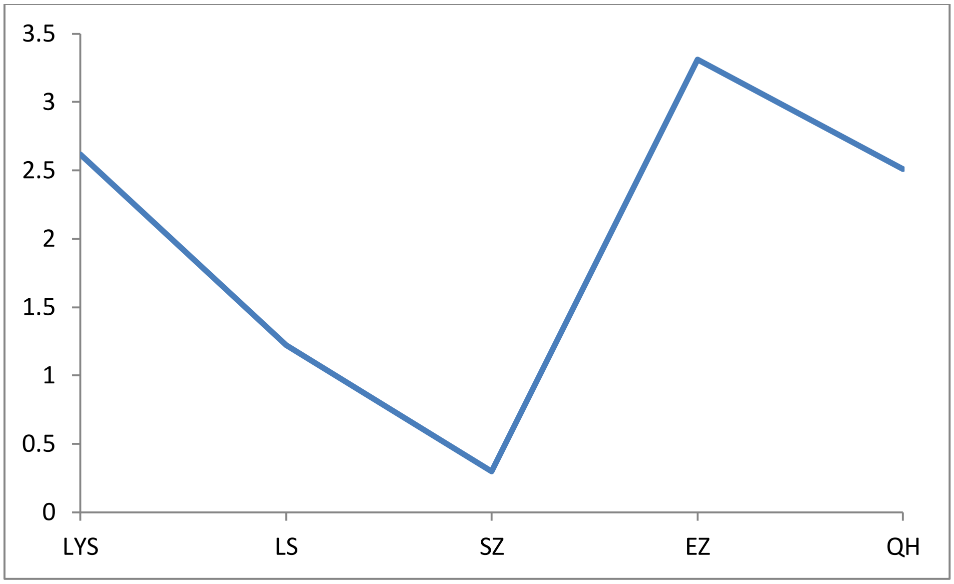


Figure 7.8 Average ACI of each period.

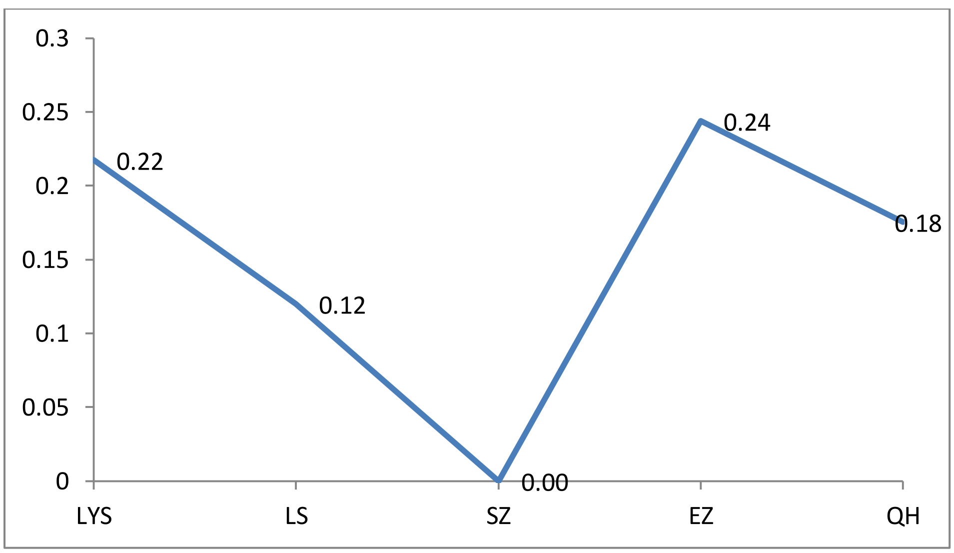


Figure 7.9 Ratio of the number of AC>1 settlement to total settlements of each period.

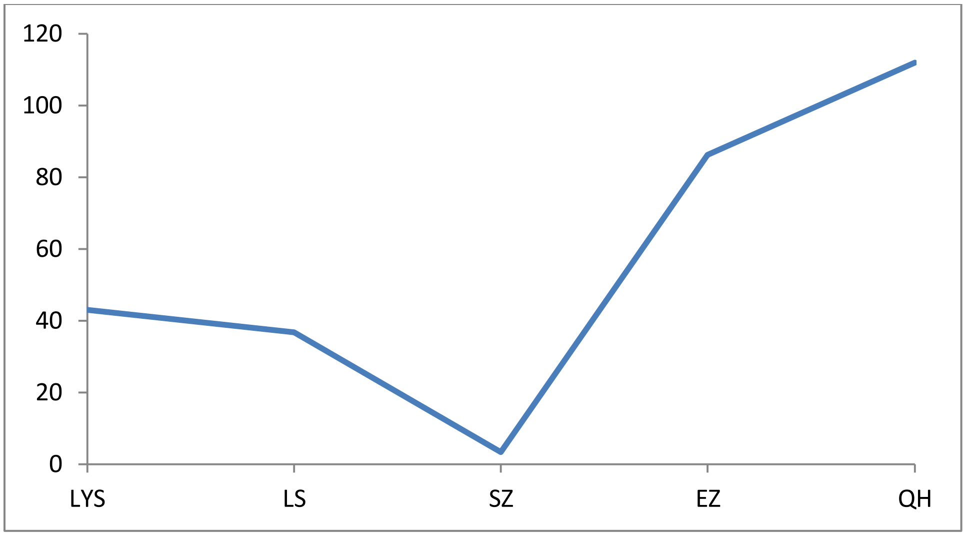


Figure 7.10 Population density of each period (people/ha).

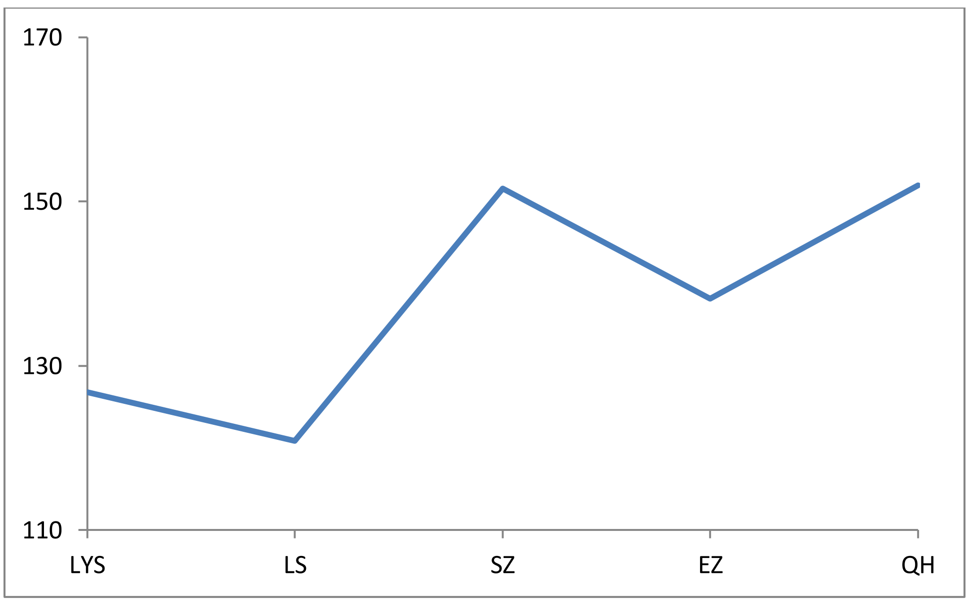


Figure 7.11 Average catchment area of each period (in hectare).

CHAPTER 8

THE SOCIOPOLITICAL INTEGRATION OF THE GUAN RIVER VALLEY

The historical ecology analysis in the last chapter reveals the socioecological dimensions of agricultural and land-use practices in the Guan Valley. While ecological preferences influenced settlement patterns and locations with varying intensity from period to period, my research shows that land use was never maximized economically. In fact, though certain ecological conditions were preferred they were never the decisive factor in determining where and at what density people lived. In this chapter, I will discuss other processes that may have influenced settlement and land use patterns.

Regional studies in China have demonstrated the developmental heterogeneity of social complexity. Regional integration, on the other hand, has not been sufficiently emphasized. Feinman (2012:36) defines integration as the "various means by which social units and their members are interconnected…[It is] the nature and degree of interdependence and self-sufficiency" (Feinman 2012: 36). In a regional study, regional integration is a meaningful lens through which to evaluate the regional social cohesion in response to changes in population and social complexity over time. An analysis of regional integration illustrates various social, political, and economic strategies social groups used to maintain cohesion. In this chapter, I will examine the trajectory of social integration, focusing on how several regional processes came together to connect communities within a single polity.

8.1 Rank-Size Graph and Regional Integration

In this chapter, I use rank-size graph to explore various degrees and systems of regional integration between large and small communities from the Late Yangshao to Qin and Han period. The Shang and Western Zhou period, the Tangsong, and Post-Tangsong Periods lack sufficient data for such analysis. Drawing on methods from Economic Geography, many archaeologists have discussed the measurement approach, sampling methods, and interpretation of rank-size graphs generated from regional archaeological records at different scales across the world (i.e. Drennan and Peterson 2004; Falcon and Savage 1995). In general, most archaeologists agree that the four different shapes of rank-size graphs represent four kinds of regional integration (Falcon and Savage 1995):

1. Log-normality distribution: interdependence between communities is high and system has a clear boundary. It often appears in long-history urbanized society with high social and political complexity (Pearson 1980).
2. Primate (or concave) distribution: the largest communities are larger, or large settlements are fewer than predicted by the rank-size rule. It may be associated with centralized economic or political systems, which emphasize boundary maintenance, macroregional elite exchange, foreign diplomacy, and warfare (Kowalewski 1982). It may also be produced by incomplete settlement data with unknown system boundaries.
3. Convex distribution: the largest community is smaller, or large communities are fewer than predicted by the rank-size rule. It indicates little integration of political and economic services among communities in a regional system, particularly less “vertical” integration between large cities and smaller rural communities. It may also reflect centralized economic organization if the graph shows a more stepwise than continuous distribution.

4. Primo-convex distribution: primate distribution in the upper section and convexity in the lower section. It may result from a centralized system superimposed on a more loosely integrated system or central place system.

In addition to the visual examination of graphs, statistical measurements are used to improve the comparison between rank-size curves. Falcon and Savage (1995) address several issues with rank-size distribution, especially the sampling issues posed by the nature of regional settlement data. They used a Monte Carlo simulation to incorporate site-recovery rates in the confidence test. However, Drennan and Peterson (2004) argue that the regional boundary determines the phenomenon under study, concluding that the random resampling of a Monte Carlo simulation is not effective. In turn they recommend bootstrap resampling to assess the confidence in the rank-size pattern. In addition, Drennan and Peterson (2004) recommend the use of a rank-size curve coefficient to compare curving of similar patterns. This coefficient, termed the A value, is equal to the area between the rank-size curve and the log-normal line. The more the curve deviates from the log-normal line, suggesting a more primate or convex distribution, the higher the absolute A value (Drennan and Peterson 2004).

As the use of A values facilitates comparisons between distribution patterns, I use Drennan and Peterson's (2004) approach to generate rank-size graphs. The rank-size curves of the Late Yangshao to Tangsong periods in the Guan Valley are shown in Figure 8.1 along with their A values. Different from Drennan and Peterson's (2004) approach, I do not apply negativity to A values of primate distribution as they suggest because all rank-size curves are primate in this study and because positive values are easier for comparison. The settlement size, indicated by the hollow dots on the graphs, illustrate how curves deviate from real values.

Figure 8.1 shows a consistent primate pattern with different A values, indicating a changing degree of regional integration throughout the periods. However, other factors have to be taken into consideration. For example, Drennan and Peterson (2004) discuss the influence of system boundaries on the formation of primate distributions. The "partitioning" of a large system can cause distortion in rank-size distribution (Johnson 1980). In the Guan Valley, the landscape forms natural barriers that bound the settlement system in the valley as well as delineate the settlement system into few sub-systems, both of which contribute to the primate pattern of distribution.

Other than natural conditions that justify primate distribution, many systematic (or stochastic) processes can also lead to regional primacy (i.e. Falcon and Savage 1995; Johnson 1997; Pearson 1980; Kowalewski 1982). System boundary plays an important role in rank-size distribution. Statement on strong regional integration has to be made with caution. In this study, the rank-size graphs provide a visual representation for period-to-period comparison of regional primacy. This comparison facilitates the exploration of various systematic mechanisms that may have increased regional intensity of interactions and interdependency between social units of different periods.

8.2 The Late Yangshao Period (3500-2900 B.C.)

The Late Yangshao rank-size curve shows a strong primate pattern with A value of 1.07. This system was centralized, shown by a clear three-tier settlement hierarchy in the region with a regional center almost three times larger than the second largest community (Table 5.1). While this supra-center is located by the side of the Guan River mainstream, other communities are clustered quite compactly with clear territories and boundaries distributed along several main tributaries (Figure 5.2). This spatial pattern implies that sociopolitical control from the supra-center was accompanied by interactions in and between sub-groups established directly or indirectly through connections with the regional center.

This hypothesis is supported by a shared ceremonialism at the site of Laofengang. This is the only excavated site reported in the Guan Valley. Laofengang adopted a funerary practice that was unknown to any contemporaneous society. This funerary practice was linked with social cooperation and inter-dependency between sub-sectors of the community. I propose that ceremonialism such as the funerary practice at Laofengang may have led to the formation of valley sub-groups, and maintained interactions between those groups with the regional center. I argue that this type of integration was developed as a response to the rapid population increase in the valley.

Laofengang

Laofengang is located 3 km to the west of the survey area, on a river terrace to the south of the Ding River, a major tributary of the Guan River (Figure 8.2). The site was excavated in 2000-2001 as a part of the Nanjing-Xi'an railroad construction project. The reported site area is approximately 1.8 ha, with 1200 m^2 of area excavated (Henan 2012). The excavation reveals 20 houses, 12 burials, 13 ash pits and a large quantity of potteries and stone tools that were dated to two succeeding phases from the Middle to Late Yangshao period.

Both houses and artifact assemblages exhibit drastic differences between Phase I and Phase II. In the Phase I, 15 semi-subterranean houses are circular, rectangular, or square in shape (Table 8.1). Thirteen of them are single-room, with sizes ranging from 2.27 to 14.8 m^2. The rectangular houses show more preparation and construction effort in the floor surfaces and surrounding walls. One square house and one rectangular house are above 10 m^2, both with hearths. None of the houses contain artifacts. Two house units share a common central wall, forming a two-room complex. There is another room in this complex, but mostly destroyed. No hearth was found in this complex.

In the Phase II, a four-room complex replaced the single units (Figure 8.2; Table 8.2). Each room has an individual hearth in the corner. Two rooms are poorly preserved and the better-preserved rooms are both around 10 m^2. Many potteries and lithic tools were found on the surface. In addition to this apartment complex, there is also a single-room house with no artifacts or hearth found.

The burials at Laofengang show unprecedented practices. A cemetery comprised of twelve burials was excavated. Ten of the burials are stone-slab tombs, with stone slabs placed at the bottom and along the walls of the burial pits, forming coffin-like cases for the bodies (Figure 8.3). After the body and funerary objects were placed inside, the tomb was sealed with further stone slabs or cobbles (i.e. Figure 8.4). There are two surface burials (Figure 8.5). Stone slabs and cobbles were used to mark a rectangular frame on the flattened surface while the body was placed in the center. Then, stone slabs and cobbles were used to cover the body and seal the tomb. Nine stone-slab burials were dated to Phase I and only one burial with fewer stones was associated with Phase II. Additionally, there are two burials without stones in Phase II. All burials, with or without stones, are in similar size and shape.

Funerary offerings are mostly domestic potteries that are similar to the ones found in the house or trash pits with the exception that most (6 out of 9) Phase I burials included a special lithic object, a yue axe. In Phase II a similar type of lithic tool, the fu axe, replaced the yue axe of the early burials. Other than the yue axe, jade objects, semi-precious stone objects, and hairpins were included in Phase I burials, but not in Phase II. Although the total amount of artifacts doubled from Phase I to Phase II in the site as a whole, Phase II burials contain fewer funerary offerings.

The Social Transition at the Laofengang Society: From Stone-Slab Burials to the Long House

It is important to note the underrepresentation of data of Phase II at Laofengang, due to the limited excavation and urgency of the project. For these reasons, the Phase II community should not be seen as less organized or complex than that of Phase I. The artifacts suggest that population or occupation length increased during the Phase II. The cemetery and major occupation zone is likely to extend outside excavation area.

Even so, the excavation of this site reveals different forms of sociopolitical investment that may be explained by a transition related to regional primacy. The sociopolitical investments include but are not limited to the emphasis on exclusive and communal group identity in the ceremonial realm and an increasing importance of cooperative households or clan organizations. This investment is shown by the use of stone-slab burials in Phase I and the house complex in Phase II.

Stone-slab burial

The similarities in artifacts and construction between Laofengang and sites in neighboring areas suggest that the socio-technological system was shared inter-regionally in the Late Yangshao period (Henan 2012). However, the stone-slab burials and the yue axe offerings are unique to Laofengang. Stone-slab burial was a ritual practice associated with Hongshan societies in 4000-3000 B.C. in the Northern China. This is the first time such burial practices have been found beyond the Hongshan region (Henan 2012). At the Huanglianshu site, which is 20km from the lower reach of the Guan Valley, two pits were lined with stones (Henan 1990).

Other than this, nothing even close to the stone-slab burials have been found for several hundred kilometers in all directions. As Hongshan was at least 500 kilometers away on the northern steppe, it is likely that the stone-slab burial practice was a local invention rather than a foreign introduction.

The offering of yue axes in these burials is also of note. Morphologically, yue axes are similar to fu axes, but yue axes are larger, mostly made of semi-precious stone, more standardized in form, sometimes drilled on top for installation, and display much less use-wear (Figure 8.6). These features persisted in the artifacts of Bronze Age, when jade or stone yue axes were commonly buried as a symbol of the military or ritual power of the deceased (Chang 1980). Like the slab burials, the yue axes found at the Laofengang have not been found in neighboring regions.

Considering that the residents of Laofengang were among the first occupants of the Middle Guan River valley since the Holocene, such disparate investment in funerary practice may have associated with legitimization of their occupation of this newly exploited area. This legitimization could have been achieved through the building of a group identity that distinguished its members from the neighbors to the south and east (such as the Xiawanggang, Huanglianshu, and Baligang communities etc. or even further), the source of most of the Laofengang's technology and perhaps even population. This group identity seems to be distinct from their neighbors, as no evidence of similar funerary practice has been found outside the Laofengang. Since all Phase I graves at Laofengang are of the same type, it can be inferred that this identity may have been shared by most, if not all, members of the community.

This exclusive, communal, and more or less egalitarian nature of the group identity is reflected in the community organization of Phase I. The lack of hearths in most houses implies that food preparation may have been conducted and or shared in the public space. Communalism was represented by the center-oriented organization of the village and other lines of evidence found in Early to Mid-Yangshao communities (Liu and Chen 2012). But at Laofengang, the burial practice is a much stronger manifestation of communalism. Similarly, a large quantity of funerary pottery (distinct from domestic potteries) was found in the Mid-Yangshao burials at the Xiawanggang site at Xichuan region, pointing to the high degree of social investment in funerary practices shared by all group members (Henan 1989).

Long house

The residential transition during the Late Yangshao period from the single-unit subterranean house pit to long house or house complex is found in many locations near the Guan Valley and elsewhere (i.e. Department of Archaeology 1998; Henan 1989). Most researchers agree that this residential transition represents a structural change in community from hierarchical segmentation to the unification of subgroups that has been identified throughout the Central Plain (Henan 1989; Liu and Chen 2012). This house complex or long house represents the increased influence of clan groups or some other kind of kinship-based household coalition on community organization.

In terms of domestic life, household coalitions were not differentiated internally. Each room in the house complex at Laofengang has a similar ceramic and lithic assemblage, reflecting the pursuit of similar domestic activities. In addition, rooms are similar in size and construction. They contain private hearths instead of a public outdoor hearth common in earlier periods. This suggests that that, at least in Laofengang, all house units participated in similar domestic activities, mostly food preparation and tool storage. Similar conclusions can be drawn from the analysis of the F34 long house at the Baligang site (Department of Archaeology 1998) and the long house at the Huanglianshu site (Henan Archaeology Group 1990), both 40 km from the Guan Valley, and the long house at the Xiawanggang site (Henan 1989), which is 80 km away.

While most long houses practiced similar domestic activities, several cases suggest that some long houses differed from others in the number of households and, to a certain extent, in function. At the Yuchisi site, some rooms in the long house are larger than others; some households may have produced tools or pottery; some may have been used for political activities (Archaeology Institute 2001). At the Dadiwan site, one 290 m^2 room in the long house (F901) was likely used for communal purposes such as food storage, feasting, gathering, or resource redistribution (Liu and Chen 2012). In general, however, Liu and Chen (2012) observe that long house organizations practiced similar household activities and were of similar sociopolitical status.

The decrease in number and quality of stone-slab burials and the replacement of yue axes with fu axes during Phase II suggests that the communal basis of group identity through ceremonial practices was gradually weakened at Laofengang. The rise of the long house suggests that social investments were increasingly diverted from funerary practice to the building of cooperative relationships between sub-groups of the community. As this transition was so pronounced in Laofengang, it would stand to reason that a similar transition in social investments should be visible at the regional scale as well.

At the regional scale, the increasing importance of the central polity, colonization of remote areas of the Guan valley, and investment in new local settlements all indicate that these transitions may have been associate with changes in regional sociopolitical strategy. Drawing on the analysis of land-use in the last chapter, I conclude that these transitions are related at least in part to the growing population and the instability of subsistence farming (disasters and crop failure). Through corporative strategy, communities could develop multiple ways to relieve shortages of food and elevating population pressure.

Regional Settlement Pattern and the Social Transition in the Late Yangshao Period

The regional settlement pattern of the Late Yangshao period can be characterized as 1) strong primacy; 2) occupation nucleation at the regional center; 3) highly clustered communities organized by secondary centers near river tributaries; and 4) large unoccupied areas between community clusters (Figure 5.2). LYS1 can be traced back to the Middle Yangshao period, an occupation contemporaneous to Phase I in Laofengang. Although the rapid expansion of MYS1and 2 into LYS1 was a much larger-scale event compared to what was observed at the Laofengang, similar social mechanisms were involved in the expansion.

Rapid population growth is manifested at both site and regional scales. The Laofengang data show a moderate growth rate: potteries doubled in quantity and more than doubled in density from Phase I to Phase II (Table 8.3 and 8.4). Population growth is more dramatic at the regional scale —population increased almost 68 times from the Middle to the Late Yangshao period (see Chapter 5). Though Middle Yangshao occupations have rarely been observed (perhaps due to colluvial processes), the Late Yangshao population increase was nevertheless exponential. As far as I am concern, this rapid increase in regional population was unlikely to have been endogenous. Instead, it was likely led by population immigration from outside the Guan Valley.

The origin of population was difficult to identify. Neighboring sites in the Nanyang basin and Xichuan show similar population increases in the Late Yangshao period, which does not support population flow between neighboring areas. As this population increase occurred at the macroregional scale, I will discuss this phenomenon at greater detail it in the next chapter when I investigate inter-regional communication.

It is not a stretch to link the weakening of group identity at Laofengang to this wave of population growth. Without more fine-grained chronological data, it is hard to tell the causal relationship here—the weakening group identity can be a reluctant response as much as a political initiative to attract more people. In any case, LYS1 developed into a dominate supra-center in the Guan Valley, and judging by the size, the largest center that may have overpowered the Nanyang Basin and the Xichuan region as well.

The rise of the long house-based cooperative society at Laofengang and neighboring areas implies that LYS1 and regional system of settlements may have pursued a similar sociopolitical strategy. LYS1's paramount size suggests that this supra-center may have performed multiple functions for and services to the occupants of LYS1 and the rest of the valley (Blanton et al. 1996).

What type of services did LYS1 provide? Since ceramic collections do not show apparent differences in the type, ratio, and production of assemblages between LYS1 and other contemporary communities at Laofengang and neighboring sites, I suspect that the paramountcy of LYS1 was not shown through differentiation in economic activities. Since households practiced similar domestic activities in long houses, the occupants of LYS1 may not have been any different with respect to economic activities. Instead, the supremacy of LYS1 may have been built on ceremonial authority. As Liu and Chen (2012) generalize, contemporaneous societies shared high ceremonial inputs. The decline of funerary ceremony, implied by the weakening of stone-slab burials at Laofengang, suggests the possibility of LYS1-administered ceremonialism at a regional scale.

The performance of such ceremonial services likely would have enhanced the primacy of LYS1. Yet, as the population increased, the community gradually lost the ability to produce enough food to sustain itself. The Agricultural Catchment Index shows that the population was 13 times above the production capability in its own agricultural catchment (see Chapter 7). The ceramic density of LYS1 also reveals that the occupation intensity of this "urban" center was much higher than contemporaneous sites.

Population increase and food shortage at LYS1 may have led to a series of territorial expansions into the unoccupied areas of the Guan Valley. The relationship between LYS1 and these new local communities may have depended on waterway transportation. The direct traveling time (Euclidian distance) between LYS1 and the furthest secondary center, LYS17, is 2.3 hours (Table 8.6, also see Figure 8.7). River crossing was the most time consuming aspect of travel. Wooden paddles and canoes dated to more than 6000B.C. were found at the Kuahuqiao Site in the Lower Yangtze River valley. However, crossing large rivers efficiently (on daily basis) was a persistent technical challenge until the Bronze Age (Ren and Wu 2010). Therefore, LYS1's political or economic control over the secondary centers on the other side of the Guan River and beyond was relatively weak. LYS1 was not a regional political or military threat to the secondary centers—no site reveals any military investment. As discussed earlier, LYS1 most likely functioned as the regional ceremonial center.

In summary, the regional settlement system of the Late Yangshao period shows that regional polities in the Guan Valley seem to be organized under a similar corporate principle to that at Laofengang. This organizational principle may have related to the rapid population flow into the valley. LYS1, the supra-center, attracted large population and mainly performed ceremonial leadership. The population increase also led to a series of expansions and the founding of several farming settlements in the Guan Valley.

8.3 The Longshan Period (2900-1900 B.C.)

The rank-size graph shows that the primate pattern of the Longshan period settlement was even stronger than the Late Yangshao period. The increased primacy can be largely attributed to the decrease of second-tier settlements. Falconer and Savage (1995) point out that the primacy pattern reflects increasing socioeconomic centralization. Without site-level data from the Guan valley, however, it is difficult to make assumptions about the social mechanisms that accounted for political or economic centralization.

As mentioned in Chapter 5, Longshan artifacts are difficult to identify in the study area. An array of Qujialing, Shijiahe, and Longshan style artifacts are found in the study area and neighboring regions. Excavations at neighboring sites, Huanglianshu and Xiawanggang, in the Xichuan region shows the dominance of Qujialing material culture from the Jianghan plain to the south from the end of the Yangshao period to the early Longshan period. Although the material culture transformed significantly, there is little understanding of how much change took place in the social, economic, and political structures at the community and regional levels. An evaluation of the evidence indicates that the Jianghan technological system brought limited, yet varied changes in the social and economic realms of these communities. A more abrupt change—the rise in dominance of the Longshan material culture—spread from the Central Plain to the Valley in the later Longshan period. In general, several interwoven processes led to the weakening and disruption of corporate-based society and a sudden decrease in regional population.

Reevaluating the Longshan Period from Neighboring Excavated Sites

In order to observe Longshan society at the community scale, I analyzed the type, composition, and assemblage of lithics, bone, and ceramic artifacts as well as houses, burials, and other important features that dated to the Longshan period (represented by the Qujialing and Longshan material culture) from the sites of Huanglianshu (Table 8.4) and Xiawanggang, 30 km to the south of the study area (Table 8.5). The results show considerable variation in the technological, social, economic, and ideological structures between these two communities during the Longshan period.

The artifacts show that considerable technological change occurred from the Yangshao to Qujialing, likely the Late Qujialing period, around 3000 B.C. (Table 8.4; Table 8.5). At Huanglianshu and Xiawanggang, half of the artifact types in the Qujialing assemblages are new (18 of 34 and 21 of 42, respectively). Interestingly, the types of bone artifacts increase significantly at both sites (from 4 to 10 at Huanglianshu and from 4 to 9 at Xiawanggang), in contrast to a moderate increase in the lithic types (from 6 to 8 at Huanglianshu and 8 to 12 at Xiawanggang). Although bone was not a new material for tools and decorations in this region and the ratio of bone artifacts to total artifacts decreased, it seems that increasing experiments with bone material took place in Qujialing. Compared to the bone and lithic artifacts that are in local style, new pottery types were more similar in form to those of the Jianghan plain (Henan 1989; Henan and Yangtze 1990).

A more dramatic change took place at Xiawanggang relative to Huanglianshu at approximately 2500 B.C.. Both lithic and ceramic assemblages changed drastically, Seven out of 13 lithic types and 10 out of 25 ceramic types in Longshan assemblage are absent from the Qujialing assemblage. In contrast, only a few changes took place at the Huanglianshu site.

Additionally, three kilns dated to this period at Xiawanggang site suggests that pottery manufacturing was much more organized in the Longshan society at Xiawanggang than at Huanglianshu (Henan 1989; Henan and Yangtze 1990).

Social structure varied between these communities as well. The long house tradition, which was prevalent in the Late Yangshao period in the nearby sites of Xiawanggang, Gouwan, Huanglianshu, Laofengang etc., was found at Huanglianshu with Qujialing component and the following Longshan component (Figure 8.8 and 8.9). At Xiawanggang, after the Late Yangshao, no house of any kind was found in the Qujialing component. Although this evidence is rather scant, it shows that long house residences were still in use in some communities while others may have abandoned the tradition. This implies that the corporate-based household coalition, which was fundamental to the Late Yangshao communities, still functioned as a dominant principle in some communities but was abandoned in others. On the other hand, Guo (2004) suggests that the long house structure at the Huanglianshu allowed for more flexibility within each apartment compared to other Late Yangshao long houses. That is, some have entrances facing other directions other than to the plaza, which may reflect the rising status of individual households or some other deviation signaling a more profound change.

Artifact analysis suggests that in the ideological realm, the emphasis on shared ideology declined. At Xiawanggang, secondary burials, group burials, and a large quantity of funerary pottery prevalent during the Late Yangshao period were absent in Qujialing and Longshan. In addition, sexual differentiation in the burial practice of the Yangshao period—dogs and arrowheads only buried with male, while turtle shell and chan spade buried mostly with male—also disappeared. New ceremonial objects, such as the jade huang plate and zu, the male penis statue, appeared in the Longshan burials. The only evidence showing ideological infusion from elsewhere are a few animal effigies that were popular in the Jianghan, which appear in the Longshan burials at Xiawanggang. However, these animal effigies were found at that site during the Yangshao period as well (Henan 1989).

There is no clear evidence that indicates a sudden increase in the subsistence farming of rice. While some archaeologists assume that an increase in rice farming accompanied the introduction of Qujialing material culture in this area, the paleobotanic studies from Gouwan near the Huanglianshu show that rice was added to the crop package during the Late Yangshao period as a secondary crop and remained as such for a long time (Fu et al. 2010). Botanical records from the Gouwan site also imply that the climate was cooler during the Longshan period, which may explain the limited extent of rice agriculture (Fu et al. 2010). In addition, lithic tools show little difference between Yangshao, Qujialing, and Longshan (Table 8.5). The fu axe continued to be the most important and prevalent tool. The ubiquity of such a cutting tool suggest the importance of land clearance, in contrast to the lack of digging tools for land preparation that were more prevalent with rice farming societies. The large quantity of net weights and arrowheads from the Yangshao to the Longshan period at both sites also imply the importance of hunting and fishing.

The Regional Settlement Pattern and the Gateway Economic System of the Longshan Period

Liu and Chen (2012:217) point out that the Longshan period shows a diverse and uneven cultural development, “whereas complex agricultural societies flourished along the great river systems…[M]any small communities in the surrounding regions continued to practice a broad-spectrum subsistence economy with simple social organization.” The Longshan occupations of the Huanglianshu and Xiawanggang, although in a similar environmental setting, size, and located only few kilometers from each other, express striking differences in technological, social, and economic realms. Such intra-regional variation is also manifested in the regional settlement pattern of the Guan Valley, which offers clues to the social mechanism behind the primacy of the Longshan settlement system.

As discussed in Chapter 5, the Longshan settlement pattern in the Guan Valley reflects the following characteristics: 1) most secondary centers disappeared while the only first-tier center, LS1 retained its dominant size; 2) the clustering pattern continued in some areas, although in weakened fashion compared with the Late Yangshao period; 3) in contrast to the Late Yangshao's emphasis on higher terraces and mounds, some communities moved to the alluvial plains (Figure 5.5). Linear regression shows that size of catchment correlates stronger with settlement size in this period (see Table 7.4).

The distribution and density of surface sherds suggests that the occupation intensity varies between settlements. For example, the high sherd density at Yanggang and Majiaying implies that these large communities were occupied more intensively, or that the population was more nucleated. In the mountainous upper river valley, the Xiaoshui settlement occupied the entire alluvial plain, but a low sherd density suggests that the occupation and land use was extensive compared to the intensive occupation at Yanggang and Majiaying. This pattern is not restricted to the upper valley, but is also found in many small lower valley communities as well (see Chapter 5).

The occupation variation also happens inside the community. The regional center, LS1, exhibits an "S" shaped occupation arrangement, with two open zones in the middle of the settlement. The sherd density comparison in Chapter 5 implies that this pattern cannot entirely be attributed to post-depositional processes. In Chapter 5, I discussed that this "S" shape may have been borrowed from the dual-settlement tradition of the Jianghan Plain. The Qujialing settlement organization at Huanglianshu suggests that the empty space may have been used as a plaza.

The dominant size and the population nucleation of LS1 are dramatic. Yet the function of LS1 is unclear. As both Huanglianshu and Xiawanggang witnessed a decline in shared ceremonialism and the development of a community-owned ritual practice during the Longshan period, I suspect that ritual practices may have been more differentiated between communities in the macroregion as well. The regional center, LS1 may no longer have functioned as a ceremonial center that performed rituals for the valley. LS1 does not seem to have been militarily or politically overpowered; distance analysis suggests that the inter-cluster traveling time is higher than the Late Yangshao period (Table 8.6). Also there is no evidence of increased use of waterway transportation routes or defensive construction. All these data suggest that LS1's political control over smaller polities did not increase. If anything, it may have decreased.

I suspect that, alongside increasingly intensive inter-regional interactions between the Jianghan Plain and the Guan Valley, LS1 may have developed a new function as an economic exchange center during the Longshan period. The function of LS1as a hub for macroregional economic exchange lacks direct support from archaeological data. However, LS1 has several properties that match Hirth's (1978) description of gateway communities. Hirth (1978:37) believes that the gateway community, found "along natural corridors of communication," developed as a means of linking regions with a wider system of exchange. Accordingly, the Guan Valley lies along the strategic North-South corridor that borders three cultural core zones. The location of LS1 on higher terraces, near the conjunction of rivers would have facilitated access to both local economic resources and a strategic exchange route connecting a broad region.

Technological variability in and near the Guan Valley during the Longshan period strongly indicates a more intense degree of inter-regional communication and exchange (discussed in further detail in the next chapter). The gateway hypothesis explains the population nucleation at LS1 and the intra-regional variation in the Guan Valley—the occupation pattern was largely due to the communities' interaction with the gateway communities and their participation in macroregional exchange (Hirth 1978). For example, the second largest and most densely occupied communities, the Majiaying community, can be easily accessed from LS1 (Figure 5.5). Numerous small communities were also established between LS1 and Majiaying, making made transportation easier. In contrast, communities along the Badie and Guzhuang Rivers had much more difficulty connecting with LS1, which contributed to the decline of these communities.

If a gateway system was formed in the valley, the population decline in the Longshan period may have been related to the malfunctioning of the gateway system. Taking the intra-regional variation into concern, the regional population in the Longshan period declined compared to the Late Yangshao. This decline was gradual—slow in the Early and much more rapid in the Late Longshan (Chapter 5). A drop from the 3094 people of the Late Yangshao to 286 people of the Shang period, illustrates the abruptness of population decrease during the Longshan period.

Blanton et al. (1996: 4) explain the difficulty in maintaining a network-based regional system as "the inability to control exchange partners at a distance and the inevitable competition from other similarly striving individuals," which may also apply to the Guan Valley. The collapse of the gateway system may have caused population decline beginning by the Late Longshan period and worsening in the Shang to Western Zhou periods. From the settlement pattern of the Shang and Western Zhou periods, it was not only groups along the tributaries of the Guan River that decreased, the regional center, Yanggang, also declined from 23.9 to 0.8 ha, indicating a total collapse of the system.

It is difficult to identify LS1's main competitor as the collapse was not limited to the Guan Valley. Most Longshan settlements in the lower Guan Valley, the Dan River Valley, and the Han River Valley to the south of the Guan Valley also went through a major population decline by the end of the Neolithic. As a series of state-level societies was established across the mountains from the Guan Valley during the Late Longshan and Shang periods, it could cause the valley and its neighbors weakened their abilities to retain the populations. The artifacts dated to the Shang period at the Guan Valley and at Xiawanggang highly resemble the ones in the core of Shang regime, which suggests that the Shang had expanded its connection to the Guan Valley, which will be discussed further in Chapter 9.

8.4 The Eastern Zhou Period (770-221 B.C.)

The rank-size graph still shows regional primacy during the Eastern Zhou period. However, compared to the previous period, the value A is much smaller, suggesting a higher degree of regional integration. If the largest center, EZ10 is excluded (for reasons which will be discussed later), the A value further drops to 0.29—almost forming a log-normal pattern (Figure 8.10). The log-normal pattern implies that the regional center was well integrated with subordinate communities, "...typical of larger countries with a long tradition of urbanization, which are politically and economically complex" such as capitalist societies (Falcon and Salvage 1996:39).

The rank-size pattern indicates an urbanized social composition in the Eastern Zhou society. Many historians agree that the Eastern Zhou was the beginning of a highly urbanized society in China (i.e. Institute of Archaeology 2004) numerous cities were rapidly built during this time. Xu (2000) records 316 cities in China that dated to this period (Figure 8.11). He divides the cities into three categories based on their size and facilities (construction of palaces and walls, etc.). The first category includes cities between 10-30 km^2. There are 10 cities in this category and all of them are capitals of large states. Most of them were destroyed when the state collapsed. The second category includes cities between 1-10 km^2. More than 100 cities belong to this category. Most of them were secondary capitals, temporary capitals, or nuclei of powerful states. Most of these cities were still used as regional administrative centers during the Qin and Han periods. The final category includes cities below 1 km^2. These number to 201 in total and are mostly the militarily fortified capitals of vassal states or regional centers of states (Xu 2000).

Xu attributes the florescence of city construction to sociopolitical competition between states and between the vassals within the states as well as economic growth and population increases led by the use of ironware and advanced agricultural technology (2000: 128). Many of these cities were built by vassals to reinforce new land ownership or regional defense in the spring and autumn seasons. In the Warring States period, these new cities, called "jun", became administrative units for states, officially replacing the kin-based social units of earlier periods (Yuan 2000; discuss in the next chapter). Military fortresses were also built in large quantities during the Warring States period. For example, of the more than 30 cities in Zhangjiakou, Hebei Province, more than 20 of them were fortresses built to defend against the nomad groups to the north (Xu 2000). In the meantime, economic activities grew tremendously especially in the private sector. Hsu (1980) proposes that the Eastern Zhou society was more market-based than following dynasties, who relied more on agrarian economy than market economy. Most of market exchanges took place in cities.

A demographic transition was deeply interwoven with the processes of urbanization in the Eastern Zhou. Yuan (2000) estimates that population increased nine times from the Western Zhou to the Eastern Zhou in the State of Qi in the Shandong province. After evaluating paleo-demographic studies and historic accounts, Ge (2002) estimates that the population increased from five million during the Western Zhou to 40 million by the end of the Warring States period. The population increase, rapid urbanization, and active market exchange, coincided with and supported by the governmental-organized large-scale agricultural development, generated numerous new occupations around the cities. This also characterizes the settlement pattern at Guan Valley and many other regions.

Settlement Pattern and Administrative Organization in the Guan River Valley

The Guan Valley was at the center of a state known as "Ruo" during the Mid-Western Zhou. Historic geographers have debated about its location and mostly agreed that the territory of Ruo was in Southwestern Henan, near the Guan River valley (Chen 2012; Xu 1987). According to Chen (2012), by the Late Western Zhou, the state split into "Upper" and "Lower" Ruo. After conducting a reconnaissance survey, Xu (1987) believes that the capital of the "Upper Ruo" was located to the north of Ding River, a few kilometers to the west of the study area. Ruo was in constant conflict with its southern neighbor, the state of Chu. The Upper Ruo became a vassal state of Chu around 670 B.C.. Lower Ruo succumbed to the power of Chu 50 years later. The royal court and the noble families relocated to central Chu, while many Chu citizens from the Yangtze River region relocated to the Guan Valley. Meanwhile, the territory of Ruo was reorganized as a new municipality called "Xi" or "Baiyu" (which translates to, white feather), with the administrative office moved to the east of the Guan River. In 298 B.C., the state of Qin sacked Xi along with 14 other municipalities along the Qin-Chu frontier (Chen 2012).

The size and location of EZ40 match the third category of Xu's classification on cities, which includes capitals of vassal states, regional centers of large states, and important military fortresses (Xu 2000). All evidence indicates that EZ40 was the city of "Xi" or "Baiyu," as it is still called today. This city must have served multiple purposes, the most important of which were as regional center of the Chu state and as a military defense against the armies of the Qin state.

The regional settlement pattern shows that communities were spatially arranged for these purposes, which may account for the rank-size pattern of this period. In Chapter 5, I discussed how the regional settlement pattern was functionally differentiated during the Eastern Zhou period. EZ40 and 41 were palatial or administrative areas, surrounded by residential zones (mostly covered by modern city construction now) that reached as far as river bank (see Figure 5.7). This coincides with most other city planning of this period, in which administrative zones were separated from vast residential areas of the commoners (Xu 2000). EZ7 was unlikely to have been a residential site, though perhaps a palace. Considering the rapid expansion of Xiaoshui in the mountainous area, and EZ7's proximity to the geographically strategic location of EZ18, EZ7 was more likely to have been a gateway administrative office for riverine transportation or military control of the Guan River region.

EZ28, which may be an elite cemetery that symbolized administrative legitimacy and authority, was also carefully arranged. Perhaps neighboring communities provided services for this cemetery such as producing ritual objects, performing funerary rituals, guarding graves, and burying servants or retainers of elites (The Institute of Chinese Archaeology 2004). To protect the cemetery from looting, upper-class cemeteries were always located far from the city during the Eastern Zhou. Administrators went so far as to forcibly relocate villages to adjacent areas in order to camouflage the cemeteries as normal occupations (The Institute of Chinese Archaeology 2004; Xu 2000).

Yanggang disintegrated into a few villages at the Eastern Zhou, after almost three thousand years as regional center. Whether this disintegration was due to an economic collapse or political intervention is unknown. Either way, the settlement, though geographically extensive, could no longer exert regional influence across the valley.

Land use analysis, described in Chapter 7, reveals the increased montane resource use during the Eastern Zhou period. For example, EZ10, or Xiaoshui, may have been used as an exploitation site for special resources, especially metal. Today the area remains one of the largest metal producers in the country. However, considering the strategic importance of the Guan Valley and the dramatic expansion at this site, EZ10 was also likely to have been a site of refuge during times of conflict. With very limited farmland, EZ10 could not have supported its population agriculturally (Agricultural Capacity Index: 67) and may have looked to EZ18 and nearby communities for food. The river channel near the new regional center, EZ40, began to have been used more intensively from this period, providing faster and more convenient exchange between EZ18 and EZ40. Small communities developed along this route, which may have served to maintain this new travel route and provide assistance to the Xiaoshui occupation.

All these highly organized spatial arrangement reveals that the Guan Valley was managed as a military frontier during the Eastern Zhou period. EZ40 focused on controlling the local population and maintaining stability during wartime. Other activities such as agriculture—the primary focus during other periods--were not emphasized as before (the average ACI is the highest of all periods; see Chapter 7). For example, one of the most productive farmlands in the region, the fluvial plain of the Badie River, was abandoned during this period. Some occupations were located in higher, agriculturally marginal areas in the mountains and probably served as shelters as well.

These shelters initiated the exploitation of montane resources, which intensified in the next period. The growing occupation near the Guan River mainstream implies an increased connection between the lower and upper streams of the Guan River. As the macroregion was a political and military frontier of Chu state, such communication likely centered on military affairs and administrative control. In the next chapter, I will discuss the inter-dependence of the valley, Chu, and other regions during this period.

8.5 The Qin and Han Periods (220 B.C.- A.D. 220)

The population increase during the Han dynasty was as dramatic as in the previous period. Following a long period of warfare that extended from the Eastern Zhou to the Qin dynasty, demographic recovery characterized the Early Han Empire. The population doubled (at least) within the first hundred years. Take Nanyang, for example; by using systematic historic demographic approach, Li (1962:236-237) estimates that the population increased from 1700 households in 200 B.C. to 3400 households by 146 B.C. Hsu (1980) found that the population growth had exceeded the growth of farmlands, leading to several serious famines and riots.

To solve the food shortage problem, the Han Empire employed multiple policies to increase agricultural production, including allowing private land ownership (Hsu 1980). The state of Qin was the only state that attracted laborers with private land ownership during the Warring States period (1980). New immigrants began to farm Qin's territory, allowing the indigenous people of Qin to fight other states. In return, new immigrants received ownership of the land they farmed. Although private landownership was common during the Warring States period, when the states were unable to control all of their lands, Qin was the only state that legalized such ownership. The policy continued into the Qin dynasty and was inherited by the Han dynasty as the basis of the land, economic and household registration systems (Hsu 1980).

Landownership also led to residential variability during the Han period. The Qin and Han administrative systems were hierarchical, with the basic unit of the administration varying between city and villages (Liu and Bai 2010). In the capital and large cities, the neighborhoods, known as *li*, were the major residential units. Historic documents on the structure of *li* in the capitals and large cities reveal high residential density, with *li* separated by walls and administered individually (Liu and Bai 2010). The site of Sandaobao in Northeastern China shows a well-preserved *li* the size of an average city or a large town (Figure 5.12a). The entrances of all houses face south or southward. Houses are 15-30 m apart, but lacked strict plans as described by scriptures. Houses have courtyards, stoves, storage pits, individual wells, drainage systems, pens or sty, and trash zones. Between these houses, there are kilns for brick production and roads paved with pebbles. Most occupants were farmers (Liu and Bai 2010; Liu 2011).

In contrast to *li*, archaeological excavation at the Sanyangzhuang site, Henan, yields a different residential pattern (Liu 2011). A survey reveals 14 house units dated to the Late Eastern Han period. Four were excavated. Unlike the *li* of Sandaobao and elsewhere, the excavated houses are not aligned in any one direction and were located, much further apart (50-200 m). Houses were separated by farmlands, the ridges of which are still visible. All house units are large (1300 m^2 on average), including the courtyard. The facilities, except for occasional mills and ponds in some households, are similar to those at Sandaobao (Liu 2011). The toilets were set outside the house units, a practice designed to collect residents' feces and remains common in many rural areas today, including the Guan Valley.

The occupation at the Sanyangzhuang was abandoned because of serious flooding. The site was buried under meters of sediment. Some scholars suggest that Sanyangzhuang represents a type of occupation that was often built on previous flooded alluvial plain between the river channel and the bank (Liu 2011). After the flood retreated, the land was fertile and exempt from governmental taxes, thus attracting many farmers willing to risk inundation. The occupation would expand quickly if there were multiple years without flood. However, Liu (2010) also proposes that Sanyangzhuang matches the description of another economic unit recorded in historic scripts called *tianzhai*, which literally means “land and house.” *Tianzhai* differed from *li* in that in *li*, farmers resided in urban settlements and farmed land outside the city. They also differed from temporary huts located in the fields, where city-dwelling farmers stayed during busy seasons. However, there is not much information on the size, administration, and economic and social status of *tianzhai* (Liu 2010).

The government’s reaction to the rapid population increase during the Han period was to encouraging the exploitation of new lands. The difference in residential pattern, illustrated by the settlement organizations at the Sandaobao and the Sanyangzhuang, reveals the economic and administrative complexity of the Qinhan period. This residential variability was encouraged by the land ownership system. This relationship between agriculture and residential variability will help us understand the regional settlement pattern of the Qinhan period in the Guan Valley, which shows that both compact *li* and dispersed households may have existed in the Guan Valley.

Settlement Pattern: Development of Agriculture and Residential Variability

In this period, the Guan Valley belonged to the newly established prefecture of Hongnong, which translates to “developing agriculture.” The name shows that agriculture was a main focus of the local administration. The rank-size graph of the Qinhan period settlements shows a degree of primacy similar to the Late Yangshao period. Even if the largest settlement, QH14, is excluded, the A value remains at 0.79 (Figure 5.13), which is still higher than the Eastern Zhou period. Based on the previous discussion of the land system and residential patterns, I believe that the system of primacy in the Guan Valley during the Qinhan period is one of the manifestations of the farmland exploitation that organized mainly through peasants, but encouraged by local administrators.

Occupations reached their peak both in number and total area during the Qin and Han periods, though the average ceramic density is the lowest on record. The largest settlement, QH14, reached 63.6 ha--triple the size of the second largest city. The quality of ceramics suggests that, in spite of its large size, the occupation was still a farming village. Aside from the first and second largest settlements, hamlets and small villages of 0.25 ha increased in number most rapidly, accounting for most of the settlement primacy. Finally, occupation continued to expand into the piedmont (Figure 5.8).

As the Guan Valley was no longer the military frontier, the administrative system of the Eastern Zhou weakened. Thus the military-based relationship between two largest settlements, EZ10 and EZ40, may have been altered, but both increased significantly in size. The Xiaoshui area was no longer a refuge site, making the expansion intriguing. Considering the need for farmland exploitation evinced by the name of Hongnong prefecture (developing agriculture), it is not far-fetched to assume that QH14 served as a base for natural resource exploitation in the uplands. This exploitation may not have been agriculture-related, but was definitely economic in nature.

One great advantage of montane exploitation was that the land was exempt from numerous taxes and levees that would have constituted a tremendous burden for the average peasant family in the Han period (Hsu 1980). Hsu (1980:66) estimates that, in a household of five, such taxes and levees contributed greatly to the annual deficit of around 10% of total income. The tax policy on newly exploited land varied, but in most cases, there were no taxes for the first few years. Nevertheless, exploiting new land with Han period technology was very costly. It was commonly carried out together by large extended families or kin groups (Hsu 1980). The kin-group organized land exploitation was most common in remote upland areas since lands at plains were mostly occupied. For example, historic texts recorded that Tian Chou's family occupied and exploited an entire mountain for a hundred years. As it was quite remote, the family thrived without burden of taxes. In a few years, this new village of Tianchou's expanded from several hundreds to 5000 people (Hsu 1980).

The Xiaoshui occupation, QH14, may have resembled the Tian Chou case. QH14 was a residential center that was also in montane area, same as in Tian Chou's case. The location was easy to protect in the time of turmoil, and had an excellent access to waterways and mountain resources. The artifacts show that QH14 was more an autonomous than government-administrated community, yielding a settlement pattern similar to the compact structure of *li*. So the community could sustain under various pressure and risk in its bounded environmental setting, i.e. flood, landslide, and crop failure. After residing in the valley for hundreds years, the indigenous population became familiar with montane farming practices. While surveying the mountain area, I was impressed by the many cobblestone terrace retaining walls until I was informed that it only took three days or less to build a 20 m retaining wall starting from scratch.

Although the exploitation of new land occurred in the lower valley, its level topography required less cooperation than in the mountains. The small hamlets dotted the whole region in a pattern that is very similar to Sanyangzhuang. Low residential density accounts for the low artifact density. In fact, in the survey, artifacts from the Han period were sparse throughout most of the Valley. The real occupation could have been much higher number than the map shows, but the pattern—scattered, small villages—would be same.

Whether or not the large-scale land exploitation in the Guan Valley was administered by local government is unknown. Judging from the prefecture's name, "developing agriculture," I expect certain policies encouraged this activity. However, from QH14 and the settlement pattern on the plain, I think this activity was largely self-organized rather than led by the government.

Large-scale montane exploitation was temporary. According to Hsu, this type of "secondary arable land" (1980:60) was more vulnerable than the "primary arable land" (1980:142) on the alluvial plains, since maintenance was very costly. This may explain the rapid population decrease after the Han period, when the region was once again engulfed by war.

8.6 Conclusion

Although the regional settlement pattern varied from one period to another, the settlement system of Guan Valley shows a consistent primacy in the rank-size distribution from the Late Yangshao period to the Qinhan period, which can be attributed to the paramount size of regional centers and lack of secondary settlements. No matter how the population levels changed, this regional primacy never altered. A combination of site and regional analyses indicate that other than geographic boundedness, the regional primacy was led by various interrelated social, ideological, economic, and political processes that connected single communities with neighbors and polities in different ways at different times. The settlements of the Guan Valley participated in these processes, developing a variety of different strategies and institutions, which all contributed to regional primacy in the settlement system.

During the Late Yangshao period, site analysis shows a transition from investing in group identity through funerary practices to an emphasis on social cooperation, in the form of household coalitions. As the regional population escalated, a similar social transition took place at the regional scale, creating a regional center of paramount size and leading to the colonization of other Guan River tributaries. While polities were structured by cooperative principles, the regional order was strengthened through the ceremonial authority of the regional center, instead of by military or political force.

As new technological systems were introduced from the remote Jianghan Plain during the Longshan period, Guan Valley communities developed in a heterogeneous manner. Even contemporaneous neighboring communities exhibit differences in social organization, economic behavior, and ideological practices. This developmental variation can be seen in the form of the settlement system of the Guan Valley. I propose that during this period of intense inter-regional contact, regional centers may have arisen as gateway communities that mediated inter-regional exchange. The developmental variability between communities could have arisen from each having different relationships with regional centers.

The failure of inter-regional interactions may have led to a drastic population decline during the Late Longshan period, which was followed by a period of low population that may have been associated with the formation of nearby states. During the Eastern Zhou period, the population of the Guan Valley recovered rapidly due to its geopolitical position at the Qin-Chu frontier. The political importance of this region altered the spatial arrangement of the settlement system. Although the Guan Valley was as urbanized as other regions, it comprised a network of interrelated settlements that centered on a single large city on the alluvial plain and extended outward to include a series of scattered montane refuges. Such a systematic arrangement demonstrates a focus on maintaining local stability.

After an era of political turmoil from the Eastern Zhou to the Qin periods, the Han Empire focused on population recovery and the development of agriculture. These initiatives strongly influenced the regional settlement system of the Guan Valley. The exploitation of uplands contributed to the further growth of a supra-village, Xiaoshui. Along the lower stream, in an unprecedented move, single households occupied eroded terraces, forming a continuous but sparsely populated farming landscape.

These temporal variations in primacy mechanisms point to processes at spatial scales beyond the valley and neighboring areas. The connection between the Valley and other regions varied in form and intensity across time. In next chapter, I will discuss some of the inter-regional interactions that shaped the regional socioeconomic trajectories revealed in this chapter so as to situate them within the broader course of Chinese civilization.

Table 8.1 Houses and burials of Phase I at the Laofengang Site

Phases	Feature	Quantity	No.	Shape	Form	Size (m2)	Other information
Phase I	House	3	F1	circular	subterranean	4.9	
			F2	circular	subterranean	2.27	overlay F1
			F3	circular		7	
		2	F18	square	subterranean	3.24	
			F20	square	subterranean	12.48	hearth
		10	F10	rectangular		8.3	
			F11	rectangular		14.3	the surface was on a layer of small cobbler, then a layer of soft soil, rammed, then burned; a hearth on the southeast corner
			F12	rectangular		14.8	similar to F11, but no hearth
			F13,14	rectangular	long house of at least 3 rooms	10; 8.6	
	Burial	7	M2	rectangular	pit		5 wan bowl; gang urn; yue axe; bo bowl; zan hairpin; zhu jar
			M3	rectangular	pit		11; wan bowl; pen basin, gang urn, yue axe, ben axe, decorations
			M4	rectangular	pit		4; wan bowl; pen basin; jiandiping jar; and a jade object placed at stomache
			M5	rectangular	pit		7; wan bowl; pen basin; bo bowl; ping jar; yue axe
			M6	rectangular	pit with secondary-platform		5; wan bowl; pen basin; yue axe; jade objects
			M8	rectangular	pit		12; wan bowl 2; shiyue axe 1; pen basin; wan bowl; jiandiping jar 2; shiyue axe 3; zu arrowhead 1
			M12	rectangular	pit		none
		2	M9	rectangular	surface		wan bowl 2; ping jar; diping jar 1; guan pot 1
			M7	rectangular	surface		3; wan bowl; ping jar; yue axe

Table 8.2 Houses and burials of Phase II at the Laofengang Site.

Phases	Feature	Quantity	No.	Shape	Form	Size (m2)	Other information
Phase II	House	4	F4-7	rectangular	house complex	9.57; 10.28;4.6	individual hearth in each room
			F4	rectangular		9.57	guan pot 6; bo bowl1; pen basin1; jiandiping jar1; ping jar; jiandiping jar1; weaving wheal
			F5	rectangular		10.28	ding tripod1; guan pot1; wan bowl1; bo bowl1; pen basin3; ding tripod1; ben axe1
			F6	rectangular		4.66	guan pot 3; pen basin 1; hu jar 1; qigai cover 1; fu axe 1
			F7	rectangular		3	bo bowl 1; pen basin 1; weng urn1; bei cup 1; qigai cover 1 ; guan pot 3
		1	F8	rectangular	surface	20.76	no hearth; empty
	Burial	2	M1	rectangular			ding tripod 1; pen basin 1; fu axe 1; guan pot4; wan bowl 2
			M11	rectangular			fu axe1
		1	M10	rectangular			gang urn 2; pen basin 2

Table 8.3 Comparing artifacts of Phase I and Phase II from the Laofengang Site (Grey: disappear in the next phase; green: newly appeared; blue: decreased from the previous phase; red: increased from previous phase).

Phase I	Ceramics	1882	ding tripod	zao stove	bo bowl	wan bowl	pen basin	small basin	guan pot
			40	13	257	49	775	9	470
			2.13%	0.69%	13.66%	2.60%	41.18%	0.48%	24.97%
	Lithics	72	fu axe	ben chopper	zao adze	yue axe	dao knife	zu arrowhead	huan braclet
			28	12	8	11	2	7	1
			38.89%	16.67%	11.11%	15.28%	2.78%	9.72%	1.39%
	Bones	3	bi knife	bone object	Hairpin				
			1	1	1				
Phase II	Ceramics	4042	ding tripod	zao stove	bo bowl	wan bowl	pen basin	small basin	guan pot
			51	17	415	19	1624	8	1315
			1.26%	0.42%	10.27%	0.47%	40.18%	0.20%	32.53%
	Lithics	273	fu axe	ben chopper	zao adze	chan spade	dao knife	zu arrowhead	huan braclet
			99	33	54	2	9	67	5
			36.26%	12.09%	19.78%	0.73%	3.30%	24.54%	1.83%
	Bones	15	chisel	arrowhead	hairpin				
			3	4	8				

Table 8.4 Comparing artifacts of Yangshao, Qujialing and Longshan phases from the Huanglianshu Site (Grey: disappear in the next phase; green: newly appeared; blue: significantly decreased from the previous phase; red: significantly increased from previous phase).

	Lithics	fu axe	dao knife	lian sickle	net weight	zu arrow	zhui chisel	decoration	
	32	14	2	3	2	1	9	1	
		43.75%	6.25%	9.38%	6.25%	3.13%	28.13%	3.13%	
Yangshao	ceramics	spinning wheel	ding tripod	weng urn	guan pot	gang urn	ping jar	bo bowl	pen basin
	68	17	6	2	more than 2	unknown	unknown	3	1
		25.00%	8.82%	2.94%	/	/	/	4.41%	1.47%
	Bones	zu arrowhead	zhui chisel	dao knife	hairpin				
	37	26	9	1	1				
		70.27%	24.32%	2.70%	2.70%				
	Lithics	fu axe	dao knife	lian sickle	ben axe	zao adze	net weigh	huan bracelet	decoration
	226	99	16	10	30	38	5	23	5
		43.81%	7.08%	4.42%	13.27%	16.81%	2.21%	10.18%	2.21%
Qujialing	ceramics	Spinning wheel	pestal	ding tripod	zeng steamer	guan pot	weng urn	gang urn	ping jar
	524	263	2	12	2	35	4	2	3
		50.19%	0.38%	2.29%	0.38%	6.68%	0.76%	0.38%	0.57%
	bones	zu arrowheads	zhui chisel	fishhooks	mask	ball	bi knife	needle	mortal
	221	163	6	2	2	2	18	2	6
		73.76%	2.71%	0.90%	0.90%	0.90%	8.14%	0.90%	2.71%
	Lithics	fu axe	ben axe	zao axe	dao knife	lian sickle	net weight	ball	zu arrowhead
	152	87	12	17	11	5	7	3	3
		57.24%	7.89%	11.18%	7.24%	3.29%	4.61%	1.97%	1.97%
Longshan	ceramics	spinning wheel	ding tripod	gui tripot	zeng steamer	weng urn	guan urn	bo bowl	wan bowl
	213	108	3	1	1	3	24	some	18
		50.70%	1.41%	0.47%	0.47%	1.41%	11.27%		8.45%
	bones	zu arrowhead	zhui chisel	needle	hairpin				
	88	66	19	1	2				
		75.00%	21.59%	1.14%	2.27%				

	Lithics								
	32								
Yangshao	ceramics	qigai cover	ball	huan bracelet					
	68	5	1	33					
		7.35%	1.47%	48.53%					
	Bones								
	37								
	Lithics								
	226								
Qujialing	ceramics	hu jar	bo bowl	pen basin	wan bowl	dou bowl	bei cup	qigai cover	huan bracelet
	524	1	9	7	12	32	70	33	37
		0.19%	1.72%	1.34%	2.29%	6.11%	13.36%	6.30%	7.06%
	bones	huan bracelet	hairpin						
	221	1	19						
		0.45%	8.60%						
	Lithics	huan bracelet							
	152	7							
		4.61%							
Longshan	ceramics	pen basin	dou bowl	pan plate	bei cup	qigai cover	ball	huan bracelet	
	213	9	9	1	more than 4	10	2	24	
		4.23%	4.23%	0.47%		4.69%	0.94%	11.27%	
	bones								
	88								

Table 8.5 Comparing artifacts of Yangshao, Qujialing I, Qujialing II and Longshan phases from the Xiawanggang Site (Grey: disappear in the next phase; green: newly appeared; blue: significantly decreased from the previous phase; red: significantly increased from previous phase).

Qujialing I	lithics	mortal										
	110	2										
		1.82%										
	ceramics	qigai cover	huan bracelet	chicken ef	dog effigy	ball						
	69	5	11	1	1	2						
		7.25%	15.94%	1.45%	1.45%	2.90%						
	bones											
	45											
Qujialing II	lithics	huan bracelet										
	40	1										
		2.50%										
	ceramics	zeng steamer	pen basin	hu jar	weng urn	gui tripot	he tripot	qigai cover	qizuo support	huan bracelet		
	138	4	3	1	1	5	2	5	1	56		
		2.90%	2.17%	0.72%	0.72%	3.62%	1.45%	3.62%	0.72%	40.58%		
	bones											
	61											
Longshan	lithics	spinning wheel	zuan drill	scraper	earring	huang plate						
	486	67	2	12	2	1						
		13.79%	0.41%	2.47%	0.41%	0.21%						
	ceramics	bo bowl	wan bowl	dou bowl	pan plate	bei cup	zeng steamer	pen basin	gui pot	hu jar	weng urn	gang urn
	434	7	7	20	3	14	4	1	1	12	20	2
		1.61%	1.61%	4.61%	0.69%	3.23%	0.92%	0.23%	0.23%	2.76%	4.61%	0.46%
	bones											
	243											

Continuing

Late Yangshao	lithics	earrings	zu arrowhead	net weight	ball	huan bracelet	ji hairpin				
	216	7	18	20	1	1	11				
		3.24%	8.33%	9.26%	0.46%	0.46%	5.09%				
	ceramics	weng urn	ping jar	gang urn	qigai cover	huan bracelet	ball				
	436	4	1	1	7	300	11				
		0.92%	0.23%	0.23%	1.61%	68.81%	2.52%				
	bones										
	104										
Qujialing I	lithics	mortal									
	110	2									
		1.82%									
	ceramics	qigai cover	huan bracelet	chicken ef	dog effigy	ball					
	69	5	11	1	1	2					
		7.25%	15.94%	1.45%	1.45%	2.90%					
	bones										
	45										
Qujialing II	lithics	huan bracelet									
	40	1									
		2.50%									
	ceramics	zeng steamer	pen basin	hu jar	weng urn	gui tripot	he tripot	qigai cover	qizuo support	huan bracelet	
	138	4	3	1	1	5	2	5	1	56	
		2.90%	2.17%	0.72%	0.72%	3.62%	1.45%	3.62%	0.72%	40.58%	
	bones										
	61										

Table 8.6 Travel time (in hour) between settlements in the Late Yangshao and Longshan periods (Travel speed: 3.5 km/hr)

Measurements	LYS	LS
Average traveling time between Settlement	2.77	3.29
Average traveling time between Settlement in the Upper Valley	0.453	0.2
Average traveling time between Settlement in the Lower Valley	1.66	1.48
Average intra-cluster distance	0.491	0.549
Average inter-cluster distance	3.555	3.351
Average inter-cluster distance in the Lower valley	1.58	2.252
Average inter-cluster distance between the Upper and Lower valley	5.53	5

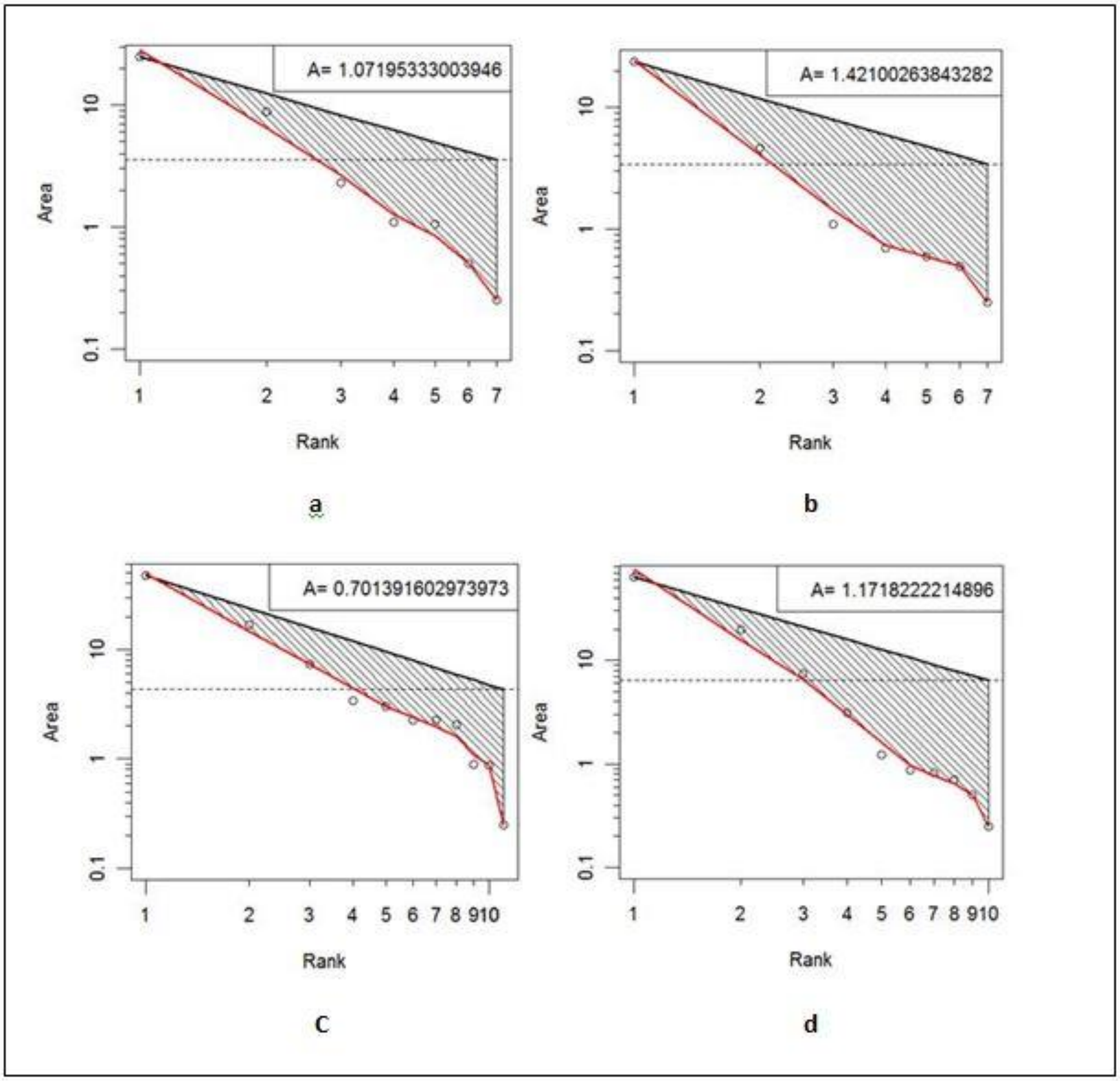


Figure 8.1 Rank-size graphs for the Guan Valley settlement system (a. The Late Yangshao period; b. The Longshan period; c. the Eastern Zhou period; d. the Qinhan period. Red line is the rank-size curve)

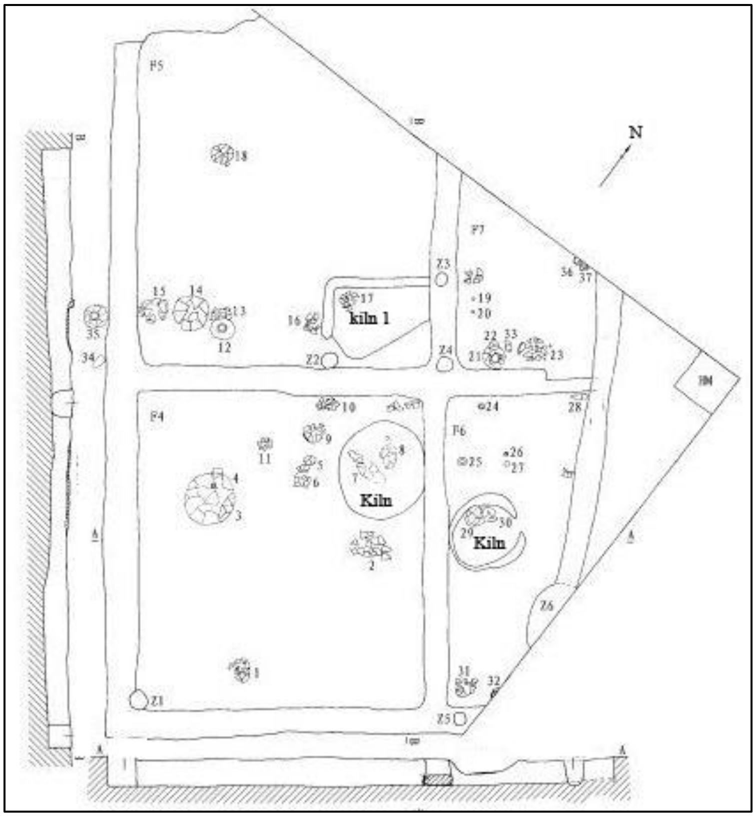


Figure 8.2 The four-room house complex of Phase II at the Laofengang Site (Henan 2012: Figure 8.46)

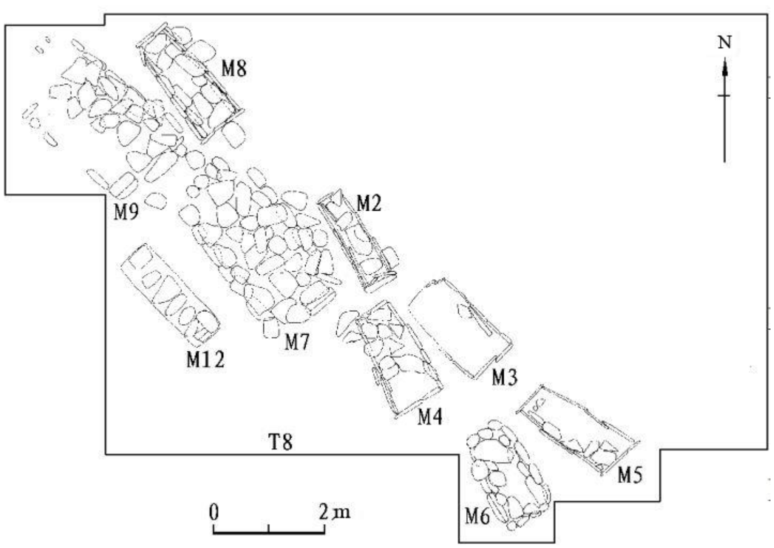


Figure 8.3 The distribution of stone-slab burials of Phase I at the Laofengang Site. (Henan 2012: Figure 13)

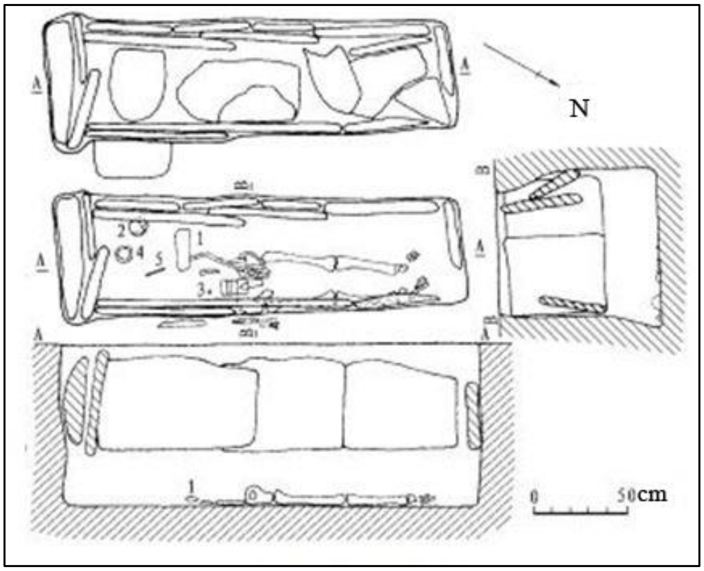


Figure 8.4 Burial M2—a stone-slab burial in Phase I at the Laofengang Site: 1. Yue axe; 2. Wan bowl; 3. Gang urn; 4; zan hairpin (Henan 2012: Figure 14)

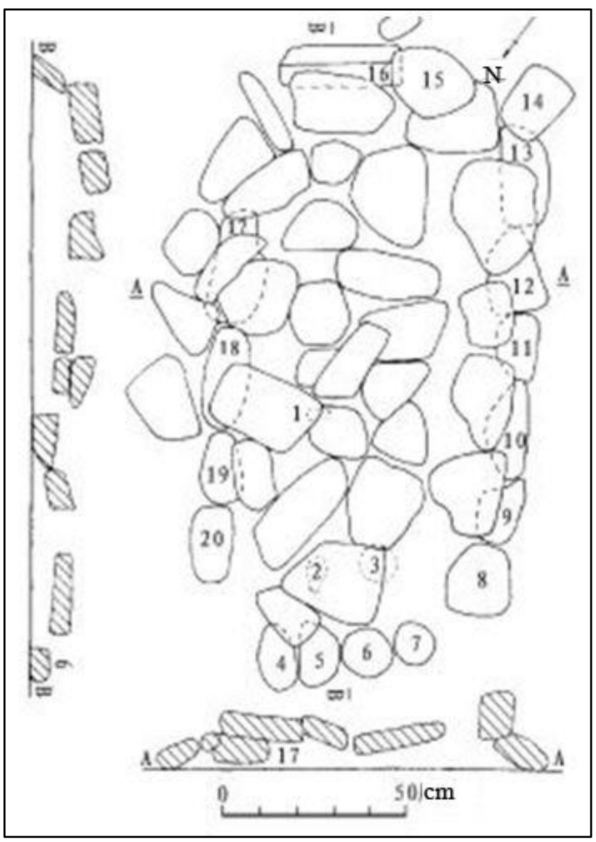


Figure 8.5 Burial M7—a stone-slab burial without gravel pit in Phase I at the Laofenggang Site (Henan 2012: Figure 19).

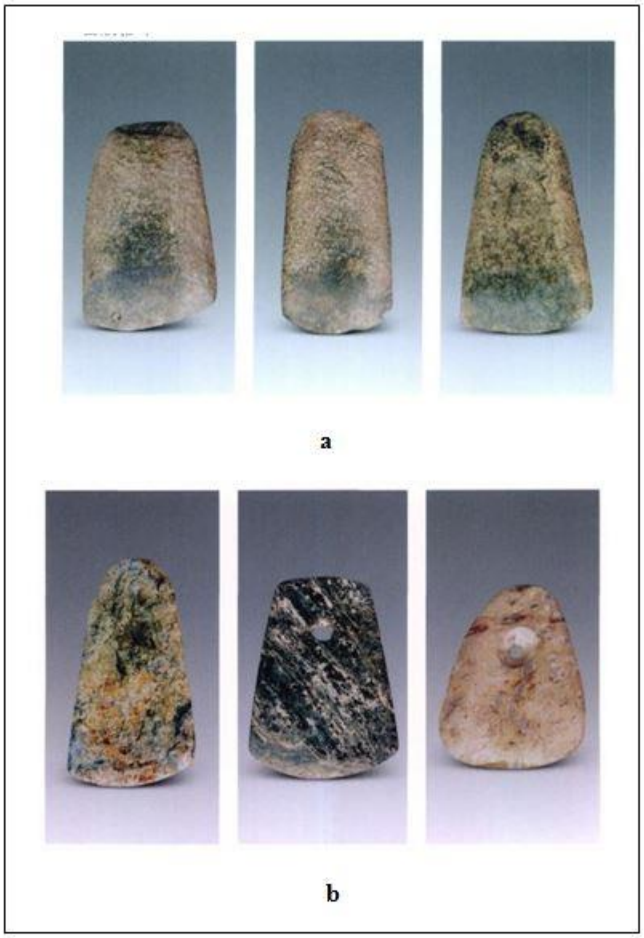


Figure 8.6 Comparing fu axe with yue axe (a. Fu axe; b. Yue axe)

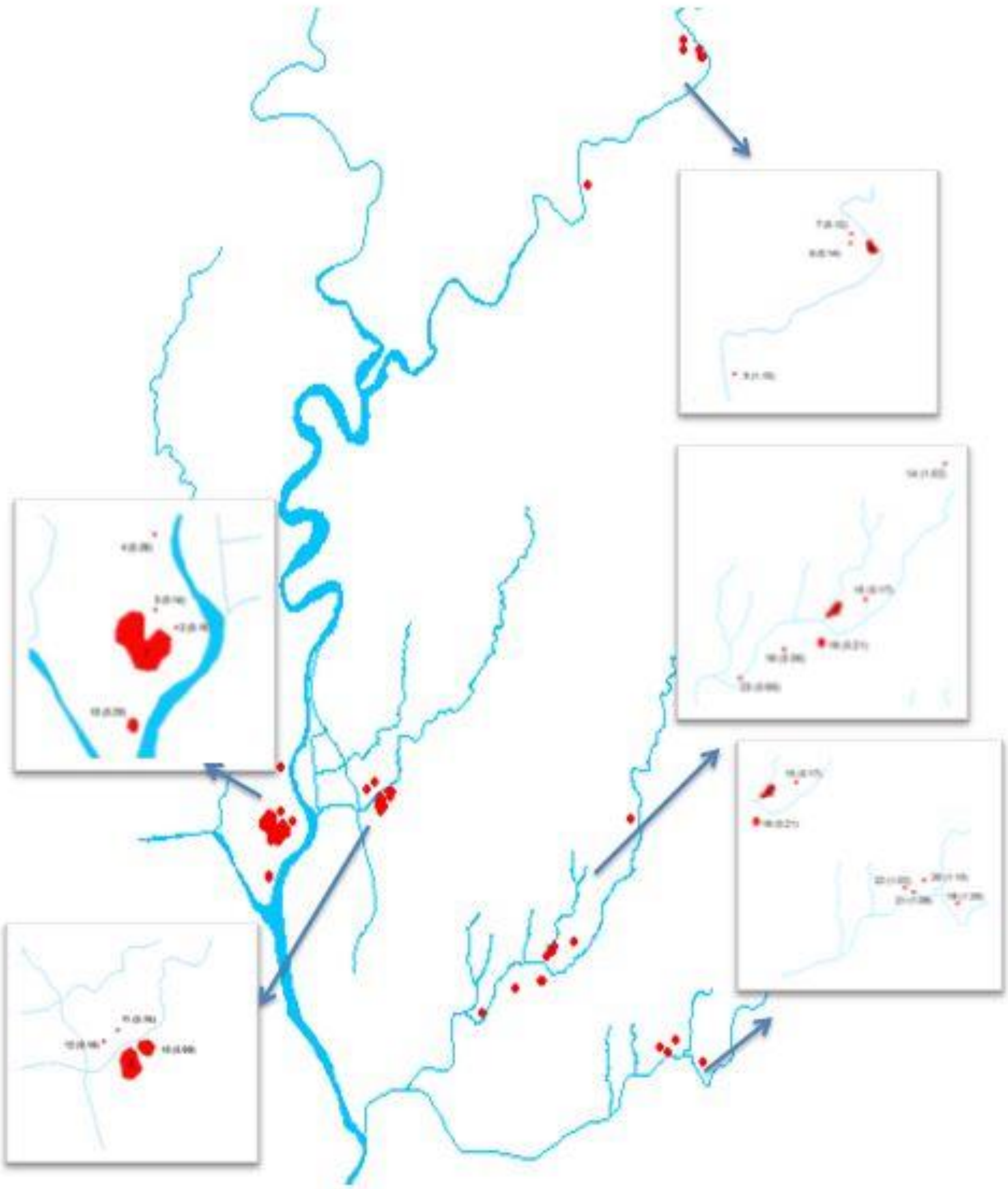


Figure 8.7 The traveling time from the center to hamlets in each settlement subgroup during the Yangshao period (Travel speed: 3.5 km/hr).

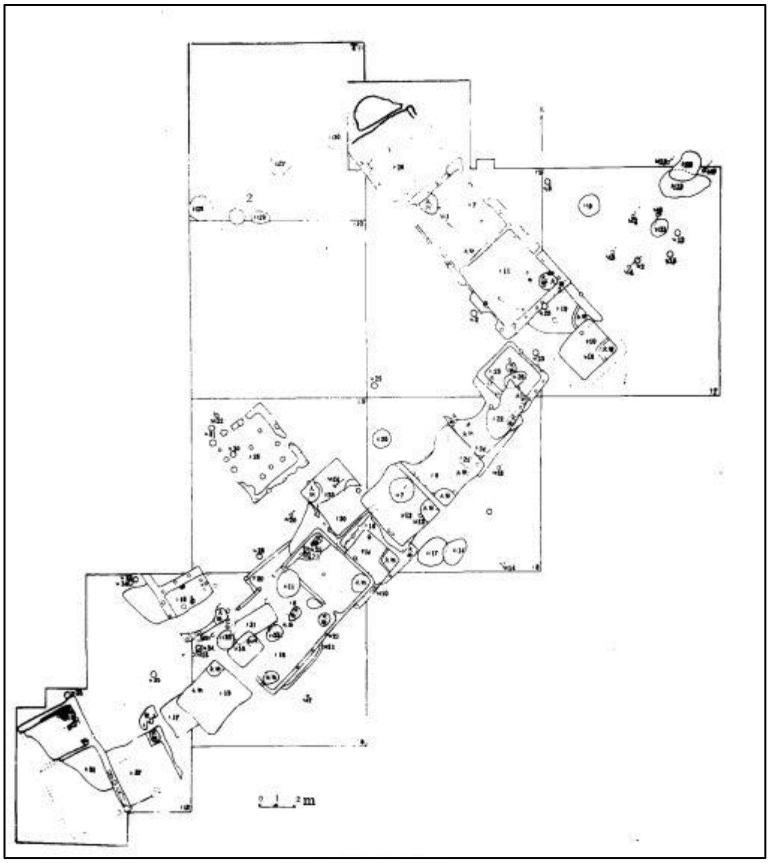


Figure 8.8   Qujialing long-house at the Huanglianshu site (Henan 1990: Figure 18).

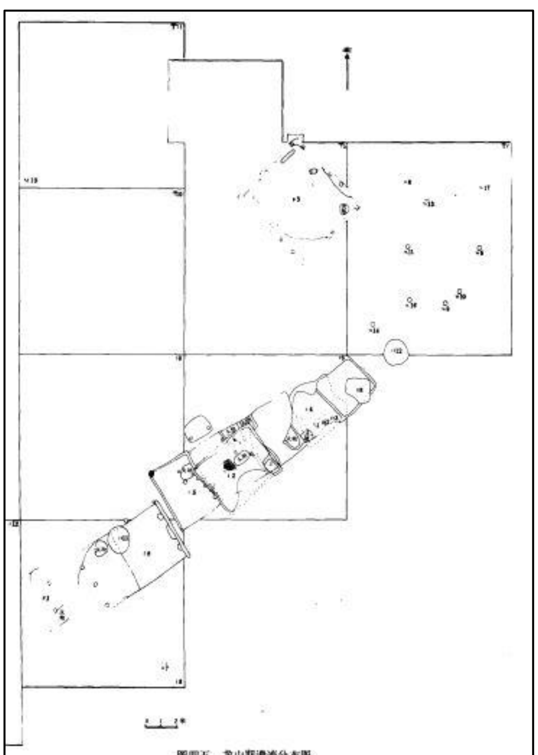


Figure 8.9   Longshan long house at the Huanglianshu site (Henan 1990: Figure 45).

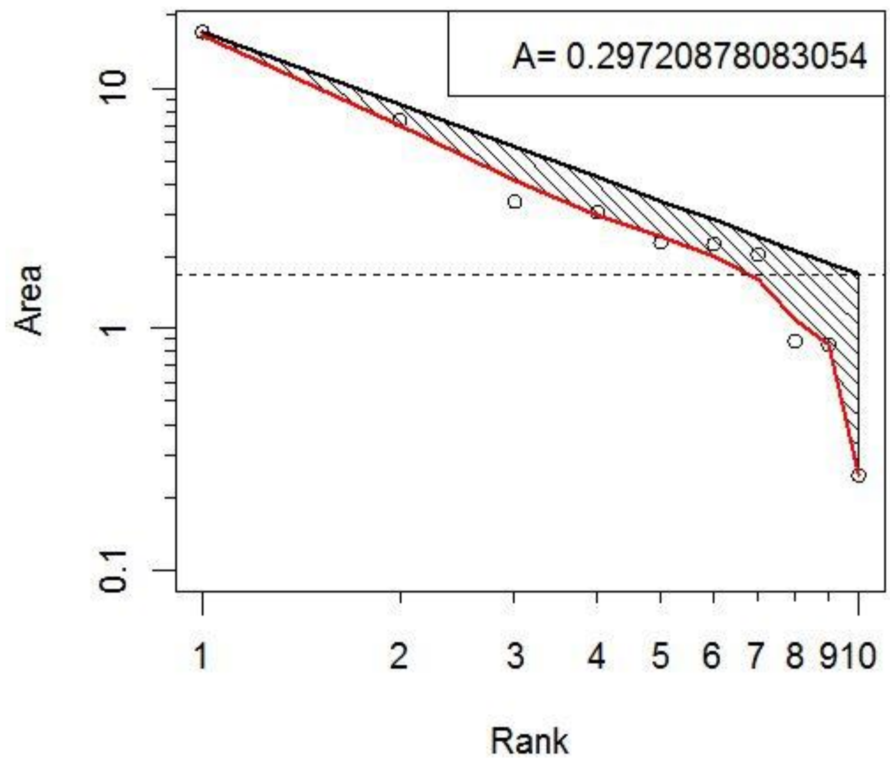


Figure 8.10 Rank-size graph of the Eastern Zhou settlement (EZ10 excluded).

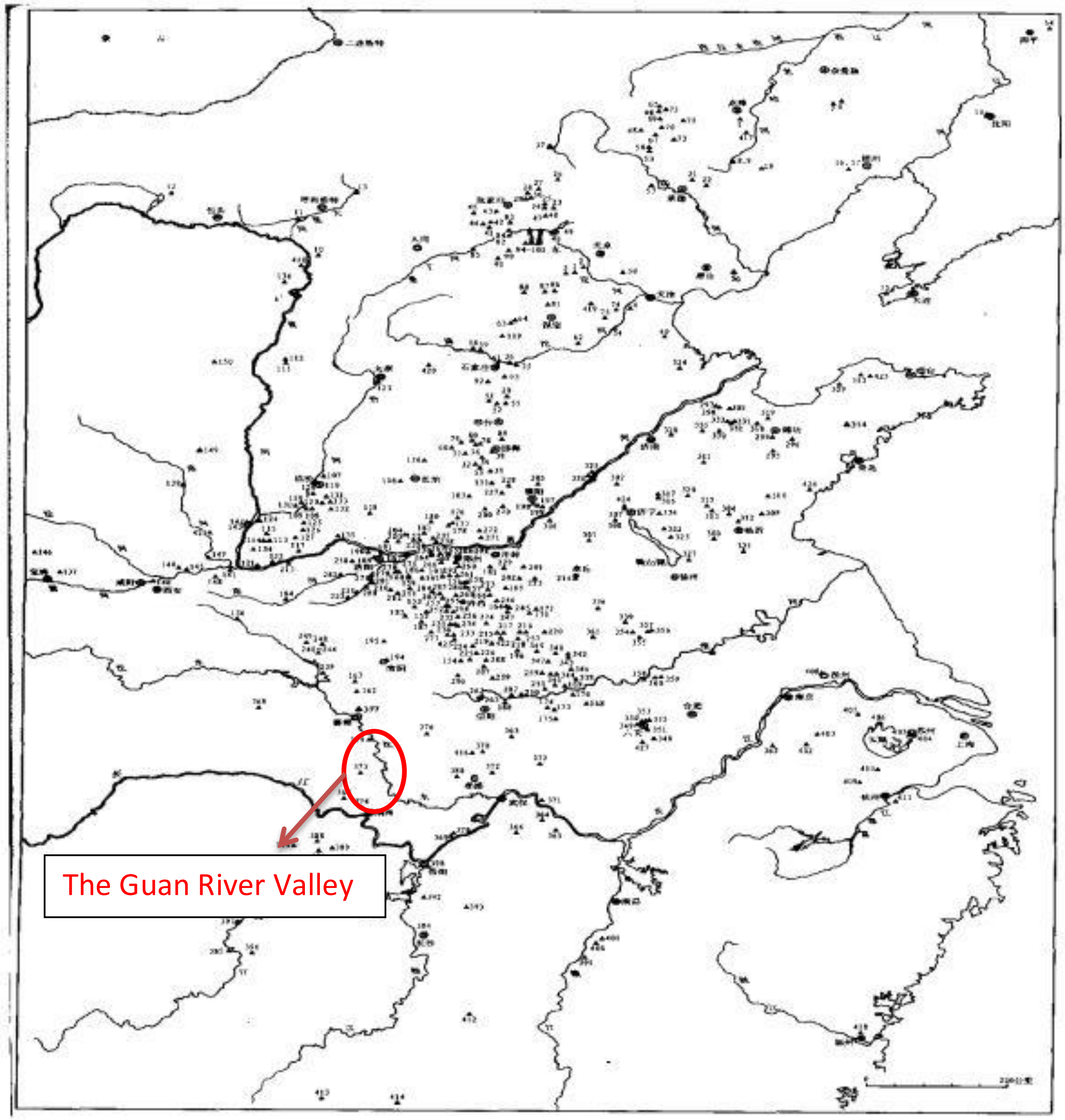


Figure 8.11 The distribution of cities in the Eastern Zhou period (edited from Xu 2000: Figure 40)

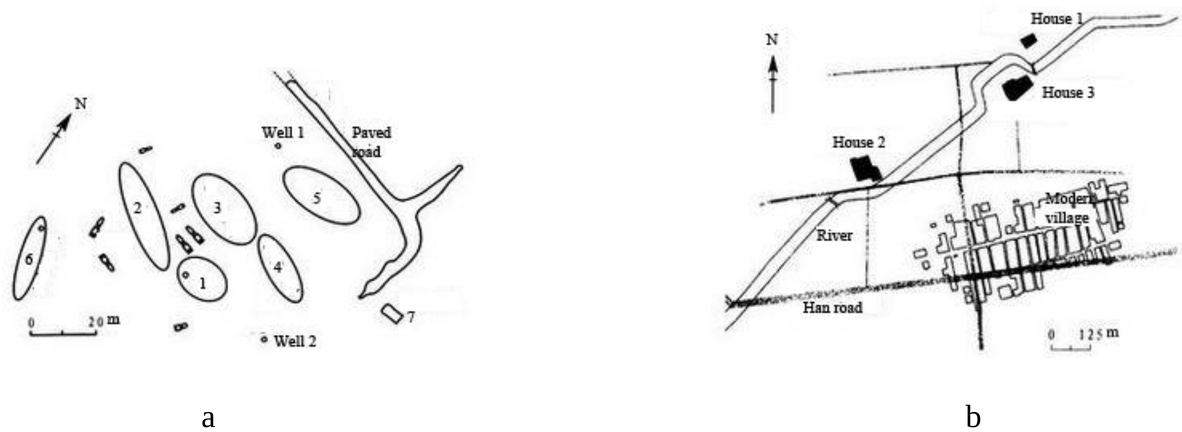


Figure 8.12 a. The settlement pattern of the “li” at the Sandaohao site (Liu 2011: Figure 8.1) and b. the settlement pattern at the Sanyangzhuang site (Liu 2011: Figure 2)

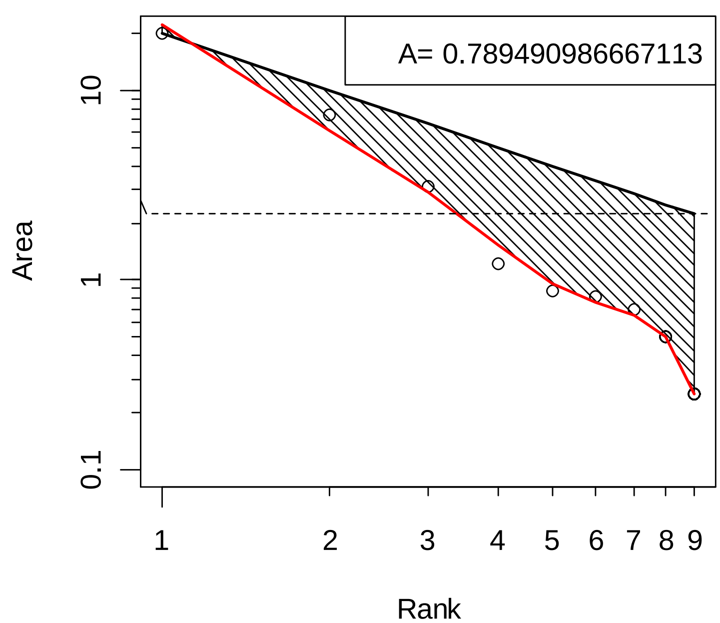


Figure 8.13 The Rank-size graph of the Qinhan settlement (EZ14 excluded).

CHAPTER 9

THE FORMATION AND DEVELOPMENT OF AN INTER-REGIONAL NETWORK

The Guan Valley is geographically circumscribed by mountains in the north. Eroded terraces fold heavily on the east and west of the valley for almost fifty kilometers, impeding contact between the Guan Valley and its neighbors. Because of such geographic impediments, the valley is most accessible from the south via Guan River. Even this point of ingress, though, is bounded by mountains and limits accessibility.

Nevertheless, the Guan Valley's history is inextricably linked with populations and cultural processes originating hundreds kilometers away. The last chapter's analyses demonstrate that regional settlement patterns—the regional primacy and the spatial distribution of settlements—are related to and shaped by social, political, and economic integration across regions. In this chapter, I contextualize the socio-political formation of the Guan Valley within the broader history of inter-regional integration (Figure 9.1). I will focus on the formation and development of an inter-regional network, which connected the Guan Valley with the "Cultural Core Zones," including the Guanzhong Basin, the Central Plain, and the Jianghan Plain. Since the neighboring areas of Xichuan region and Nanyang Basin deeply influenced the integration of the valley and connected the valley with the "Cultural Core Zones" (Chang 1984), I include them in the macroregion centered on the Guan Valley (Figure 9.2). The discussion in this chapter will illustrate that this macroregion was integrated into an inter-regional network that was formed as early as the Paleolithic period. Over time, the interaction became increasingly intense and complex.

9.1 Pleistocene-Holocene Transition

Between the Paleolithic and the Late Neolithic period, there was a long-term occupation gap at not only the Guan Valley, but also throughout the Eastern Qinling Mountain Range. A regional survey found no settlement before the Middle Yangshao period in the valley and only three Early-to-Middle Neolithic sites (9000-5000 B.C.) in the Eastern Qinling Mountains as a whole (Chinese 1991). Although this extremely low occupation density may be due to unknown colluvial processes, the discovery of Early-to-Middle Neolithic settlements remains intriguing, standing in contrast to the mountains' dense and geographically pervasive Paleolithic occupations. Such occupations were so dense, in fact, that the Eastern Qinling Mountain Range had the densest inhabitation in China during the Paleolithic period. A Paleolithic site survey found eight localities at the Guan Valley, all dated to the Middle Paleolithic (100,000-35,000 BP) (Pei and Song 2006; Figure 9.3). During the Late Pleistocene, the population was more clustered than previous periods (Liu and Chen 2012). However, by the Pleistocene-Holocene transition, the Eastern Qinling Mountains were mostly abandoned. During the Early Neolithic, settlements reappeared on the eastern, northern, and western piedmont of the Eastern Qinling Mountains, but not its southern end, where the Guan Valley is located.

Tool and dietary analysis from Shizitan (19,000-6,500 B.C.) and Longwanchan (18,000-13,000 B.C.) on the western edge of the Eastern Qinling Mountain suggests an increasing dependency on plant food during the Late Pleistocene, especially nuts and wild cereals (Liu and Chen 2012). Liu and Chen (2012) further argue that the spatial pattern of human activities went through a transition from mountains to piedmont "led by the adoption of collector strategy as an adaptation to the Pleistocene-Holocene Transition, which is characterized by relatively stable residential bases, logistical procurement of food from non-residential settlements, more complex and specialized procurement technology, and the presence of food storage facilities" (2012: 45).

This cultural ecological model explains the large-scale migration from mountains to piedmont at the Pleistocene-Holocene Transition. However, it cannot account for the temporal-spatial heterogeneity of human occupation in the Eastern Qinling Mountains from the Late Pleistocene to the Early Holocene. The questions here are: what caused the abandonment of Eastern Qinling Mountain at the Pleistocene-Holocene Transition? And why does the southern piedmont (home to the Guan Valley) not display evidence of human occupation during the Early Neolithic? Although these questions are difficult to answer with current data, an alternative perspective that draws on behavioral ecology could provide new insights overlooked by the cultural ecological model. In the following section, I will discuss how these new findings suggest that the occupational gap from the Late Pleistocene to Early Holocene may have been related to the rise and failure of a networking strategy that was familiar to the microlithic societies of Northern China. This strategy was achieved through the control and procurement of lithic resources.

Distribution of Microlithic Technology and the Resource Acquisition Network

Microlithic technology, associated with a broad spectrum of hunting and gathering, especially ungulate hunting, was sensitive to technological transformation or population migration during the Pleistocene-Holocene Transition (Lu 1998). There are over two hundred archaeological assemblages and locales with microlithic tools in China, dating to as early as around 30,000 BP. Most are dated to the Pleistocene-Holocene Transition, mainly in the middle to high latitudes (An 2000; Figure 9.4). The microlithic tradition is most prevalent to the north of the Qinling Mountain Range, complementing the locally dominant flake technology. In contrast, there are only four microlithic findings to the south of the Qinling Mountain Range, all dated to after 7000 BP. The distinct similarities in microlithic tools between these sites support a diffusion hypothesis—that the technology transmitted from the north to the south. Lu (1998) proposes two possible routes based on the chronology of these sites: 1) through the Tibetan plateau (see also Jia 1978); and 2) through Central China, though the specific route remains unclear.

New evidence suggests that the microlithic technology could have been transmitted to Southern China through the Eastern Qinling Mountain Range much earlier than previously suspected. The northern edge of the Qinling Mountain Range has many microlithic sites (see Figure 9.4). Recent findings at Longquandong (30,000-28,000 BP), 60 km to the north of Guan Valley, record 60 flake tools, 30% of which were described by the excavators as “proto-microblade” (Zhou et al. 2011). This evidence shows that the Eastern Qinling Mountains may have been one of the earliest areas to adopt microlithic technology in China. Another excavation has recently found a considerable concentration of microblades at Boshan, 30 km to the south of the Guan Valley, which possibly date to 20,000 BP (Song, personal communication).

Both sites are among the earliest sites with microlithic tools, implying that the transmission of microlithic technology occurred much earlier and more rapidly than expected, crossing the “natural barrier” of the Qinling Mountain Range between 30,000-20,000 BP. This hypothesis is not yet sounding with current data and research. These two recent studies provide new directions for the study of the early inter-regional network dynamic in the Eastern Qinling Mountains. Since the nature of this network is understudied, research on the microlithic sites in North China may provide some clues.

The establishment of an inter-regional network may have accompanied population replacement from the Northern China. Bettinger et al. (2010) use the microlithic tools from the Dadiwan site as support for the notion that the site went through population replacement by the end of the Pleistocene. They contend that hunting-based groups who used microlithic technology expanded from the north or northwest and took over the original groups. The microlithic technology was fully developed and consisted 32% of the lithic assemblage at 8000 BP at the Dadiwan, a ratio similar to those at the Longquandong site. Most of microlithic tools were modified repeatedly, possibly due to the scarcity of the fine-grained raw material (cryptocrystallines) the microlithic technology required. It is very likely that the raw material was obtained through trade or long-distance travel and that the microlithic tools were so valuable as to compel investment in recycling (Bettinger et al. 2010).

The effort of obtaining raw material is supported by another study on the lithic tool and source at the Nihewan Basin (Du 2003). By the Late Upper Paleolithic, the locally-available but coarser material (such as vein quartz) was abandoned, and the scarce cryptocrystalline material was obtained as far as 80 km away from the residential base, far beyond the 5-10 km activity radius established during the Early and Middle Paleolithic (Figure 9.5). Du (2003) thus suggests that, as late as the Early Upper Paleolithic, certain groups may have exclusively controlled traveling routes. The regional multi-lined network of resource acquisition was integrated into or formed the basis of the political landscape in the Nihewan Basin (Du 2003).

These studies show that microlithic technology not only signifies the varying importance of hunting in addition to foraging and colleting in the subsistence strategy during the Pleistocene-Holocene Transition. Moreover, the microlithic technology was also reforming social and political behaviors through the production and distribution of tools, through which a regional social and economic network based on the acquisition of scarce raw material was formed.

Compared to the Nihewan Basin, the microlithic assemblages of Early Upper Paleolithic in the Eastern Qinling Mountain range are older (30,000-20,000 BP) and the materials are mostly vein quartz rather than cryptocrystallines (Zhou et al. 2011). In contrast to the Dadiwan site and the Nihewan Basin, the microlithic tradition in the Qinling Mountains did not continue after 20,000 BP. Instead, local groups with flake-and-shattered technology continued to settle in clusters in the northern and southern piedmont of the Eastern Qinling Mountain Range (Liu and Chen 2012). This implies that the microlithic technology, after it was transmitted into the mountains, failed to transfer its influence from the technological to social realm and was unable to compete with the dominant flake-and-shatter technology.

A cultural ecological view may help trace the endo- and exogenous mechanisms of the disappearance of microlithic technology in the Qinling Mountains, although such en environmental deterministic view on its own would offer an overly simplistic explanation as such tools continued to be used to the north of mountains (Liu and Chen 2012). In both locations, the food resources are not significantly different, especially with respect to the abundance in ungulate species which microlithic groups were after. Bettinger et al. (2010) attribute the abandonment to resource depletion, which was caused by “stable limit cycle.” interactive mechanism between hunter-gatherer population, resource abundance and associate return rates.

In sum, new findings at the Longquandong and Boshan sites suggest that microlithic technology was brought to the Eastern Qinling Mountain Range by a population influx from Northern China, which may have replaced the local population or driven them to the piedmont. The microlithic technology not only influenced subsistence structure by increasing the importance of hunting, it may have accompanied a sociopolitical system that incorporated network acquisition of raw materials. However, this socio-technological system failed to develop in the Eastern Qinling region in the same manner as in Northern China. The collapse of this system may have caused occupational gaps in the region. Before 4000 B.C., the low occupation density at the Guan River valley, which was a part of Eastern Qingling geographic zone, may have related to this process. As a consequence, the groups who depended on nuts and wild cereals thrived in the piedmont at the Pleistocene-Holocene Transition.

9.2 The Late Yangshao Period (3500-2900 B.C.)

The settlement pattern of the Late Yangshao in the Guan Valley—the rapidly increased occupation, highly clustered spatial distribution, paramount size of LYS1, and regional hierarchy–is not a unique finding. Archaeological surveys in several regions reveal evidence of settlement nucleation, formation of a political center and social hierarchy, and rapid increases in population and regional integration around 4,500-3,000 B.C. (i.e. Linduff et al. 2004; Liu et al. 2004). In contrast to the Middle Yangshao period, when a hierarchically organized settlement system appeared only in isolated areas, complex regional systems flourished in many parts of the Yellow River valley in the Late Yangshao period (Liu and Chen 2012).

The widespread population increase and development of social complexity across regions provide the background for rapid regional development in the Guan Valley. In Chapter 8, I discussed the corporate-based social structure of the Guan Valley during the Yangshao period. Lineage groups were interacted and cooperated on community and regional scale through the sharing of ceremonies and regional ideology. In the following section, I will explore the mechanisms that accounted for the population increase at the Guan Valley. Evidence shows that the population growth at the Guan Valley during the Late Yangshao period could have been attributed to the population fluidity in the Dan Valley and the Guanzhong Basin. In relation to this population growth, the focus on ceremonialism in the Guan Valley was shared throughout the regional system in the Nanyang Basin, contributing to macroregional integration and development of social complexity.

The Guanzhong Basin to the Guan River Valley: Population Flow Hypothesis

The Qinling Mountains posed a physical barrier to intense interaction between the Guan Valley and the Guanzhong Basin, which was the most densely occupied region in the Yangshao period (Figure 9.1). The most likely route connecting these two regions is through the Dan River, which joins the Guan River about 40 km to the south of the study area. After evaluating the settlement systems in the Guanzhong Basin, Dan River Valley and Guan Valley, I suspect that the Dan River Valley may have also played as the migration route for populations to travel to the east and south during the Yangshao period.

This hypothesis is supported by Liu's model (2004). She proposes that different combination of environmental preconditions and settlement patterns affected trajectories in the development of complex society (Liu 2004). The Dan River settlement system was similar to Liu's description of a "mono-centered centrifugal regional system," in which the settlement system shows a low degree of integration and was bounded by a semi-circumscribed environment (Liu 2004:188). Reconnaissance surveys have identified 29 sites dating to the Yangshao period in the Upper Dan River Valley (see also Table 9.1). These sites can be divided into three tiers and the rank-size graph shows a primate to log-normal pattern (Figure 9.6). Liu (2004) proposes that the lack of social integration was related to the semi-circumscribed environment, which facilitated population migration out to other regions with more desirable farmland.

The Guan Valley matches Liu's model of "mono-centered centripetal regional system," a system characterized by settlement hierarchy alongside large regional centers in an environmentally-circumscribed region. The system was nucleated and socially integrated. The sociopolitical integration also accompanied population growth, "which was partially caused by a population pushed from other areas to the already well-populated and environmentally circumscribed region" (Liu 2004:188).

According to Liu's (2008) hypothesis, the environmental configuration plays an important role in the formation of both mono-centered centripedal regional and mono-centered centrifugal regional systems, with the former being situated in more circumscribed environmental settings than the latter. Comparing with the Dan Valley, which connects the Guanzhong Basin with Jianghan Plain, the Guan Valley is much more circumscribed—the upper river valley is narrowly bounded by mountains.

The contrast between the Dan River and the Guan Valley implies that the two neighboring river valleys followed very different developmental paths in the Late Yangshao period and that this difference was perhaps related to their differences in geographic configuration. It is not unreasonable to suspect that at least some of the population increase at the Guan Valley was related to the population flow from the Guanzhong Basin through the Dan River Valley.

The Guanzhong Basin was the most densely occupied region during the Yangshao period, with more than 1200 sites found in reconnaissance surveys (Table 1; Xu 2001, 2002). As most settlements at the Guanzhong Basin are to the north of Yellow River, the Jing, Gan, Qi, and Wei River basins to the south of Yellow River, which are 30 km away from the Dan River region, was most likely to be the source of population migration through the Dan River (Figure 9.1).

During the Yangshao period, these river basins had a dense, four-tier settlement system, comprised of more than 270 sites, seven of which were larger than 50 ha.

Fan's (2000) study of the material cultures of this macroregion, which focuses on the neighboring Xichuan region, Nanyang Basin and the Dan River Valley, provides some evidence for varying population compositions from the Dan Valley to the macroregion of Guan Valley. Fan (2000)'s analysis reveals that inter-site differences in material culture are stronger in the Dan River Valley than Xichuan region or Nanyang Basin. Although the Dan Valley exhibits more inter-regional similarities to the Guanzhong Basin, this connection varies from one site to another, even between sites that are across the river from each other.

In contrast, although the macroregion was still within the Yangshao Cultural Sphere, it showed strong local characteristics that distinguished it from those of the Central Plain and Guanzhong Basin. The lack of polychrome pottery, the funerary pottery and group burials at Xiawanggang, the stone-slab burials at Xiawanggang, the long-houses at Laofengang, Xiawanggang, Baligang and Gouwan are all unique to the macroregion (Fan 2000).

Fan (2000) study on material culture suggests that the population composition was perhaps fluid and mixed at the Dan Valley, resembling Liu's (2004) "centrifugal" model of settlement system. The population at macroregion of Guan Valley may have developed a much stronger regional identity than that of the Dan Valley. This "centripetal" system may have attracted people to settle from other areas. Although Liu's (2004) cultural ecological model reduces social development to geographic configuration, it presents explanation for the rapid population growth in the Guan River valley during the Late Yangshao period. It also provides a sociopolitical explanation for material cultural variations between the macroregion of Guan Valley and the Dan Valley.

As discussed in the last chapter, population growth was intertwined with the development of a shared of regional identity. This identity was established through an emphasis on ceremonialism in the Late Yangshao period, which also reinforced the paramountcy of the regional center. The macroregional material culture suggests that this cultural emphasis may have been a macroregional phenomenon.

The Nanyang Basin: Jade Production

An analysis of jade production and distribution in Nanyang Basin supports the hypothesis that regional ceremonialism, a focus of the regional centers, greatly influenced sociopolitical integration. The Nanyang Basin is connected to the Xichuan region and separated from the Guan Valley by eroded terraces and mountains (Figure 9.1). The basin has always been the passage between the Central Plain and the Jianghan Plain to the south (Figure 9.2). Yu (2006) describes the Nanyang Basin as a melting pot in the Late Yangshao period. The influxes of material cultures from various regions formed a distinctive regional material culture. Evidence suggests that jade production and distribution was integral to the regional center and contributed to the formation of an integrated regional system at the Nanyang Basin by the Yangshao period.

Several reconnaissance surveys have located 52 Yangshao period sites in the Nanyang Basin (Xu 2002, 2003; Table 9.1). These sites were organized along a four-tier settlement hierarchy. Unfortunately the size of each site is unavailable. The largest site, Huangshan, was excavated in 1958 with a reported area of 30 ha. Although no field report has been published, the excavator, Guo introduced the findings in his book on Chinese history (1976). The site yielded a long-house of 6 rooms, which is similar to the house complexes of Xiawanggang, Baligang, and Laofengang. As discussed in the last chapter, these long-houses represent cooperation between kin-group units, an important strategy for social cohesion during the Late Yangshao period.

Unlike other sites in the area, Huangshan was a major producer of jade products. The excavation yielded several exquisite jade artifacts, including two jade chan spades, two zao adzes, and a huang plate (Guo 1976). In 2008, local institutions conducted a series of small-scale regional surveys to identify the distribution of jade artifacts and their possible lithic source. The team found 393 ceramic sherds and more than 617 lithic objects, of which 396 pieces were categorized as "jade objects" made of quality nephrites (Jiang et al. 2008). Of these jade objects, more than 100 pieces were made from a local nephrite source called "Dushan." Researchers identified that most of the jade objects were similar to farming tools, including fu axes, chan spades, ben axes, lian sickles, dao knives etc., with a larger proportion of chan spades (75%) (Table 9.2). Surveys also found cores, unfinished products, and drilling tools, suggesting that the jade production was systematic and that jade items were locally processed (Jiang et al. 2008).

Jiang (2009) also argues that Huangshan-made jade products were widely distributed. Jade chan spades with similar appearance and production techniques as those found in Huangshan have also been found in more than 11 sites in the Nanyang Basin and neighboring areas, including Yanggang in the Guan Valley (Jiang 2009). From these findings, it is clear that the Huangshan site was the center of a large-scale regional exchange network of jade chan spades.

Unfortunately, Jiang et al. (2008) acknowledge that it is difficult to identify the precise ceremonial nature of most jade objects; they could be farming tools as much as ceremonial objects, or both. Thus, it is uncertain if this exchange network was ceremonial or economic, or both. According to Jiang et al. (2008), the Mohs scale of mineral hardness of Dushan quartz is 6.5, much higher than the lithic source used by the other two contemporaneous jade production centers—Hongshan, in inner Mongolia, and Liangzhu, on the east coast of China. Scholars have identified these two centers as highly ceremonial societies (Liu and Chen 2012; Ren 2010). The difficulty of processing Huangshan jade reduces the possibility that the products were used for farming activities. Though it was made of shale, the chan spade found at the Dazhangzhuang site supports this hypothesis, as the shape is similar to those made in Huangshan (Nanyang 1983). This difference in raw material may have been related to differences in functional between the two objects.

The above evidence suggests that jade production and distribution was highly systematic. It was led by producers in Huangshan, but the distribution network expanded to include the whole Nanyang Basin and the Guan Valley. This regional or macroregional economic network was likely to have been ceremonial in nature, as jade products were more likely to be ritual objects than utilitarian farming tools. This emphasis on ceremonial objects coincides with high investment in ceremonialism in the nearby Guan Valley.

As discussed in the last chapter, the relationship between population growth and the regional ceremonial network is unclear. However, the emphasis on ceremony enhanced the macroregional integration of the Guan Valley. This system may have attracted outsiders and facilitated the integration of these new residents into Guan Valley communities. The relationship between population growth and regional ceremonialism was built on an inter-regional network and may have been accounted for the rapid social development seen during the Late Yangshao period.

9.3 The Longshan Period (2900-1900 B.C.)

In the last chapter, I demonstrated the heterogeneous nature of social systems in the Guan Valley and neighboring regions during the Longshan period. During this period, settlement patterns in the macroregion, which include the Guan Valley and neighboring Xichuan region and

Nanyang Basin, began to change, as regional centers became smaller and there were fewer secondary centers. Considering this transition, I suspect that the occupations at the Guan Valley formed a gateway system, in which the regional center, Yanggang, functioned as the gateway community that protected and promoted exchange networks throughout the macroregion and perhaps beyond. In this chapter, I will further explore the structure and function of this exchange network in the context of the "Qujialing invasion." Evidence shows that although the material culture at the Guan Valley underwent significant change, the social organization largely stayed the same. The "Qujialing invasion" likely facilitated the acquisition of exotic materials that were essential to the Jianghan Plain societies. The Guan Valley may have participated in this long-distance exchange. However, production analysis shows that, although there was a long tradition of specialized production of lithic and bone tools in the Xichuan region, the local production may have served only the macroregion. I suspect that there could have been another production center located to the northern mountains that provided Jianghan Plain through Yanggang's management.

"Qujialing Invasion"

As stated in the last chapter, the material culture of the macroregion including the Guan Valley, the Nanyang Basin, and the Xichuan strongly resembles that of Qujialing and Shijiahe during the Longshan period. This material culture was typical of the Jianghan Plain. Many studies have supported the notion that the Qujialing artifacts were found further north into the core of the Central Plain (i.e. Meng 2011; Figure 9.7). However, the degree of integration of Qujialing technology into local material culture varies from site to site and from region to region.

As shown in Figure 9.7, Huanglianshu, Xiawanggang, Gouwan in the macroregion of Guan Valley are among the earliest sites found with Qujialing material features outside of the Jianghan Plain. In the Middle–to-Late Longshan period, the localized material cultural of the

Yangshao period began to exhibit strong similarities to the Qujialing material culture system (Fan 2000; Meng 2011).

Nevertheless, as discussed earlier, the artifacts from these sites possess differential resemblance to the Qujialing material culture. This inter-site variation has also been identified at the Zijing and Donglongshan sites in the upper Dan River Valley. The Donglongshan site, only a few kilometers away from the Zijing Site, presented a different material culture from Zijing (Shaanxi 2011; Wang 1987). At around 2,500 B.C., the Jianghan-Plain-style artifacts began to disappear from the Central Plain, the Nanyang Basin, and the Dan River Valley. In their place, these regions developed variants of Longshan material culture. This replacement phenomenon was seen by many archaeologists as symbolizing the retreat of once powerful Jianghan cultural system to the north of Jianghan Plain.

Qujialing Society and the Exchange Network

The expansion of the Qujialing technology system did not correspond with an expansion of Qujialing social organization. Regional settlement patterns differ significantly between the Yangtze River regions and the Xichuan or Nanyang Basin. Xichuan and Nanyang had much lower occupation densities compared to the Yangtze River (Meng 2011). In addition, the population was much more nucleated near the Yangtze River; small, walled settlements or supra-centers exceeding 50 ha were frequent in the middle Yangtze River region (i.e. Shijiahe was 8 sq. km and Menbanwan was more than 100 ha; from Zhang 2003). Although systematic survey data does not exist, reconnaissance survey data indicates that the smallest sites were barely smaller than few hectares. These sites were larger than those in the Guan Valley and neighboring areas, where most sites were under or around 1 ha (Chapter 5; Meng 2003). More importantly, when population increased rapidly in the Middle Yangtze River region between 3,500 and 2,500 B.C., the occupation at macroregion of Guan Valley was stagnant or in decline.

Zhang (2003) argues that the settlement systems in the Yangtze River region represent unions of tribal units or proto-states. He attributes the highly complex social organization in Yangtze River region to internal growth of material wealth, as well as growing control over exotic resources and technology. The redistribution of exotic resources established social relations and functioned as a source of power. Then the failure to retain control of exotic resources led to the social collapse of the Yangtze River region around 2000 B.C..

Zhang's (2003) hypothesis, though it could stand further development, explains the expansion of technological system occurred. The expansion may have accompanied population migration from the Yangtze River region, a process that was rapid yet had little effect on local settlement pattern or subsistence pattern (i.e. the crop package stayed same at Gouwan as suggested by Fu et al. 2010). Zhang (2003) argues that new occupations were founded to ensure the control of local resources as well as to facilitate exchange in and between regions. For example, Zhang (2003) contends that people moved into Xichuan to explore alternative lithic resources in addition to the lithics from the Three Gorges. Zhang's (2003) argument supports the hypothesis that the development of Yanggang as a gateway community was aimed at ensuring the exploitation and trade of lithic or other exotic materials in the macroregion and beyond. However, an investigation into specialized, macroregional production is needed to understand how the exchange network functioned.

The Production and Distribution Network of Lithic Products

As discussed above, the macroregional network for production and distribution of jade was an integral part of strengthened regional ceremonial identity. This network may have become more specialized and multi-faceted in the Longshan period. If the Guan Valley was organized as gateway system during the Longshan period, specialized production at the macroregional scale should yield insights into the Guan Valley's role within the broader network.

In his book on the prehistoric settlement pattern of Yangtze River region, Zhang (2003) compares the lithic assemblage in the Three Gorge region and the Middle Yangtze River plain. He argues that lithic tools were manufactured in the Three Gorges region, where lithic sources are much more abundant, and traded eastward to the Jianghan alluvial plains, where raw materials are scarcer.

Zhang (2003) further speculates that lithic tools were also traded from the Xichuan region to Nanyang Basin during the Late Yangshao period in a similar fashion. This argument is based on the evidence that both Xiawanggang and Zhangjiaping in the Xichuan region have several lithic workshops and a large amount of lithic tools. Compared to these two sites, contemporaneous sites in the Nanyang Basin lack lithic sources and yield fewer lithic tools. By studying artifact composition, Zhang (2003) proposes that traded tools were mostly different types of axes (fu axe, ben axe, zao adze, yue axe) and some arrowheads. In addition, Xiawanggang and Baligang sites may have been bone production centers in the Yangshao period, although no workshop has yet been found (Zhang 2003).

To test Zhang's (2003) hypothesis, I conducted an inter-site comparison of artifact composition, focusing on the lithic/ceramic and bone/ceramic ratios between the Laofengang, Huanglianshu, Xiawanggang, Dazhangzhuang, Donglongshan, and Zijing sites, using the best available data (see Table 9.3 and Figure 9.8). These two ratios are indices of production, based on the assumption that the quantity of ceramics is an indicator of population. Although Zhang (2003) points out that pottery was part of this regional exchange network, he also notes that most domestic pottery was produced locally. Therefore the amount of ceramics can be used to evaluate the scale of other productive activities.

Figure 9.8 show that the Xiawanggang site, in general, yields a higher ratio of lithic tools than all other sites. The ratio of lithic tools at Huanglianshu is only half of that at Xiawanggang. The highest lithic/ceramic ratio appears in the Western Zhou portion of the Xiawanggang site, where lithics are more than twice as prevalent as ceramics. The Donglongshan site and the Longshan component of the Zijing site also yield high ratios of lithics.

These observations confirm Zhang's (2003) proposition that Xiawanggang likely acted as the lithic production site. This production center had been active since the Yangshao period and reached its peak in the Western Zhou. During the time when Qujialing material culture superseded local traditions, lithic production at Xiawanggang was maintained. In the Late Longshan period, lithic production continued and may have increased in scale at Xiawanggang. Meanwhile, lithic production also became important at Donglongshan and Zijing in the Dan River Valley. Only Xiawanggang maintained lithic production and continuous occupation in the Shang and Zhou periods.

It is unclear if axes (fu, yue, ben) were the main lithic product in Xiawanggang or any production site. Figure 9.9 shows that the proportion of axes to other lithic tools matches the ration of axes to ceramics, suggesting that the changes in axes mostly coincided with the change in population. There are three exceptions. Laofengang and Donglongshan have distinctively high proportions of axes considering their populations (as shown by axes/ceramics). The Western Zhou component at Xiawanggang presents an opposite picture, suggesting that axes were no longer important as lithic tools. Zhang (2003) suggests that axe use originated in the Yangtze Valley and spread to Xichuan with Qujialing material culture. He argues that the axes, which were commonly used for land clearance, increased in the Nanyang Basin as rice cultivation was brought in with Qujialing material culture. However, Figure 9.9 shows that the production ratio of axes was stable at Xiawanggang from the Yangshao to Qujialing periods. In fact, the axe ratio increased at Huanglianshu, Xiawanggang, and Zijing after Qujialing material culture receded. In addition, as discussed in a previous chapter, current data show that the use of rice did not increase much in the Qujialing components at the Nanyang Basin or Xichuan sites.

Compared to lithic production, bone tool production at Xiawanggang was smaller in scale. The ratios of bone tools at Xiawanggang are not significantly higher or lower than the contemporaneous production at Huanglianshu. It was not until the Shang period that bone tools became more dominant in the production activities. In contrast, the Donglongshan site in the Dan River Valley has a much higher ratio of bone products during the Longshan period.

In summary, this evaluation shows that the Guan Valley may not have been a major player in the lithic production. However, there is evidence of specialized production and an exchange network of certain products in the macroregion of the Guan Valley. Xiawanggang and other sites were production centers for lithic and perhaps bone tools. Without sufficient data from the Nanyang Basin, it is unclear whether these lithic products were traded directly to the Nanyang Basin. Sites in the Nanyang Basin, Dazhangzhuang, and Baligang have yielded very few lithic tools. Although, the volume of production at Xiawanggang was not unusual for settlements in the Longshan period, it is unlikely that the site supplied areas beyond the macroregion.

Considering the geographic location of the Guan Valley, Yanggang was likely to have been a connector to the northern mountainous region, where lithic resources are more abundant and varied. I suspect that there are unidentified lithic production centers to the north of

Yanggang that flourished during the Early Longshan period. In the Late Longshan period, after the demand from the Jianghan Plain weakened, this center may have collapsed. In turn, the Xichuan region, which provided for the macroregion, recaptured and heightened its prominence among producers of lithic and bone products. This may explain that in the Late Longshan to the Western Zhou period when settlement system of the macroregion drastically shrank and most sites mentioned in this chapter were abandoned, Xiawanggang successfully maintained its occupation size and intensity.

9.4 The Shang to Western Zhou Period (1900-771 B.C.)

To understand the low and dispersed settlement pattern of the Guan Valley and its macroregion during the Shang and Western Zhou periods, one has to examine the relationship between the Valley and the early states located on the other side of the Qinling Mountain Range. The rise of those early states in the Central Plain had a significant impact on local and neighboring regional systems. The nature of the Shang and Western Zhou political landscape is still under debate (Chen 2006; Li 2008). Various regional material cultures beyond the states' core zones—their capitals and surrounding areas of direct control—present a variety of population compositions and socioeconomic structures, from highly similar to the capital to completely different from them (see Chang 1980; Chen 2006).

Numerous excavations and regional surveys have recorded the settlement structure, population scale, and administrative hierarchy of the Shang and Western Zhou core zones. Beyond the core zones, only a few large cities or towns have been excavated, and even fewer village-level settlements have been studied systematically. Current data reveal that the rapid population loss outside of the state cores corresponds to the population explosion in the capitals.

Table 9.4 shows how rapidly capitals expanded from regular settlements. The population nucleation at the state capitals were as rapid and extensive (IACASS 2005; Zhongmei 1998). In the Yiluo River Basin, which is less than 20 km to the west of Erlitou (the earliest capital of Shang), the regional population increased four times from the Late Longshan to Shang period, and more than 20 times from the Early Longshan (Qiao 2007). This increase corresponds to the population loss in the neighboring regions. Beyond the core zones, all regional surveys show significant population loss (see Table 9.5) and inconsistent settlement patterns from clustered (such as in Huangtucheng) to more dispersed (as in Rizhao and Guan River) during the Shang period.

The regional settlement patterns are related to sites' connections with the royal courts (Li 2008). Chen (2006) analyzes the location of secondary cities and the functions (military defense, transportation, and strategic control) of these cities in relation to the royal court in the Shang period. He also compares several excavated Shang villages outside the core zones and argues that large villages (or towns) were arranged for the convenience of administration, as populations were nucleated in large villages (or towns) and nearby satellite villages.

Liu and Chen (2001) argue that the control of strategic resources strongly influenced the geographic configuration of settlements outside the capital zones. Li's examination of bronze vessel inscriptions suggests that the relocation or establishment of new towns may have been aimed at ensuring political or military control (Li 2008).

The Guan Valley, the Xichuan region, and the Nanyang Basin may have acted as the sites of resource control and political frontier in the political landscape of the Shang and Western Zhou. During the Shang period, there are no signs that indicate that this macroregion was of strategic importance to the royal court. Chen (2006) suggests that the Nanyang Basin was under control of Panlong, a large city near the Yangtze River. Panlong was established to exploit copper resources, which were transported to the Central Plain (Chen 2006; Li and Chen 2001). The easiest transport route was through the waterways from the Yangtze River, to the Han River, Dan River, Luo River, and Yellow River on to the capital of Erlitou (Chen 2006). Shang material culture has been found in many locales along this route. For example, archaeologists have discovered ox scapulae used for oracle bone inscription at Xiawanggang, near the Dan River, suggesting the site's ideological connection with the Shang system (Henan 1989).

In the Western Zhou, the Nanyang Basin became more politically strategic to the royal court. Li (2008) explains the relocation of Nanshen state from the Huai River region in the east to the Nanyang Basin during the Early Western Zhou period as an effort to strengthen the control of the southern border. This notion is supported by the bronze vessels inscribed with the titles of Nanshen's rulers in Nanyang. However, the city of Nanshen has not yet been located. It is also the time that the production of lithic tools reached its peak at the Xiawanggang site, suggesting that the Xiawanggang site was once again actively participating in regional production and exchange networks.

In summary, during the Shang and Western Zhou period, the decreasing population of Guan River, Xichuan, and Nanyang Basin may have been related to population nucleation in the capitals. However, this macroregion was still integrated with the political landscape of the Shang and Western Zhou to ensure resource acquisition and protect the political frontier.

9.5 The Eastern Zhou Period (770-221 B.C.)

In the last chapter, I argued that the Guan Valley during the Eastern Zhou period was organized along strict administrative and defensive lines. As the geopolitical frontier, the political and military organization of the valley was developed to serve the state of Chu, whose capital was more than 500 km away. The Guan Valley was politically significant because the macroregion surrounding the Guan Valley was enmeshed in a multi-faceted inter-regional network. This network was based on rapid urbanization, a new administrative system, more specialized and centralized production, and intense interactions and conflicts between states. An investigation of the role of the macroregion of Guan Valley in this inter-regional network will provide a better understanding of its settlement pattern.

A New Administrative Unit at the Macroregion of Guan Valley: The Founding of *Xian*

Zhang (1988) argues that the Eastern Zhou was a transitional period in terms of human occupation, in which location choice was mainly influenced by the political landscape rather than geographic configuration. The statistical analyses in previous chapters seem to support this argument at the regional scale. In the administrative system, this transition is represented by the founding of the *junxian* organization that replaced regional polities (Xu 2000; Zhang 1988).

The macroregion of the Guan Valley played important role in this transition. By the Western Zhou period, Henan province had more than fifty regional states. Some of these, such as Nanshen, sought to defend against the rise of Chu in the south. Between 700-600 B.C., a large area in south Henan, including Nanshen and Ruo, was incorporated into the territory of Chu, pushing Chu's northern border 300-400 km away from its administrative center (He 1989). As discussed in the last chapter, Xichuan and the Nanyang Basin also served the interests of neighboring states, Qin and Jin. In fact, Nanshen and Xi (another state to the east of Nanshen, sacked by Chu at around the same time) were less than 50 km from the Gui and Jirong districts of Qin. To secure the frontier, Chu turned the conquered states into *xian* (a political structure similar to counties). Although they differ in name, they were not much different from vassal states, where populations consisted of kin-groups. The largest difference is that some *xian*, including Nanshen, were directly administered by the kings of Chu instead of the local hereditary ruler's family. All the tax incomes from these *xian* were used to finance military actions instead of supporting the local elites (He 1989; Zhou and Li 2009).

In the Late Spring and Autumn periods (770-476 B.C.), *xian* were stabilized as the administrative unit with four features distinctive from earlier phases: First, all land belonged to the state king instead of individual families. Second, the administrative position was no longer hereditary. The king could appoint or dismiss officials. Third, the territory was determined politically, not by geographic configuration. Fourth, the administration of *xian* was hierarchical, with *xiang* and *li* as the basic units. In the Warring States period, small, dispersed villages were combined into new *xian*, making them the fundamental administrative units in most states (Zhou and Li 2009).

The Guan Valley, Xichuan, and Nanyang Basin were some of among the earliest *xian* established by the state of Chu. The state of Nanshen in the Nanyang Basin became *shen xian* around 685 B.C.. Lv, which is to the west of Nanshen became *lv xian* around 675 B.C.. *Xi xian* and *shang xian* were set up in the Guan Valley (or the east) and Xichuan (some say the Dan River Valley, or *jun xian* in Hubei) around 613 B.C.. This macroregion is also the earliest to have been sacked by Qin around 290 B.C. (He 1989; Zhou and Li 2009).

***Xian:* Facilitating an Inter-Regional Economic Network**

The transition to *xian* organization encouraged population mobility and the flow of goods inter-regionally. In some cases, *xian* functioned as the major supporters and protectors of long-distance trade. For example, other than military defense, the macroregion was also important as a route for the merchants of Chu and the major cities in the northern states. In fact, the states of Jin and Chu agreed to protect trading routes from the macroregion of Guan Valley to the Central

Plain. One important trading route stretched from Chu to Qin, beginning in the Jianhan Plain and extending to the Nanyan Basin, Xichuan, the Guan Valley, and the Dan River Valley. This route connected two powerful capitals and important cities, Yong and Yueyi. Another important route connected the capitals of Chu and Jin, beginning in the Jianghan Plain, and proceeding to the Nanyang Basin, through the Fangcheng mountain pass into Zhengzhou, and on to the Yellow River. This route also passed through Zhengzhou, the inter-regional transportation hub of the Eastern Zhou period. A third major transportation route linked Chu to Luoyang. It started in the Jianghan Plain and went on to link the Nanyang Basin, Xiang River Valley, and Yiluo River Valley (Ma 1985; see Figure 9.10 for other routes).

In addition, *xian* were major organizers and supporters of large-scale production activities (Liu 1996). Many scholars discuss the highly developed long-distance trade networks and highly specialized production of the Eastern Zhou (i.e. Liu 1996; Ma 1985). Chu was famous for its copper and gold mines, metallurgy, textiles, and lacquer. All production centers were scattered outside the capital and organized at certain *xian*; i.e. shen *xian* was the metallurgy center of Chu. These activities turned *xian* into cities by attracting migrants and market exchanges (Liu 1996). The production and trading of glass items illustrates this highly developed trading network.

Integrating into the Inter-Regional Network: A Case Study of the Production and Trading of Glass Items

The mid-6th century glass beads found at Xiasi in Xichuan were among the earliest glass beads associated with the Chu state. How did glass beads, a non-local item, reach the macroregion of the Guan Valley?

The precise origin and production methods of these glass beads are debated by archaeologists and historians (Zhang 1983). Some believe that the soda-lime glass was imported from Mesopotamia, while the lead-barium glass was produced in China (Zhang 1983). Other researchers argue that the glass products of the Eastern Zhou period were all imported (i.e. Liu 1998). Some archaeologists think that the glassmaking was borrowed from the glaze techniques for pottery-making as early as the Late Shang (Liu 1998). Others contend that the techniques originated from the lacquered bronze vessel technique in the Western Zhou period (Watson 1962).

Nevertheless, most researchers accept that glass-making in China was inspired by long-distance trade with Western Asia. Based on the concentration of glass items in the state of Chu, Zhang (1987) argues that the trading route for glass was not the terrestrial one through Central Asia. Instead, he contends that the glass was transported to India from Central Asia by sea, then brought by merchants in southwestern China to the capital of Chu. In the meantime, lacquer products were traded to the Southwest and Southeast Asia from Chu.

Chu burials yielded more glass items than burials of any other contemporaneous states. For example, the famous tomb of Lord Zeng at Sui xian, Hubei has more than 110 beads and other decorative items made of glass. Most of the glass items were found at Hunan, Hubei, Henan, and Anhui, all of which were located within Chu's territory. The glass artifacts found in other regions were probably either war trophies from or the result of trade with Chu. For example, five glass beads were found at burials in Lu state, Shandong Province. Zhang (1987) argues that they were exported to Shandong from Chu through one of the trading routes through the Xichuan and Nanyang Basin. As Lu was the main salt exporter in the region during the Eastern Zhou, this trading route must have been very important to the people in Chu. The glass beads buried at Xichuan and Shandong were among many items traded through this route. Through trade, the macroregion of the Guan Valley was integrated into this inter-regional exchange network that not only covered Chu and Lu, but also possibly South Asia, India, and Western Asia.

The Eastern Zhou was a transformative period in Chinese history. Kin-based social organizations became political administrative units. The setting of *xian* facilitated state control of regions further away from the capitals. As the political frontier of Chu, the macroregion of Guan Valley was a militarily strategic location. Moreover, the setting of *xian* also facilitated integration of the region into intensive, highly-developed, multi-lined exchange activities between regions, states, and across the continent. The vast exchange network of glass beads provides an example of how intensive and extensive exchange activities were. Despite its marginality, the macroregion of Guan Valley was an active player in the socioeconomic history of the Eastern Zhou.

9.6 The Qinhan Period (220 B.C.- A.D. 220)

In the last chapter, I discussed the population increase and agricultural expansion during the Qinhan period. The regional settlement pattern was a strong manifestation of these two essential processes, which characterized the history of the Guan Valley, its macroregion, and many other parts of China during the Qinhan period. In general, the population increased from six million to sixty million within the two hundred years of the Western Han, which necessitated substantial increases in agricultural production at a similar scale—an annual increase of 1.2% (Ge 2002). Technologies, such as iron tools, draft power, new ploughs, irrigation methods, and an alternative faming system contributed significantly to the increased agricultural yields. Ge (2002) speculates that these technologies helped doubled the yields in the Western Han period. The *dai-tian* method, which emphasizes intensive labor investment in farming, may have heightened the yield eightfold. Other than technology, the administrative measures and markets were the two most powerful tools to address food shortages in the Qinhan period. Both techniques are manifested in the settlement records at the Guan Valley and its macroregion.

Administrative Policies on Agricultural Development and the Issues with National Food Supply

Administrative measure aimed at controlling the population and food distribution were achieved at the national scale through household registry and tax system, as the empire reached an unprecedented size (Ge 2002; Zhang 2006). Inherent conflicts between population, agriculture, and urbanization were mostly resolved locally during the Qin and Han dynasties.

Increasing farmland under production was the priority of economic policies. It was manifested in the settlement pattern of the Guan Valley, where individuals or groups of farmers converted uplands to farmland (see Chapter 7 and 8). In fact, this exploitation of new farmland was national in scale; territory in northwestern China was also transformed into new agricultural zones. With limited drainage conditions, new lands were just enough to support the newly migrated population and the armies in these regions. The Chengdu Basin, secluded by mountains, was also developed into a rice cultivation center during the Han period. Farmers in the Guanzhong Basin and Central Plain (as well as Nanyang Basin) constructed large irrigation facilities from the Eastern Zhou to the Han period, greatly expanding the area of arable land (see Table 9.6). For example, an irrigation project increased 4,500 ha of farmland in 95 B.C. at the Guanzhong Basin. The staggering increase in agricultural yields achieved during the Qin and Han periods suggest that these regions should be able to maintain and support rapid increasing populations for some time (Ge 2002).

Administrative measures also helped balance inequalities of agricultural resources between regions by facilitating the flow of people and goods. In the Eastern Han period, thousands of tons of food were shipped to Guanzhong Basin from the Lower Yellow River Plain each year (Ge 2002). The Yangtze River region had relatively small population (lower than national average, which is 14.73 people/sq.km), in keeping with its relatively basic level of farming technology. As new technologies such as drainage and draft power were introduced, a large population was relocated to the Middle and Lower Yangtze River Plain. Two government-led migrations were documented at the transition from the Western to the Eastern Han and at the end of the Eastern Han. The population increased fivefold in some regions. Still, the Yangtze River region sustained itself; historical documents only rarely record the presence of famine or food shortage.

The resilience of the agrarian economic system at the regional and inter-regional scales was difficult and costly to maintain. The extensive and intensive farming at the Middle Yellow River (including the Guanzhong Basin and Central Plain), caused serious erosion and a series of natural disasters in the Lower Yellow River Plain, one of the most populated regions in China since the Western Zhou period (almost 30 million at the peak during the Western Han). In the two hundred years of the Western Han, the Yellow River burst its bank ten times and rechanneled five times. Five out of eight documented famines were in the Lower Yellow River Plain. Droughts increased as well (Table 9.7). Finally, the Guanzhong Basin's population increased from half a million to 2.5 million (Hsu says 7 million) in the Western Han period and continued to grow until it exceeded the carrying capacity of available farming land in the early Eastern Han (Ge 2002).

In addition to natural disasters that caused regional food shortages, agricultural yields were highly unbalanced intra-regionally (Ge 2002). As shown by tax rates and associated land ranks, fertile lands produced three times more than poor lands on average in Guanzhong Basin (Hsu 1980).

The Economic Network and Its Ability to Support Local Economies

Aside from administrative measures, the market was another powerful tool to relocate the production and distribution of food and necessary household items. A large amount of exchange was conducted at the regional and inter-regional levels during the Han period. On the regional level, other than specialized, large-scale production and urban trading, markets were found in most towns, held by farmers who sold their domestically produced goods in the slack seasons. Such market activity played an integral part of the domestic economy of most of households, and included the production of food and cash crops, textiles, livestock, wine, tools, potteries, etc. The exchange of these products linked scattered households, hamlets, villages and towns into a regional network Hsu (1980:152) describes thusly,

> Family-farm production, therefore, would encourage development of a mercantile agrarianism by which transactions were carried along a treelike structure that seemed to tie the scattered settlements (villages and towns) into a marketing network. Indeed, the geographic area covered by the farmer-trader could be fairly extensive…transactions are conducted within two circles: the larger with a radius of two hundreds kilometers, and the smaller with a radius of fifty kilometers. There are cities, marketing towns, small markets, and side markets, already showing the development of a hierarchical network of trading posts.

Inter-regional exchange mostly took place in cities at a much larger scale and was more involved with the government. Zhang (2011) proposes that 40% of Han's population lived in cities. Cities were production and exchange centers for products that were less likely to be produced within the domestic setting. The city of Wan in the macroregion of Guan Valley was one of the nineteen largest cities of the time, with a population of almost 200,000. Wan was one of Chu's metallurgy centers during the Warring State period. Eventually, metallurgy became industrialized during the Qin and Han periods, after the government forcibly relocated a famous ironsmith, Kong, and his family in the Early Han period. A local official, Du Shi, invented a hydro-power blower, significantly increasing the industry's efficiency. As most metallurgical production was controlled by the government, some families or powerful landlords or aristocrats participated in iron-casting. The increasing need for iron tools made this industry one of the most profitable business since the beginning of the Han period. Documents record that the most merchants were business associates of Kong's family in Wan (Li and Chen 1995).

The discovery of metallurgy sites at Nanyang further confirms historical records that report that Wan was a metallurgical center. A reconnaissance survey found 11 iron-casting sites in the Nanyang Basin, three of which showed evidence of smelting and casting, while the remaining eight were mainly used for smelting. The largest one, Wafangzhuang is close to the city. The site is 600×200 m, with 17 furnaces, four kilns, and other ventilation facilities and crucibles. Furnaces contained more than 300 kg of iron slabs and more than 600 pieces of molds, including those for farming tools, weapons, domestic utensils (mirrors, lamps, and irons), chariot parts, and coins (Li 1991; Figure 9.11).

Some products and molds have marks of either "Yangyi (Nanyang One)" or "Yang'er (Nanyang Two)", indicating that the government controlled the production and distribution of these products. Similar findings in Henan and other regions of China suggest that "Yangyi" were the only workshop to supply the Nanyang Basin and surrounding regions, while "Yang'er" were sold to other regions. Figure 9.12 shows the distribution of "Yang'er" spades outside of the Nanyang Basin. It matches the historical records that Wan monopolized financial and metal provision for 17 newly founded *jun* (districts) in southern and southwestern China (Li and Chen 1995).

During the Qin and Han period, the population faced increasing agricultural shortfalls in some regions. The government adopted administrative measures, including the expansion of farmland, population relocation, food redistribution, and the encouragement of technological innovation, to increase food supply on the national level. Some of these measures manifested in the settlement pattern of the Guan Valley; namely, the exploitation of uplands and dispersed settlements throughout the valleys and mountains.

The vulnerability of the agricultural economy proved too much for these interventions, which were insufficient to address regional food shortages. The market became more interwoven with people's lives as a more flexible means for regional redistribution of resources. Many households produced goods, which they exchanged locally through various kinds of markets. This exchange may have significantly increased the resilience of agricultural economy on a regional level. In addition to such small-scale production and exchange, specialized, large-scale production and distribution carried out in cities helped to link geographically distinct regions into an empire. As a famous production center of iron goods, the Guan Valley systematically produced and traded items with other parts of the empire, indicating how deeply embedded the region was within the empire's sociopolitical system.

9.7 Conclusion

The inter-regional network played an important role in the history of the macroregion of Guan Valley, Nanyang Basin, and Xichuan. This macroregion, although marginal and relatively secluded from the "Cultural Core Zones," was increasingly integrated into inter-regional cultural, economic, and political networks that extended far beyond the macroregion itself.

The inter-regional network was formed as early as the Paleolithic period through the transition of microlithic technology. However, the sociopolitical system that underlay that technological system did not take root in the macroregion. The microlithic technology was soon abandoned, which may have influenced the depopulation of the macroregion from the Pleistocene-Holocene Transition to Early Holocene.

In the Yangshao period, the emphasis on ritual investment was shared by the macroregion, forming a highly integrated social system in this rather geographically circumscribed region. This integrated system attracted population from other regions. The Dan River Valley, which had a mixed population and varied forms of occupation, may have functioned migration route between the Guanzhong Basin and the Guan Valley.

In the Longshan period, contact between different areas of the macroregion intensified and the inter-regional network linked the macroregion with the Jianghan Plain. The “Qujialing invasion” did not accompany the sociopolitical transition that took place in the macroregion in the Early Longshan period. However, this technological invasion was more likely to have been used for the acquisition of exotic goods and raw materials essential to the Jianghan societies. The Guan Valley may have functioned as a gateway in this long-distance trade. Analysis of lithic production shows that Xichuan, although it had a long tradition of specialized tool production, may have not supplied the Jianghan Plain. Instead, another production center in the northern mountains may have been important at this period. When Qujialing material culture disappeared from the macroregion, the northern production center may have become defunct and was likely replaced by producers in Xichuan.

In the Shang and Western Zhou periods, the state-level society in the Central Plain exerted strong influence on other regions. The dramatic population boom in the capitals and their surroundings corresponded to the depopulation of other regions, including the Guan Valley. The macroregion remained integrated in the political landscape of the earliest states in multiple ways, the most important of which were ensuring resource acquisition and stabilizing the political frontier.

In the Eastern Zhou period, the macroregion was integrated into the state of Chu through the establishment of new administrative units known as *xian*. The founding of *xian* facilitated the state of Chu's control over the macroregion. Moreover, as inter-regional exchange intensified alongside urbanization and administrative development, *xian* also facilitated integration into intensive exchange that linked regions, states, and even opposite ends of the continent.

In the Qinhan period, residents sought to manage the disjuncture between population levels and agricultural production through administrative policies and market activity. Governments encouraged increased land exploitation and relocated the population to balance resource inequalities on a national level. However, markets also became increasingly important means for redistributing local resources. In the meantime, specialized, large-scale production and distribution linked geographically separate regions into an empire.

Table 9.1 Yangshao settlement clusters and hierarchies in some regions. Jing, Gan, Qi, Wei Rivers are mentioned in the chapter as the origin of population movement (Gong 2003; Chinese 1991; Xu 2001)

Source	Province	Regions with Yangshao Cultures	Total number of sites	Supra: >50 ha (some large sites)	Large: 30-49 ha (some large sites)	Medium: 10-29 ha	Small: <10 ha
	Gansu-Shaanxi	Upper Wei River	136		2(36&40)	8	24
		Upper Jing River	260		1(36)	4	195
	Shaanxi	Yong, Wei, Qian, Wei Rivers	526	8(70, 80, 80, 50, 50, 50, 50)	4 (unclear)	28	309
		Jing, Gan, Qi, Wei rivers	275	7	5	21	113
		Shichuan River	86	1	3	9	34
Gong 2003		Southern Wei River	232	5	6	12	96
	Shaanxi-Shanxi	Northern Luo and Yellow River	301	5(120)	4	30	136
	Shanxi	Shu and Fen River	61	3(150)	4	15	39
		Hong and Jian River	141	6 (140)	2	11	48
	Henan	Yi and Luo River	229	4 (150)	4	25	127
		Ying and Yellow River	88		2	9	57
		Qin and Mang River	53	2		6	32
Chinese	Shaanxi	Dan River	29		1	3	25
Xu	Henan	Nanyang Basin	52		2(30&25)	6	44
2001	Henan	Xichuan				1	19

Table 9.2 The lithic assemblage from the Huangshan regional survey (Jiang et al. 2008).

Lithic collection	Chipped	Fu axe	Chan spade	Spade shape tools	Flake	Cutting tool	Sraper	Plate-shape object	Zu arrowhead		
		22	120	8	3	3	1	2	1		
	160	14%	75%	5%	2%	2%	1%	1%	1%		
	Grounded	Fu axe	Chan spade	Spade shape tool	Ben axe	Zao drill	Lian sickle	Dao knief	Zu arrowhead	Ball	Chui hammer
		13	168	12	3	14	4	4	2	1	3
	224	6%	75%	5%	1%	6%	2%	2%	1%	0%	1%

Table 9.3 The quantity of lithics, ceramic and bone artifacts of different phases from Laofengang (LFG), Huanglianshu (HLS), Xiawanggang (XWG), Donglongshan (DLS), Zijing (ZJ) and Dazhangzhuang (DZZ) (Periods: YS: Yangshao; QJL: Qujialing; LS: Longshan; S: Shang; WZ: Western Zhou).

	Lithics	Ceramics	Bones
LFG_YS	345	966	314
HLS_YS	32	68	37
XWG_YS	1254	1402	418
DLS_YS	42	46	47
ZJ_YS	10	54	8
DZZ_YS	7	67	0
HLS_QJL	226	524	221
XWG_QJL	150	207	106
ZJ_QJL	0	14	0
HLS_LS	152	213	88
XWG_LS	486	434	243
DLS_LS	44	81	27
ZJ_LS	22	26	11
XWG_S	278	257	189
XWG_WZ	327	133	138

Table 9.4 A comparison of the size of the largest sites between pre-capital period and capital period in core zones showing the rapid increase in site size.

Period	Region	The size of capital (ha)	Largest site in previous phase (ha)
Pre-Shang	Yiluo	60	20
Shang	Luoyang	5.4sq. Km	50
Shang	Yinxu	24 sq. km	15
Western Zhou	Zhouyuan	32 sq. km	112

Table 9.5 A comparison of largest site size between Shang and Pre-Shang period in other regions showing occupation decreased during the Shang period.

Region	Largest site in Shang period (ha)	Largest site in pre-shang Period (ha)
Rizhao	2.9	367
Huangtucheng	10	30
Guan River	0.8	23.9

Table 9.6 The irrigation projects mentioned in historic documents show that the distribution is uneven spatially.

Irrigation projects in Han	
Shaanxi	18
Henan	19
Shanxi	4
Hebei	5

Table 9.7 Occurrences of droughts and floods in the historic documents show that the droughts and floods were much more frequent in the later period than earlier.

Period	Droughts	Floods
722-480 BC	14.23	22
246-180 BC	9.4	22
179-141 BC	7.8	9.75
140-87 BC	4.07	9.38

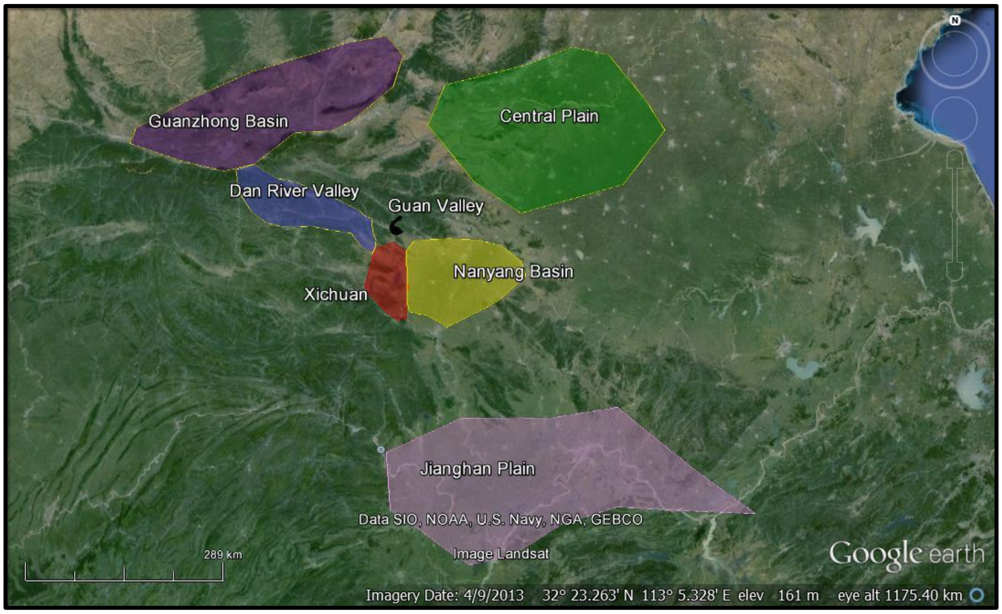


Figure 9.1 Regions mentioned in this chapter.

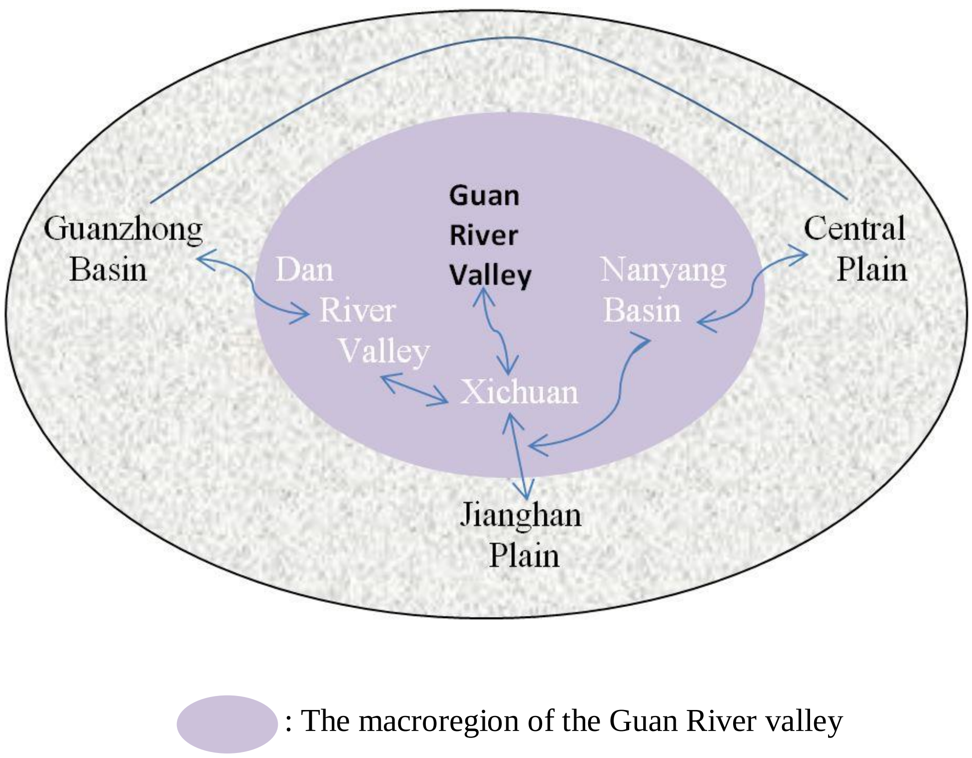


Figure 9.2 The macroregion of the Guan Valley and inter-regional connection through the macroregion.

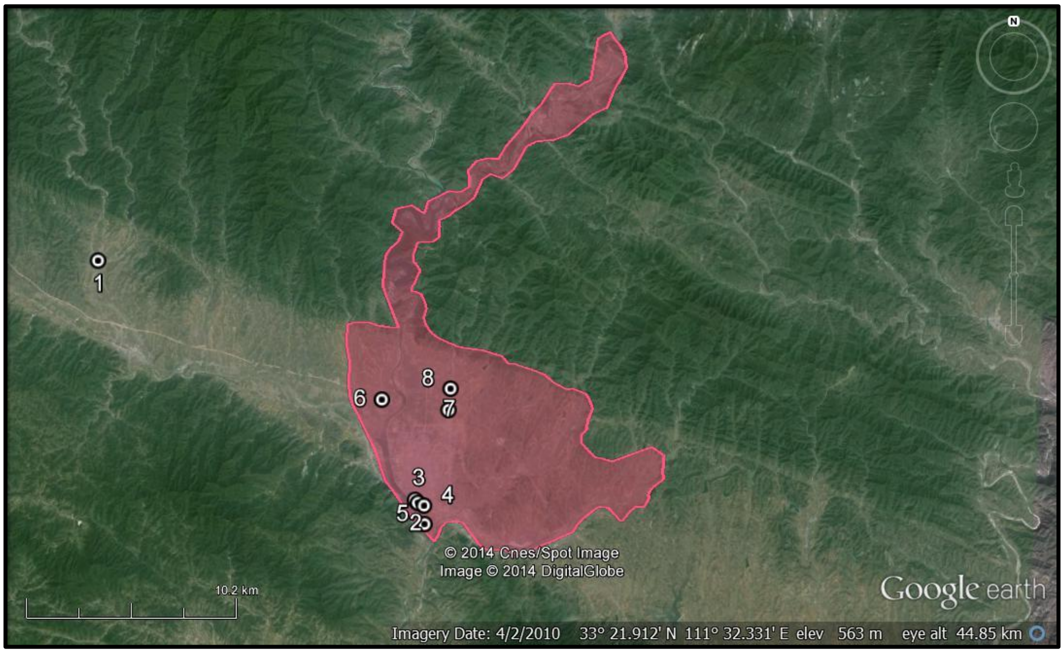


Figure 9.3 Paleolithic localities in Xixia (Pei and Song 2006).

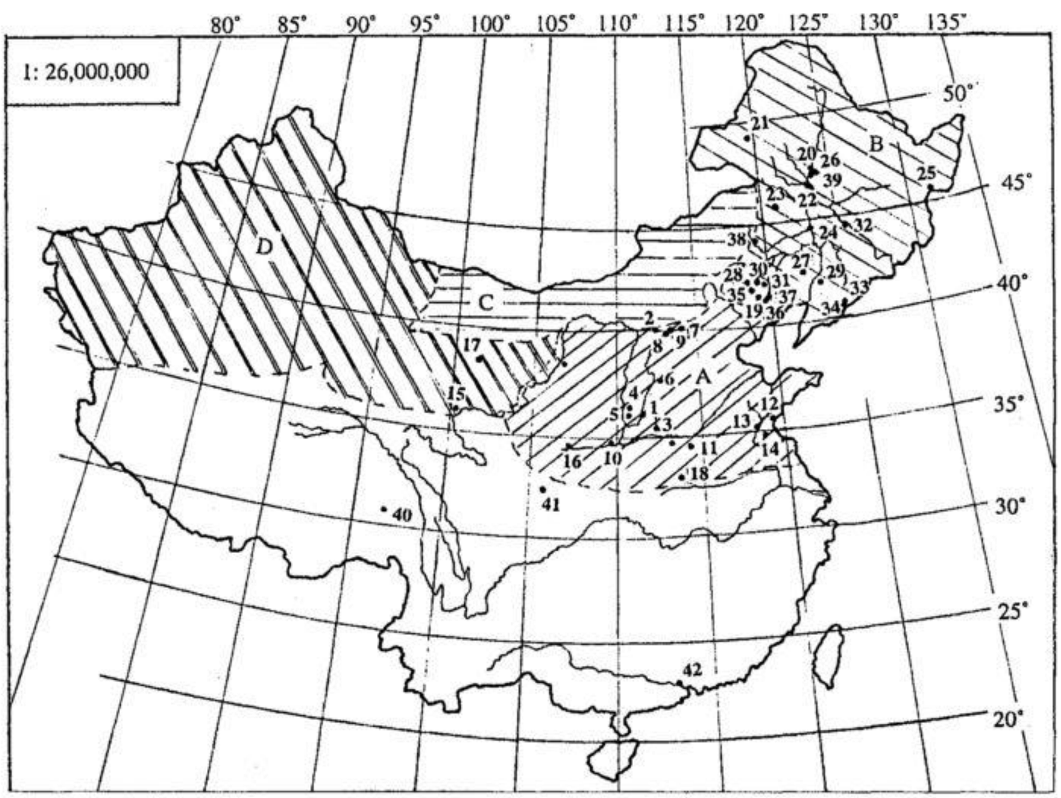


Figure 9.4 The distribution of microlithic localities in China (from Lu 1998: Figure 9. 1).

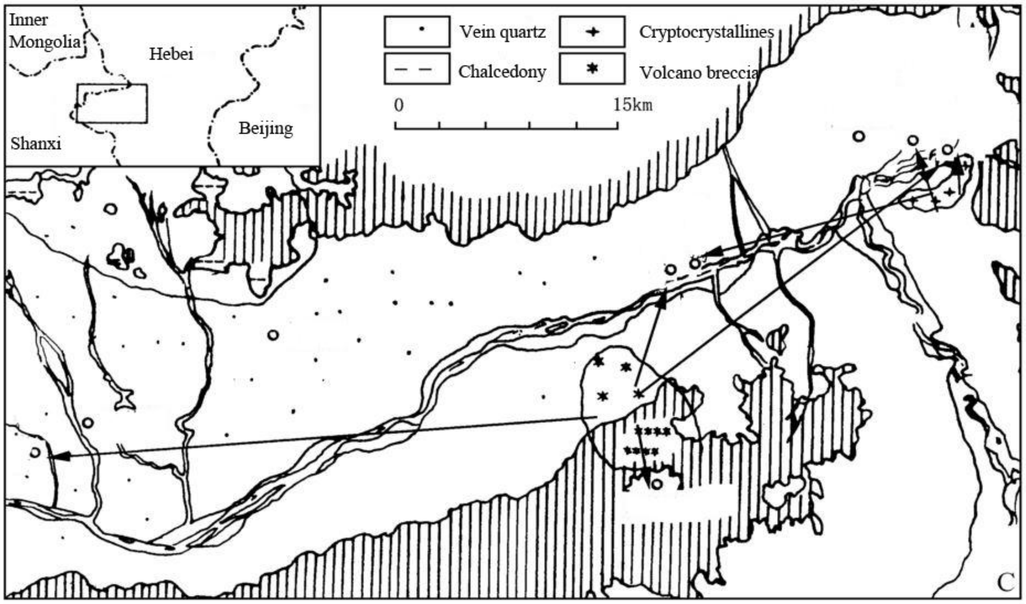


Figure 9.5 The distribution of sites and cryptocrystallines in the Nihewan Basin (from Du 2003: Figure 9. 2c).

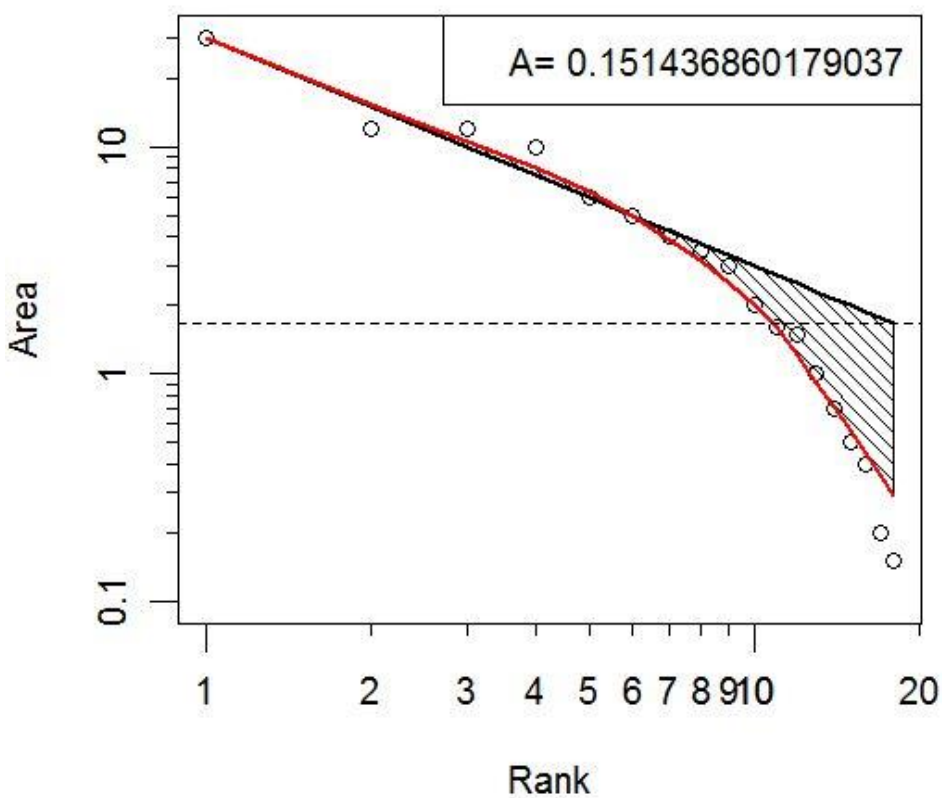


Figure 9.6 The rank-size graph of Yangshao settlements at the Dan River Valley.

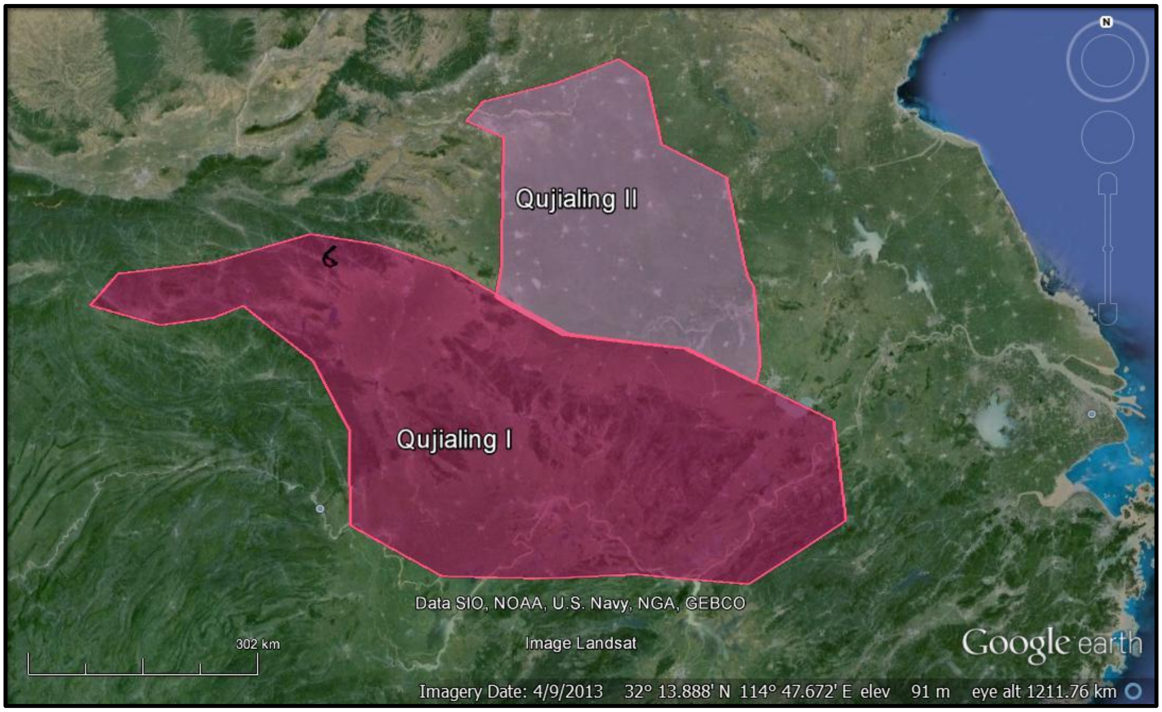


Figure 9.7 The distribution of sites (to the north of Yangtze River) with Qujialing material features in the periods of Qujialing I and Qujialing II.

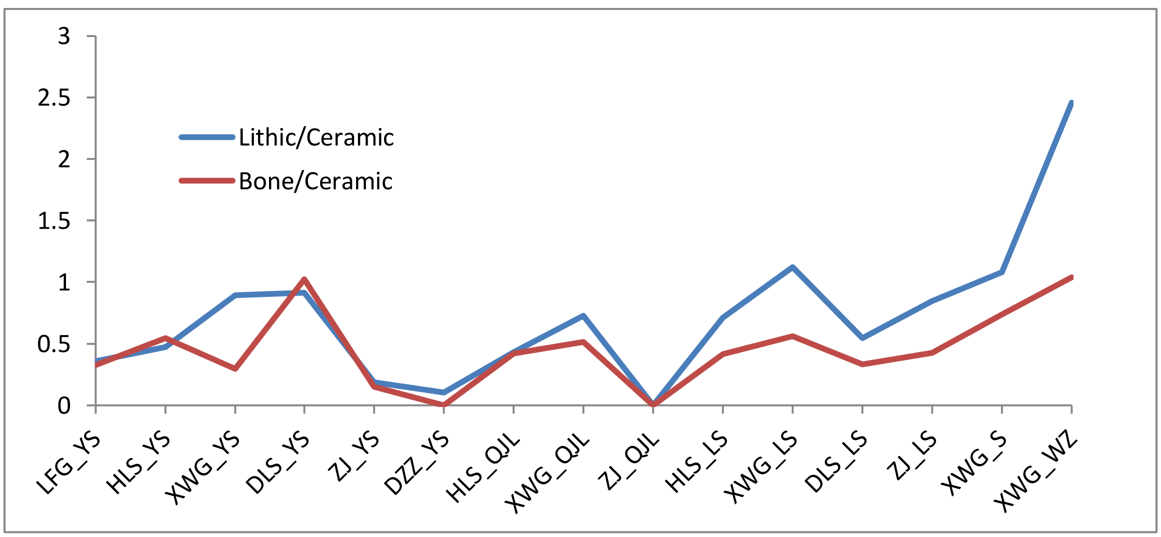


Figure 9.8 The ratios of lithic/ceramic and bone/ceramic showing degree of centralized production in different periods at Laofengang (LFG), Huanglianshu (HLS), Xiawanggang (XWG), Donglongshan (DLS), Zijing (ZJ) and Dazhangzhuang (DZZ) (Periods: YS:Yangshao; QJL:Qujialing; LS: Longshan; S: Shang; WZ: Western Zhou).

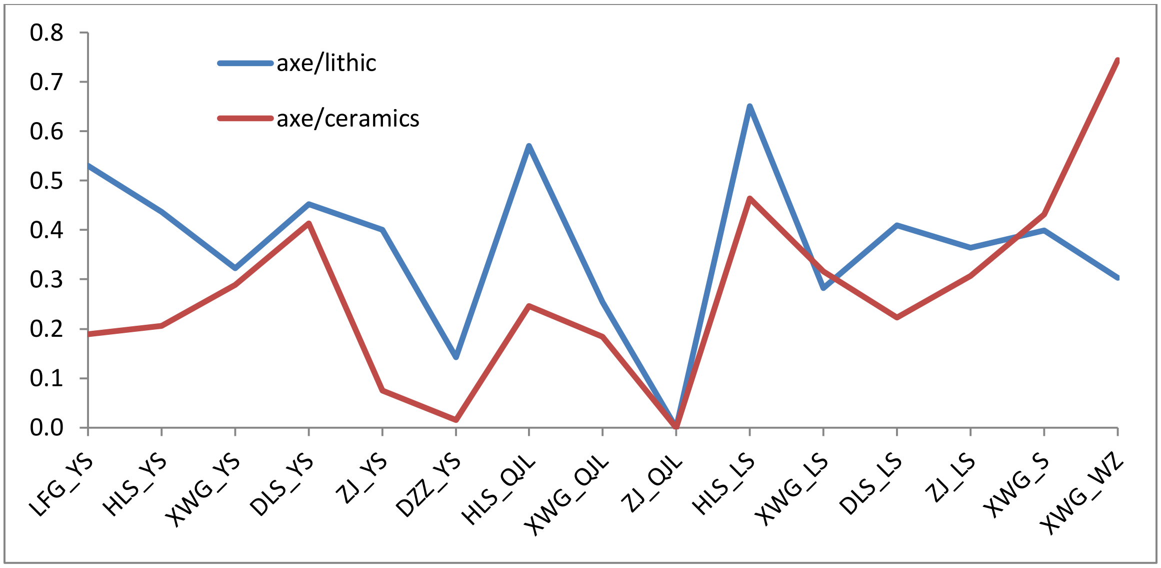


Figure 9.9 The ratio of axes/lithics and axes/ceramics showing the production of axes in different period at Laofengang (LFG), Huanglianshu (HLS), Xiawanggang (XWG), Donglongshan (DLS), Zijing (ZJ) and Dazhangzhuang (DZZ) (Periods: YS:Yangshao; QJL:Qujialing; LS: Longshan; S: Shang; WZ: Western Zhou).

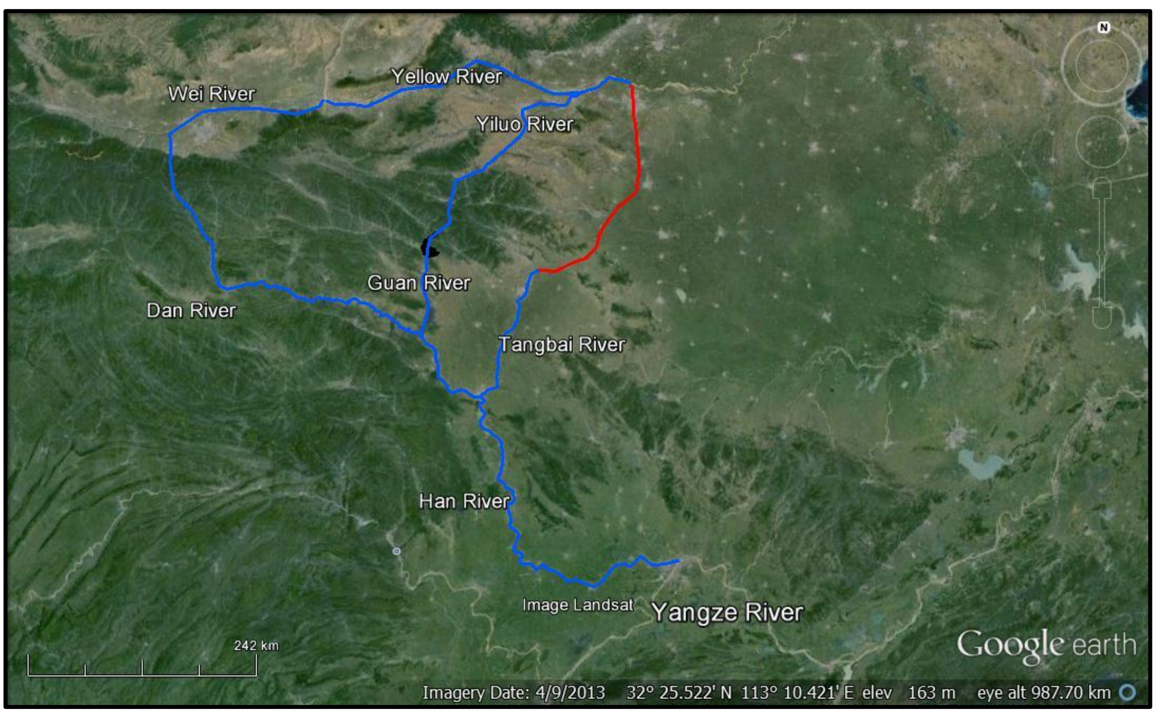


Figure 9.10 Some of riverine routes connecting the Yangtze River to the Yellow River (blue lines are trading routes through waterways; red line is the terrestrial routes through Nanyang Basin).

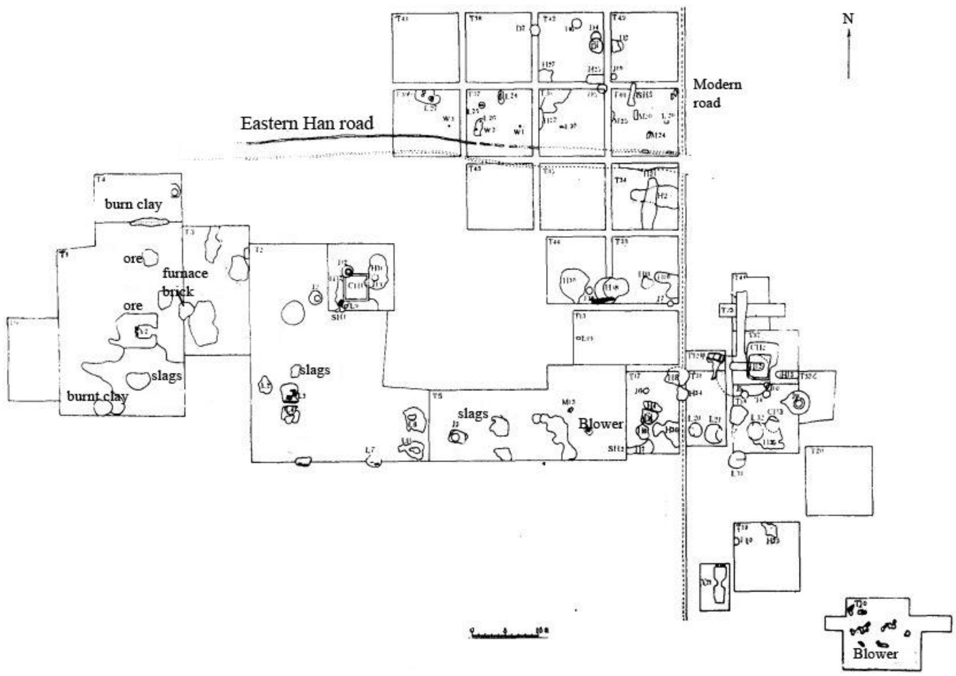


Figure 9.11 The excavation of Wafangzhuang workshop (from Li 1991)

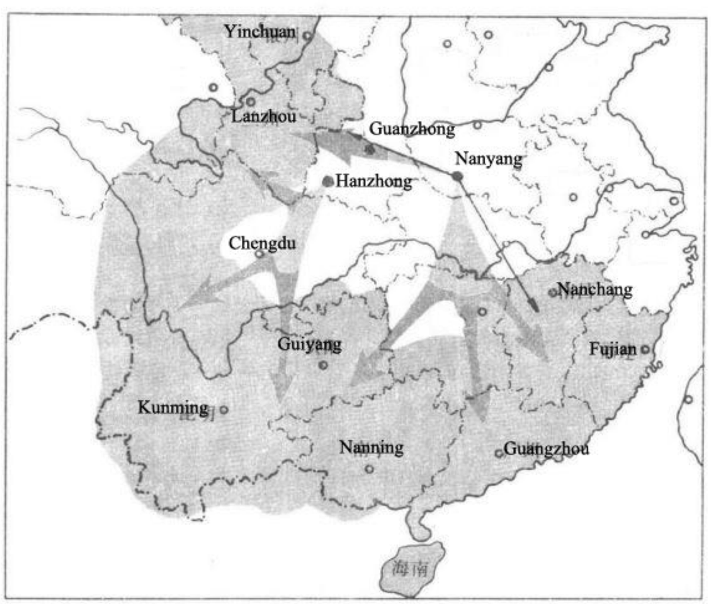


Figure 9.12 The distribution of "Yang'er" iron products (from Li and Chen 1995).

CHAPTER 10

CONCLUSION

This study of the regional history of the Guan Valley addressed the questions of how settlement pattern, land use practices, and inter-regional integration influenced the trajectory from a collection of autonomous villages to an integral part of empire. To observe these changes from an evolutionary perspective, I adopt Blanton et al.'s (1993) framework that focuses on the interplay between societal scale, integration, and complexity. My analytical procedures attend to multiple spatial scales: the land use practice analysis was based on individual settlements and their immediate ecological conditions; the social integration analysis examines sociopolitical trajectories at the regional scale; and the inter-regional network analysis examined the relationships between multiple regions. My study reveals that occupation and land use practices were strongly adapted to local ecological and cultural contexts. Also, inter-regional integration played an important role in shaping the occupation and land use history at the valley. Such multi-scalar analyses demonstrate that a single evolutionary sequence cannot adequately capture the broader processes of sociocultural evolution, which depend on cross-scalar relationships and mechanisms of change.

Settlement Patterns

Through their attention to settlement patterns, regional full-coverage survey methods provide crucial insight into and empirical documentation of history of human occupation as it unfolded across the landscape. Settlement patterns are also manifestations of all kinds of social, political, and economic processes that influence human occupation. In the Guan Valley, settlement patterns show more structural variation between the settlements of historic (after 1900 B.C.) and prehistoric periods (before 1900 B.C.) and more incremental changes in settlement patterns within prehistoric and historic periods. The number of occupations and their geographic areas were high in the Late Yangshao period, decreased during the Longshan and Shangzhou periods, recovered rapidly in the Eastern Zhou period, and reached a second peak during the Qinhan period. Settlement hierarchy across these periods varies from one to four tiers. Settlement aggregation was stronger and more bounded during the prehistoric period than the historic period, in which settlement organization was more hierarchical, specialized, and structured. The central place was formed as early as the Late Yangshao period, relocating to the east side of the Guan River during the Eastern Zhou period. Settlements were concentrated first along the rivers and gradually expanded inland over time. Human expansion into the montane area began with the establishment of dispersed hamlets as early as the Longshan period and expanded and nucleated during the Eastern Zhou. Occupation intensity, which differed from settlement to settlement, was generally higher during the prehistoric periods than the historic periods.

Land Use Practices

The Guan River valley is characterized by environmental patchiness. Located within the Eastern Qinling Mountain Range, the region is bounded by mountains and is comprised of many eroded terraces and hills and alluvial plains along the rivers. The ecological conditions are not ideal for agriculture, posing challenges which have encouraged land use adaptations that are in clear contrast to those of farmers on the broad alluvial plains to the east and south.

Statistical analysis in Chapter 7 shows that land use practices were more tied to environmental conditions in the prehistoric period than in the historic period. Avoiding periodic flooding may have been the greatest influence in the formation of regional centers in the prehistoric period when occupations were mostly concentrated along the rivers. Over time, residents placed a greater emphasis on the use of montane resources in the historic period. Factors influencing settlement location choice varied for settlements of different tiers and sociopolitical organization. Interestingly, some farming conditions that are important to modern farmers, such as soil or aspect, do not have appeared to have played a significant role in determining settlement size and hierarchization.

Inter-Regional Integration

Culturally speaking, the Guan Valley region was located at the intersection of three major "Cultural Core Zones" of ancient Chinese civilization: the Central Plain, the Jianghan Plain, and the Guanzhong Basin. The Guan Valley was in various senses marginal to all of these three cultural centers. Its geographic circumscription hindered easy contact with the cultural centers. Yet various routes were established to connect the valley to points beyond, leading to the formation of macro-regional relationships. The Guan Valley was thus subject to multiple, overarching processes of change and influence, which fluctuated in intensity between the valley and external centers.

Such inter-regional processes shaped social organization and land use practices in the Guan Valley. The central place formed in response to inter-regional flows of people and ideas during the Late Yangshao period and was maintained as gateway center through inter-regional exchange activities during the Longshan period. The seemingly sporadic, indirect, and unsteady nature of inter-regional interactions in the historic period was altered. The emergent state level society intensified and administered inter-regional integration, leading to increasing organizational complexity in the Guan Valley as a military frontier and an important hub for trade during the Eastern Zhou. In the Qinhan period, the settlement system of the Guan Valley was a miniature empire, with the development of administrative and economic organizations that increased agricultural production and balanced resource distribution.

The above review of settlement patterns, land use practices, and inter-regional integration answered research questions that were proposed in Chapter 1. In the following section, I connect each of the three research objectives to reconstruct a period-to-period reconstruction on the regional history of the Guan River valley.

The Late Yangshao period (3500-2900 B.C.)

After the establishment of the first occupation in the Guan Valley during the Middle Yangshao period (4000-3500 B.C.), the settlement pattern of the Late Yangshao period was characterized by a rapid formation and expansion of a regional center, the inhabitance of all Guan River tributaries, and the high degree of settlement clustering (Chapter 5). The population grew from 50 to more than 3000 people during this period (Figure 6.1). The regional center was comprised of 25 ha of terraces in Yanggang, which were surrounded by few nearby hamlets. Other than the Yanggang communities, all other occupations were located to the east of the Guan River. These other communities were spread out along the upper reach of the Guan River and more densely clustered along its major tributaries. Other than the paramount size of regional center, secondary centers of varying sizes clustered to form local communities with 4-5 hamlets per watershed (Figure 5.2; Table 5.1).

All settlements were in close proximity to the watercourses for convenient access to water and alluvial soil. Economic and political centers tended to be located on elevated lands—

terraces, mounds, or ridge tops, while most of satellite villages and hamlets were positioned on flood plains. As indicated by the land use analysis in Chapter 7, there appears to have been a rather strong concern for flood risk, a concern shared by contemporary farmers. Among all seven environmental variables, including catchment area, distance to waterways, soil, landform, slope, flow accumulation, and aspect, the distance to water and catchment areas are the two variables that correlate most closely with each other and with settlement location (Table 7.3).

The land use analysis points out that the settlement area increased as distance to waterways increased (Table 7.9). This positive correlation means that although all occupations were close to rivers, larger settlements were more likely to have been further from rivers, to have had larger catchments, and sometimes more cultivable landforms. This practice of locating centers away from rivers may have been another strategy to minimize the risk of flood.

Settlement location seems to have been influenced by proximity to preferable farming conditions such as larger catchment and access to alluvial plains. Agriculture was the dominant subsistence strategy during the Yangshao period; however, other evidence also suggests that fishing and other food collections may also have been important. Some occupations were near the river banks and residents may have used them for fishing or other riparian resource acquisition. Also, the agricultural capacity analysis shows that more than 20% of settlements were unable to support their populations with millet from their surrounding catchments, implying the presence of other subsistence practices or exchange (Figure 7.9).

Given the relationship between agricultural and population size, the regional center, LYS1, at first glance, would seem to have faced food shortage. However, this center somehow maintained its paramount size into the next period, suggesting that the economic risk of food shortage was overcome by other means. I argue that LYS1's primacy over the Guan River was the result of shared corporate strategies based on ceremonialism. The same strategies also led to the expansion into the Guan tributaries and the highly clustered settlement pattern during this period (Chapter 8).

My study of regional integration suggests that in addition to an increase in population, the region went through a sociopolitical transformation. At Laofengang, a site near the Guan River valley, the practice of stone-slab burial disappeared and long houses, a tradition that was popular in the broader macro-region of Guan Valley, became increasingly. My analysis reveals that this change in cultural practices may have represented a process in which communal basis of group identity through ceremonial practices was gradually weakened. In the meantime, integration was achieved through the building of corporate relationships between sub-groups of the community, toward which people diverted their social investments (Chapter 8).

At the regional scale, this transition was manifested by the rise and supremacy of LYS1 and the relationship between LYS1 and other communities along the tributaries. LYS1 may have been built on ceremonial authority that increased intra-regional interactions and strengthened regional integration. By performing ceremonial services, LYS1 would have maintained and enhanced its primary status. Judging by its size, LYS1 may have overpowered nearby areas as well. Despite its ceremonial role, however, LYS1's political or economic control over the secondary centers on the other side of the Guan River and beyond may have been relatively weak (Chapter 8).

The population increase and areal expansion of LYS1 may have led to expansion of its control into the unoccupied areas of the Guan Valley. Organized by the same corporate strategy, new communities began to aggregate in clusters and were perhaps colonized by kin groups. Separated by the Guan River, LYS1's influence over the new colonies was weak. The sociopolitical integration of sub-groups, established directly or indirectly through ceremonial connections with the regional center, further contributed to the supremacy of regional center (Chapter 8).

The sociopolitical integration of the Guan Valley was not an isolated phenomenon and involved connections with neighboring and distant regions. My investigation of the inter-regional network shows that the population growth in the Guan Valley during the Late Yangshao period was possibly due to population movements from the neighboring Dan Valley and more distant Guanzhong Basin. The less integrated settlement system and mixed material culture traditions of the Dan River Valley suggest that the valley was possibly an avenue connecting different regions, including the densely occupied Guanzhong Basin and Guan Valley. The ceremonial focus of the Guan Valley was shared by the neighboring Nanyang Basin, whose residents developed a systematic jade production and distribution system. This macro-regionally shared emphasis on ceremonialism contributed to increased macro-regional integration and social complexity (Chapter 9).

During the Late Yangshao period, both land use practices and increasing regional integration contributed to the increasing regional integration to shape settlement patterns. Land use practices emphasized the minimization of flood risk and maximization of land resources. The food problem at the regional center was compensated for or resolved by regional integration, which maintained the supremacy of regional center and ensured the aggregation of communities along tributaries. The interaction between these two sets of strategies was closely related to the rapid population increase in the valley.

The Longshan Period (2900-1900 B.C.)

The Longshan settlement pattern inherited most traits from the Late Yangshao period, but with some variations. The occupation at the Yanggang terraces was still the largest, though it shrank slightly from 25 ha to 24 ha. Settlements were more aggregated in some areas, while more dispersed in other areas. A three tiered settlement hierarchy and clustered distribution continued to characterize the regional settlement pattern. Riverbanks were still favored for settlement location, however secondary-centers decreased in number and size. Additionally there appears to have been more intensive use of alluvial plains compared to the previous period (Chapter 5; Figure 5.5; Table 5.2).

The land use analysis shows similar continuity, also with some variations. As most settlements were in close proximity to rivers, distance to the river still played an important role in the ecological setting of settlement location (Table 7.5). The distance also correlated with settlement area as in the previous period, but the correlation decreased in significance (Table 7.10). This suggests that the concern for flood risks was inherited from the previous period but reduced in importance. The area of catchment, in turn, correlated more significantly with settlement area, a finding which coincided with the visual inspection of an intensive occupation on the alluvial plain (Table 7.10). This increased emphasis on alluvial plain resources may have also contributed to increased agricultural production, as agricultural capacity rose much higher. Only 12% of settlements were unable to produce enough cereal from their surrounding catchment, which was less than half of previous period (Figure 7.9).

As the regional settlement pattern and land use show more continuity rather than change from the previous period, some evidence suggests that changes in inter-regional interactions led to different and more subtle social integration strategies. The “Qujialing invasion” describes the expansion of material cultural traditions, the Qujialing, from the Yangtze River regions into other regions during the Early Longshan period (2900-2500 B.C.). As one of the earliest regions to develop Qujialing material culture outside the Yangtze River Valley, the social organization largely stayed the same in the Guan Valley and the macro-region. The greatest impact brought by this material culture transition was the development of heterogeneity between communities.

In the Guan Valley, the sherd density and distribution suggests that the intensive use of alluvial plain occurred alongside a more extensive occupation in the montane area of the upper part of the valley (Chapter 5; Figure 5.14). The occupation density increased in the upper valley, but there was no sign of a regional center in the upper reach. In the lower reach, there were also few occupations dispersed on the alluvial plain that were not associated evidently with any clusters. This dispersal pattern contrasted with the highly nucleated occupation pattern of the regional center and some other communities.

Evidence of occupation variation is evident inside regional center. As the regional center, LS1's supremacy was maintained until the Late Longshan period. However, this occupation developed a different settlement organization; there appears to have been an open space close to 2 ha at the center of the occupation, dividing it into two sectors (Figure 5.25). This separation within the settlement was similar to a type of dual-settlement organization in the Middle Yangtze River region, where some large centers contain two separate living areas.

In the macro-region, my review shows significant intra-regional variation in technological, social, economic, and ideological realms, even among neighboring sites (Chapter 8). Other than cultural heterogeneity, the "Qujialing invasion" did not correspond with replacement or other cultural transformation. Thus, settlement pattern and land use practices show more continuity from the previous period (Chapter 9). Zhang (2003) argues that the

"Qujialing invasion" was more likely to have facilitated acquisition of exotic materials that were essential to Jianghan Plain societies, and was not reflective of population migration or cultural assimilation. Other regions were woven into the inter-regional network that facilitated trading and resource acquisition.

The involvement of the Guan Valley and macro-region in an inter-regional network led to the developmental heterogeneity in the region. In the Guan Valley, this process led to the formation of a gateway system, which maintained the primacy and population nucleation at LS1. It may have also created differences in occupational intensity through communities' interaction with the gateway communities and their participation in the network (Chapter 8). For example, the second largest and most densely occupied community, Majiayingy, can be easily accessed from LS1 (Chapter 5: Figure 5). Distant settlements were more dispersed and smaller in size.

Zhang (2003) speculates that, the need for lithic raw material was perhaps one of the reasons for the "Qujialing invasion" into the macro-region of Guan Valley, which also occurred in the Three Gorge region. The production and distribution analysis shows that, although there was a long tradition of specialized production of lithic and bone tools at Xiawanggang, Xichuan region, this production center may have supplied only neighboring areas. The supremacy of the regional center suggests that there could have been another production center located to the north (Chapter 9).

A dramatic decrease in the number of occupations occurred during the Late Longshan (2500-1900 B.C.) and corresponded with the disappearance of material cultural traditions from the Yangtze River regions, known as the "Qujialing retreat." In the Yangtze River region, the state, or paramount chiefdom of Shijiahe collapsed. In the Guan Valley, settlements dwindled to three (Figure 5.4). The difficulty of maintaining the network may have led to the collapse of the regional center and settlement system in the Guan Valley (Chapter 9; Blanton et al. 1996). Meanwhile, Xiawanggang, the site which provided products locally, expanded lithic and bone production and successfully maintained its population and occupation density in the Xichuan region (Chapter 9).

In general, other than more intensive agricultural practices, the settlement pattern and land use practices lasted from the Late Yangshao to Longshan period. However, the "Qujialing invasion," which was a network-based inter-regional communication and trade system, contributed to increased intra-regional heterogeneity in the valley, increased organizational complexity at the regional center, differences in occupational intensity, and the formation of a gateway system. It also led to structural variations between sites in the social, economic, ideological realms at the macro-regional scale.

Shang to Western Zhou Period (1900-771 B.C.)

Small, dispersed settlements and low occupation density characterized the regional settlement pattern (Chapter 5). However, considering the rapid population decrease at the Late Longshan period, occupation actually recovered from 3 to 11 locations during Shangzhou. As there is not much information on the settlement pattern of the Shangzhou period, inter-regional analysis suggests that the low occupation density of the Guan Valley corresponded to a high degree of population nucleation at the centers of the early states of the Central Plain. This low occupation density was not unique to the Guan Valley. Many regional studies on non-Central Plain regions show similar population decreases during this period (i.e. Ren 2008; Underhill et al. 2008). Even in the Central Plain and Guanzhong Basin, where the early states were located, once the capital was relocated, the old capital shrank and new capital expanded quickly and dramatically, indicating that state centers developed a strong sociopolitical gravity that attracted a large population (Table 9.4).

In addition, the macro-region was integrated into the political landscape of Shang and Western Zhou to ensure resource access and protect the political frontier (Chapter 9). As Liu and Chen (2001) argue, the control of strategic resources strongly influenced the geographic configuration of settlements outside the capital zones. The macro-region of the Guan Valley was located along the transportation route that connects the copper reserves of the Yangtze River region with the political centers of the Central Plain. Ox scapulae used for oracle bone inscription were found at Xiawanggang, a sign of Shang's ideological system (Henan 1989). In the Western Zhou, the Nanyang Basin became a political frontier to the royal court at the Guanzhong Basin.

The Eastern Zhou Period (770-221 B.C.)

The Guan River Valley was a geopolitical frontier between the states of Chu and Qin. The settlement system went through a series of changes very different from those of the Neolithic period. Settlement number, size and hierarchy all increased rapidly. The spatial pattern and settlement system structure also changed. The largest settlement (about 47 ha) was located in the montane area near the river's upper reach. The administrative center was a 17 ha walled city located east of the Guan River on the alluvial plain. Instead of settlement aggregation, functional differentiation appears to have occurred. Occupations expanded further inland to marginal areas (i.e. uplands and eroded valleys; see Chapter 5, Figure 5.7).

As the settlement system became more complex, land use practices also show that environmental variables seem to have played a much less significant role in settlement location selection? Flood risk was no longer a major concern. There was a series of occupations on the banks of the Guan River. Sloping lands and landforms of hills and mountains correlate more significantly with settlement areas, which indicates that there were more and larger occupations at elevated areas, including hills, eroded terraces and mountains (Table 7.12). This increased occupation in the hills and mountains may have been related to population growth and the threat of warfare (Chen 2012). Both factors led to a low agricultural capacity. Almost 25% of settlements were unable to produce enough millet with their surrounding catchment land (Figure 7.9).

A review of the archaeology of the Guan Valley and Eastern Zhou shows that the region was incorporated into the state of Chu during the Eastern Zhou and was maintained as a military frontier until it was sacked by Qin. Archaeologically, the regional settlement system was organized for the purpose of administrative control and military defense. Compared to the Yanggang terraces, the location of the administrative center on the east of Guan River was more convenient in terms of regional administration, communication, and movement of goods, labor, and information between the center and peripheries. Other than the separation of administrative and residential areas, there was also a cemetery, gateway administrative office, and refuge sites. The largest occupation, which was located along the river's the upper reach, developed into a refuge or resource exploitation site. The expansion of this occupation intensified communication and transportation between the upper reach and lower reach, encouraging the establishment of more occupations along the river (Chapter 8).

All of these spatial arrangements are mentioned in the historical records that speak of the Guan Valley as a military frontier during the Eastern Zhou period. The administrative center focused on controlling the local population and maintaining stability during wartime, while agriculture may not have been a major emphasis. For example, one of the most productive farmlands in the region, the fluvial plain of the Badie River, was abandoned. Some settlements in higher, agriculturally marginal areas in the mountains were occupied as shelter in times of stress and as a source of new farmlands. The exploitation of marginal lands generated alternative agricultural practices, which grew significantly in the next period (Chapter 8).

The settlement pattern of the Guan Valley reflected the increasingly rapid inter-regional integration in the Eastern Zhou, which was characterized by urbanization, new administrative systems, and intense interactions and political confrontations. *Xian*, the fundamental administrative unit of the new hierarchical, centralized administrative system, redefined the geopolitical landscape and facilitated the reorganization of settlement system. The establishment of *xian* at the Guan Valley led to the area being functionally reorganized as a military frontier. It also connected the valley with other regions, states, and even other parts of the continent through complicated long-distance trading networks. As described in historic documents, the Guan Valley was one of the most important trading routes for merchants of Chu and the major cities of the northern states (Chapter 9).

The settlement pattern went through major transformations during this period. Despite an increase in area, number, and hierarchy, an administrative center was formed that organized the settlement system by function. This spatial arrangement was a product of multiple interlocking processes, mainly population increase and sociopolitical competition. As one of the results, land use practices were also influenced by social factors.

The Qinhan Period (220 B.C.-A.D. 220)

High occupation density and low occupation intensity were two of the main features of the Qinhan settlement pattern. Occupations increased unprecedented number and area to unprecedented levels (Figure 5.8). The largest settlement in the montane area of the upper reach expanded to almost 64 ha. The administrative center remained in use and included part of the northern hills, expanding to 20 ha. Second-tier settlements of 1 to 10 ha decreased in number, while small occupations of 0.25 ha increased in number and expanded into what was previously a remote area of valley floors and piedmont. In contrast to increasing occupation area, the low occupation intensity is represented by the lowest ceramic density of all time, suggesting fewer occupants or a shorter occupation period (Figure 5.14). The contrast between occupation density and occupation intensity indicate that the nature of occupation went through a dramatic change from a nucleated to dispersed occupation of shorter duration.

The increased emphasis on the use of hills and mountains is also supported by land use analysis. However, the concern for flood risks had an important influence on land use (Table 7.7). Landform correlated more significantly with settlement area in a negative direction, perhaps suggesting that larger settlement size likely accompanied unfavorable landforms, which included eroded terraces, hills, and mountains (Table 7.13). This correlation may have been biased by the overrepresentation of the montane occupation, Xiaoshui, which was the largest occupation of the time.

As hamlets increased and centers decreased in number, population nucleation also weakened. Population dispersal increased regional agricultural capacity. Compared to previous periods, there was a greater area of farmland in use (Figure 7.11). However, the agricultural capacity was still low as more than 20% of settlements were unable to produce enough millet with their surrounding catchment (Table 7.8). Other than population dispersal and an increase of farmland, the market may have also played an important role in resolving the food production problem.

The reorganization of regional settlement hierarchy suggests that settlement system of the Eastern Zhou period was altered. Rank-size graphs show increasing primacy (Figure7.1). As the largest site of both periods, Xiaoshui's paramount size was possibly due to its special function (refuge, resource exploitation). Without this upper reach "outlier," the rank-size graph changed from an almost log-normal system to a primate system from the Eastern Zhou to Qinhan period. The study combining the history and archaeology of Qinhan period reveals that this regional primacy was an adaptation to the food production problem and marginal nature of agricultural productivity in the Guan Valley (Chapter 8). As favorable farmland was limited in this region, the exploitation of "secondary arable land" was necessary and led to residential variability in the valley (Hsu 1980: 80).

The Guan Valley belonged to the newly established prefecture of Hongnong, which translates to "developing agriculture." The name suggests that agriculture was a main focus of the local administration. Population doubled in this region within 50 years (Li 1962:236-237). Private land ownership was thus adopted to encourage farmland exploitation, especially in remote areas. The scale of farmland exploitation varied. In the Guan Valley, it was organized mainly through the efforts of peasants, but encouraged by local administrators, leading to residential variability in land use and distribution. The presence of *li* (sociopolitical units similar to modern-day villages) was manifested as nucleated occupation at urban centers and several large villages, while *tianzhai* (a form of inhabitance characterized by individual households surrounded by farmland) were dispersed settlements along rivers, at hills, mountains and eroded terraces.

When investigated from an inter-regional perspective, the exploitation of farmland was one of the many administrative practices that sought to balance population and resource distribution. However, the resilience of the agrarian economic system on regional and inter-regional scales was difficult and costly to maintain. The ecological vulnerability of the upland farming system was related to several regional riots during the Qinghan period in mountains regions (Hsu 1980). Thus, the market became another powerful tool to adjust the production and distribution of food as well as other necessary household items. Neighboring to one of the main iron-making centers of the time, Guan Valley may have also been incorporated into specialized, large-scale production and distribution, which further linked this geographically, separated regions with the rest of empire.

Other than specialized, large-scale production and trading in the cities, markets were found in most towns and conducted by farmers who carried domestic, non-specialized productions in the slack seasons. These domestic production activities, which included the cultivation of food and cash crops, textile manufacture, animal husbandry, winemaking, tool and pottery manufacture, etc., were an integral part of the domestic economy of most of households. The intra-regional economic network was thus strengthened to ensure and balance the local availability of food and other items (Hsu 1980).

The residentially varied settlement pattern of the Qinhan period was characterized by high occupation density and low occupation intensity. This variation was caused by population increase and agricultural development in marginal areas. The exploitation of montane lands has had a long history in the Guan Valley. In the Qinhan period, this land use practice was strengthened and possibly encouraged by the government. In the meantime, the development of the market economy also contributed to the balancing the inequality of agricultural resources, and further linked the region with the rest of empire.

As secluded as the Guan River Valley may have seemed?, it was never really secluded. The settlement history of the Guan Valley shows that the landscape that people inhabited was never entirely cut off from other areas. Over time, residents devised an increasing array of economic, social, or political strategies to overcome the physical barriers posed by the mountains.

Contributions, Limitations, and Future Research

Contributions

This study contributes to the investigation of social complexity in ancient China in a few important ways. First, it provides a new and substantial set of empirical data for regions thus far understudied by archaeologists. Prior work in the Guan Valley has been limited to reconnaissance surveys and salvage excavations (Henan 2012; Xixia 2000). With the exception of the site of Laofengang, no complete maps or chronological data are available for most of the Guan Valley. During my survey in this region, the team located 96 archaeological sites across the 135 km^2 of survey area. In contrast, a recent reconnaissance survey in 2011 only recorded 9 sites in the same coverage, four of which were destroyed by city construction before this project began in the fall of 2012. All sites were collected, documented, and mapped.

This survey represents an important contribution to the standardization and popularization of the field survey methodology in China. The project is the first regional survey to incorporate such a diverse landscape, which required modifications to previously established field practices. The methods used to survey the alluvial plain, terraces, eroded valleys, hills, and mountains were tailored to achieve the most efficient coverage. I also tried to limit sampling bias by using standardized criteria. In an effort to understand the full scope of history of the settlement pattern of the valley, I abandoned the traditional neoevolutionary approach or cultural ecological approach. Instead, I incorporated a multi-scalar analysis and a variety of techniques and modeling to study land use practices, social integration, and inter-regional networks. To interpret the results of these quantitative analyses, I used both archaeological data and historical studies to explain continuity and change. My research reveals that multiple intertwined processes have shaped the trajectories of land use patterns, sociopolitical strategies, and the economic articulation of the region and with other regions. These processes, including but not limited to subsistence practices, population migration, group cooperation, and the establishment of an inter-regional trading network, have integrated the Guan River Valley and neighboring regions into the formation and evolution of cultural landscape that much beyond the study area.

This study also contributes to anthropological theories of the relationship between inter-regional interactions. In the Guan Valley, the inter-regional network, which varied in organization, area, and intensity from one period to the next, was one of the driving forces behind social complexity. The nature of this network was ritual, commodity-based, subsistence-based, exotic-goods-based, or information- and technology-based. The organization changed as the practices of production and distribution changed. The coverage expanded and shrank, at its height reaching far beyond Chinese borders. The intensity also ranged from sporadic exchange to highly-specialized exchange activities.

To date, the importance of inter-regional network has been overlooked by Chinese archaeologists. Knightley (2004) argues that widespread availability of resources has diminished the importance of exchange networks in the formation of Chinese civilization. Liu and Chen (2012) also emphasize the ritualistic and political nature of the inter-regional network in the Neolithic and Early-state period China. However, both works neglect the societies at sociopolitical periphery or societies that did not have ready access to abundant resources. As shown in this study, these conditions force local communities to develop flexible strategies to connect and integrate with other regions.

Finally, this study contributes to anthropological studies of sociocultural evolution. Following Blanton et al.(1993), I eschewed the traditional evolutionary sequence approach and adopt an interactive model to frame my study. By incorporating scale and integration into the consideration of complexity, I was able to analyze interrelated strategies and mechanisms of at expanding scales. This departure from evolutionary sequence does not imply the categorical abandonment of evolutionary synthesis. Instead, it allows us to appreciate the diversity and complexity of sociocultural evolution.

Limitations

The regional settlement pattern study is limited in spatial scale, providing only a fragmented picture of the history of the Guan River valley. The absence of a refined chronology led to the "lumping" of time periods, which impeded a more accurate period-to-period study of settlement patterns. In addition, I made no systematic study of the late historical period as the dataset is much less complete. The lack of previous archaeological work in the region also increased the use of indirect works in the analyses.

Future research

I propose several directions for future research. First, the survey area should be expanded to the north, south, and west to produce a more comprehensive coverage of the Guan Valley. My study over-sampled the alluvial plain and lower reach on the east bank and overlooked the montane regions and the areas to the west of river. For a regional full-coverage survey, expanding the spatial coverage is the best way to reduce sampling bias and misinterpretation.

Also, I recommend excavations on both Neolithic and historic settlements to provide a more refined chronology and more thorough account of settlements.

Another urgent research direction is a reconstruction of the valley's fluvial geomorphological history. Multiple sedimentation records demonstrate that fluvial process was among the most influential landscape-shaping processes. The spatial patterning of settlements was also a product of fluvial processes, which we currently know very little about.

In addition, a survey of paleobotanic records, raw materials, and clay resources is also recommended for future research. This information, which has yet to be collected, is crucial for a comprehensive understanding of the subsistence economy, craft production, and exchange networks in the region.

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APPENDICES

APPENDIX A   A LIST OF SITES

A total of 96 sites were found in the Guan River regional survey. This appendix includes site number, site area, longitudes, latitudes, elevation and containing components or periods: MYS—Middle Yangshao; LYS—Late Yangshao; ELS—Early Longshan; LLS—Late Longshan; LS—Longshan; SZ—Shangzhou; EZ—Eastern Zhou; QH—Qinhan; TS—Tangsong; PTS—Post-Tangsong.

Site No.	Site area	Latitude	Longtitude	Elevation (m)	Component
S001	32.7	N33°19.975′	E111°27.382′	225	MYS, LYS, E
S002	0.25	N33°19.984′	E111°27.909′	223	LYS, EZ
S003	0.5	N33°20.101′	E111°27.725′	225	LYS, ELS, QI
S004	0.25	N33°20.663′	E111°27.852′	236	LS, TS
S005	0.6	N33°20.746′	E111°27.771′	238	LYS, EZ, QH
S006	0.25	N33°20.845′	E111°27.635′	236	TS
S007	2	N33°20.599′	E111°27.677′	245	QH
S008	1.3	N33°20.398′	E111°27.450′	245	QH, TS
S009	0.25	N33°20.689′	E111°27.453′	244	QH, TS
S010	0.25	N33°21.308′	E111°27.009′	270	Terrace remai
S011	0.25	N33°19.879′	E111°27.001′	227	EZ
S012	0.5	N33°19.878′	E111°27.218′	224	EZ, TS
S013	0.25	N33°21.427′	E111°27.440′	247	TS
S014	0.25	N33°21.305′	E111°27.480′	251	QH
S015	0.25	N33°20.933′	E111°27.871′	234	PTS
S016	0.25	N33°21.052′	E111°27.976′	227	QH
S017	1.5	N33°21.088′	E111°27.973′	228	TS, PTS
S018	3.5	N33°20.208′	E111°28.256′	229	EZ, QH, TS
S019	0.25	N33°26.183′	E111°30.716′	319	PTS
S020	0.6	N33°27.383′	E111°33.133′	321	LYS, EZ, QH
S021	2	N33°28.109′	E111°34.480′	334	LS, EZ, QH,
S022	57.2	N33°28.659′	E111°34.744′	348	LYS, LS, SZ,
S023	0.25	N33°28.882′	E111°34.551′	380	QH
S024	0.75	N33°20.099′	E111°28.845′	238	ELS, QH
S025	0.25	N33°19.755′	E111°28.828′	226	QH
S026	0.5	N33°19.606′	E111°28.691′	224	ELS, QH
S027	0.25	N33°19.785′	E111°28.436′	213	EZ
S028	0.25	N33°20.963′	E111°28.371′	226	QH
S029	0.25	N33°19.556′	E111°29.051′	225	LS
S030	0.25	N33°19.596′	E111°29.164′	238	TS
S031	0.25	N33°19.882′	E111°29.050′	227	EZ
S032	0.25	N33°20.047′	E111°29.020′	235	EZ
S033	0.25	N33°20.457′	E111°28.965′	226	QH
S034	0.25	N33°19.599′	E111°29.537′	236	EZ
S035	0.7	N33°19.833′	E111°29.180′	226	QH,TS
S036	0.7	N33°19.934′	E111°29.294′	231	LS
S037	10.3	N33°20.118′	E111°29.506′	253	LYS, LS, EZ,
S038	5.9	N33°20.438′	E111°29.451′	243	LYS, LS, EZ,
S039	1.3	N33°21.269′	E111°28.437′	239	EZ, QH
S040	0.25	N33°20.835′	E111°29.287′	209	QH
S041	0.25	N33°21.098′	E111°29.559′	273	EZ
S042	0.5	N33°19.347′	E111°27.518′	216	LYS, EZ
S043	0.25	N33°19.521′	E111°30.662′	246	Unknown
S044	1.5	N33°19.853′	E111°30.856′	262	QH, TS, PTS
S045	0.25	N33°19.625′	E111°31.185′	266	EZ
S046	0.25	N33°20.165′	E111°31.251′	246	TS
S047	0.25	N33°20.768′	E111°31.594′	343	EZ
S048	1.65	N33°19.974′	E111°33.917′	317	LYS, ELS, PT

Site No.	Site area	Latitude	Longtitude	Elevation (m)	Component
S049	0.5	N33°19.647′	E111°33.735′	307	QH
S050	0.25	N33°19.415′	E111°33.567′	297	QH
S051	0.25	N33°19.369′	E111°33.894′	298	EZ
S052	0.25	N33°18.954′	E111°33.138′	271	TS
S053	0.5	N33°18.894′	E111°33.033′	258	QH, PTS
S054	0.7	N33°18.552′	E111°32.825′	266	LYS to LS
S055	0.8	N33°18.459′	E111°32.865′	270	TS
S056	0.25	N33°18.290′	E111°32.438′	242	QH
S057	0.25	N33°18.047′	E111°32.546′	260	QH
S058	0.25	N33°17.370′	E111°31.890′	246	QH
S059	0.75	N33°18.028′	E111°31.799′	249	LYS, LS, EZ,
S060	1.9	N33°18.440′	E111°32.454′	273	LYS, QH
S061	0.5	N33°18.086′	E111°32.261′	255	LYS, SZ
S062	0.5	N33°18.057′	E111°36.054′	312	LS, EZ
S063	0.25	N33°17.880′	E111°36.026′	287	EZ
S064	0.25	N33°17.822′	E111°35.937′	283	TS
S065	0.25	N33°17.509′	E111°35.584′	284	TS
S066	0.25	N33°17.736′	E111°35.921′	294	QH
S067	4.7	N33°17.148′	E111°35.078′	278	LYS, SZ, EZ,
S068	0.25	N33°17.792′	E111°34.810′	272	TS
S069	12	N33°17.455′	E111°34.589′	262	LYS, LS, SZ,
S070	0.6	N33°17.135′	E111°34.076′	250	LLS, QH
S071	0.5	N33°17.164′	E111°34.198′	251	SZ, QH
S072	0.25	N33°18.345′	E111°35.537′	282	EZ
S073	0.25	N33°17.567′	E111°34.488′	268	QH
S074	0.25	N33°16.959′	E111°33.599′	252	EZ
S075	0.25	N33°19.059′	E111°28.481′	227	QH
S076	2.7	N33°18.686′	E111°27.903′	224	EZ, QH
S077	0.25	N33°18.160′	E111°27.991′	219	EZ
S078	1.9	N33°17.971′	E111°28.107′	217	SZ
S079	0.6	N33°17.075′	E111°28.827′	237	YS to LS, EZ
S080	0.25	N33°18.925′	E111°29.242′	221	EZ
S081	0.25	N33°19.054′	E111°29.199′	231	QH
S082	0.25	N33°17.959′	E111°29.453′	243	QH
S083	0.25	N33°18.177′	E111°29.606′	247	EZ
S084	6.2	N33°18.264′	E111°29.465′	243	SZ, EZ, QH,
S085	0.25	N33°18.739′	E111°29.359′	256	EZ
S086	0.5	N33°18.607′	E111°29.271′	250	LS, EZ, QH
S087	0.25	N33°18.464′	E111°29.227′	248	EZ
S088	0.25	N33°17.520′	E111°29.449′	234	QH
S089	1.1	N33°17.718′	E111°31.179′	227	LYS, ELS
S090	0.6	N33°17.815′	E111°31.471′	232	QH, TS
S091	0.25	N33°17.582′	E111°31.264′	226	TS
S092	0.25	N33°16.923′	E111°31.508′	257	QH
S093	0.25	N33°16.650′	E111°31.525′	256	QH
S094	0.25	N33°16.645′	E111°32.239′	240	QH
S095	0.25	N33°16.783′	E111°32.137′	244	QH
S096	0.25	N33°17.831′	E111°32.152′	281	TS

APPENDIX B A LIST OF COMPONENTS IN EACH PERIOD

This appendix includes site number, containing components, component areas, and component sherd count in each period. Components with ambiguous dating, which were excluded in the discussion on settlement pattern, are included here: MYS—Middle Yangshao; LYS—Late Yangshao; YL—Yangshao to Longshan; ELS—Early Longshan; LLS—Late Longshan; LS—Longshan; SZ—Shangzhou; WEZ—Western Zhou to Eastern Zhou; EZ—Eastern Zhou; QH—Qinhan; TS—Tangsong; PTS—Post-Tangsong.

a. The Middle Yangshao components.

Site no.	Component	Size	Sherd no.
S001	MYS1	0.25	7
	MYS2	0.25	15

b. The Late Yangshao components.

Site no.	Component	Size	Sherd no.
S001	LYS1	24.8	979
S002	LYS2	0.25	3
S003	LYS3	0.25	3
S007	LYS4	0.25	1
S020	LYS5	0.25	5
S022	LYS6	1.05	8
	LYS7	0.25	3
	LYS8	0.25	3
S037	LYS9	8.8	241
	LYS10	1.1	12
S038	LYS11	0.25	14
	LYS12	0.25	2
S042	LYS13	0.5	7
S048	LYS14	0.25	2
S054	LYS15	0.25	5
S059	LYS16	0.25	4
S060	LYS17	2.3	99
S061	LYS18	0.5	9
S067	LYS19	0.25	4
S069	LYS20	0.25	2
	LYS21	0.25	2
	LYS22	0.25	3
S089	LYS23	0.25	1

c. Yangshao to Longshan components.

Site no.	Component	Size	Sherd no.
S001	YL1	0.25	196
	YL2	2.5	565
	YL3	1.3	136
	YL4	0.25	45
S022	YL5	0.25	4
	YL6	0.25	6
	YL7	0.5	9
S037	YL8	0.6	14
	YL9	0.25	5
S038	YL10	0.25	6
	YL11	0.25	5
	YL12	0.25	2
S054	YL13	0.25	3
S069	YL14	0.25	4
	YL15	0.25	3
S079	YL16	0.75	5
S086	YL17	0.25	4

d. The Early Longshan components.

Site no.	Component	Size	Sherd no.
S001	EL1	13.6	818
S003	EL2	0.25	9
S022	EL3	0.25	5
	EL4	0.5	1
S024	EL5	0.25	6
S026	EL6	0.25	6
S036	EL7	0.25	2
S037	EL8	0.25	1
S038	EL9	0.25	17
S048	EL10	0.25	4
S089	EL11	0.25	3

e. The Late Longshan components.

Site no.	Component	Size	Sherd no.
S001	LL1	1.6	93
S022	LL2	0.7	8
S070	LL3	0.25	5

f. The Longshan components.

Site no.	Component	Size	Sherd no.
S001	LS1	23.9	1070
S003	LS2	0.25	9
S004	LS3	0.25	5
S019	LS4	0.25	16
S022	LS5	0.25	10
	LS6	0.25	5
	LS7	0.25	5
	LS8	0.25	1
	LS9	0.5	3
	LS10	0.25	1
	LS11	0.25	4
	LS12	0.25	9
	LS13	0.7	5
S024	LS14	0.25	6
S026	LS15	0.25	6
S029	LS16	0.25	7
S036	LS17	0.6	10
S037	LS18	4.65	26
S038	LS19	0.7	26
S048	LS20	0.25	4
S059	LS21	0.25	3
S062	LS22	0.25	6
S070	LS23	0.25	5
S086	LS24	0.25	3
S089	LS25	1.1	10

g. The Shangzhou components.

Site no.	Component	Size	Sherd no.
S001	SZ1	0.8	27
	SZ2	0.25	1
S022	SZ3	0.25	7
S037	SZ4	0.25	18
S061	SZ5	0.25	1
S067	SZ6	0.25	1
S069	SZ7	0.25	3
	SZ8	0.25	6
S071	SZ9	0.25	2
S076	SZ10	0.25	3
S078	SZ11	0.25	21

h. The Western Zhou to Eastern Zhou components.

Site no.	Component	Size	Sherd no.
S001	WEZ1	0.6	6
	WEZ2	0.6	19
S007	WEZ3	0.25	6
S012	WEZ4	0.25	13
S022	WEZ5	0.25	8
	WEZ6	0.25	13
	WEZ7	0.25	5
	WEZ8	0.25	5
	WEZ9	0.25	7
	WEZ10	0.25	3
S034	WEZ11	0.25	2
S051	WEZ12	0.25	3
S059	WEZ13	0.25	2
S061	WEZ14	0.25	1
S067	WEZ15	0.25	6
	WEZ16	0.25	6
S076	WEZ17	0.25	3
S084	WEZ18	0.5	11

i. Eastern Zhou components.

Site no.	Component	Size	Sherd no.
S001	EZ1	3.4	62
	EZ2	0.89	46
	EZ3	0.25	16
	EZ4	0.25	4
S002	EZ5	0.25	7
S011	EZ6	0.25	17
S018	EZ7	2.27	15
S020	EZ8	0.25	12
S021	EZ9	0.25	2
S022	EZ10	47.37	290
	EZ11	0.25	7
S027	EZ12	0.25	3
S031	EZ13	0.25	3
S032	EZ14	0.25	4
S037	EZ15	0.25	4
S038	EZ16	0.25	8
	EZ17	0.25	3
S039	EZ18	0.25	6
S041	EZ19	0.25	3
S042	EZ20	0.25	7
S045	EZ21	0.25	4
S047	EZ22	0.25	5
S062	EZ23	0.25	4
S063	EZ24	0.25	1
S067	EZ25	0.87	55
	EZ26	0.25	3
	EZ27	0.25	4
S069	EZ28	7.3	21
	EZ29	0.25	3
	EZ31	0.25	5
S071	EZ30	0.25	2
S072	EZ32	0.25	3
S074	EZ33	0.25	7
S076	EZ34	2.28	47
S077	EZ35	0.25	7
S078	EZ36	2.05	5
S079	EZ37	0.25	4
S080	EZ38	0.25	10
S083	EZ39	0.25	3
S084	EZ40	3.07	23
S085	EZ41	17	12
S086			
S087			

j. The Qinhan components.

Site no.	Component	Size	Sherd no.
	QH1	7.5	230
S001	QH2	0.25	6
	QH3	0.82	19
	QH4	0.25	4
S003	QH5	0.25	8
	QH6	0.5	21
S007	QH7	0.25	3
	QH8	0.25	9
S008	QH9	0.25	4
S009	QH10	0.25	3
S014	QH11	0.25	5
S016	QH12	0.25	4
S021	QH13	0.25	5
S022	QH14	63.61	275
S023	QH15	0.25	3
S024	QH16	0.7	11
S025	QH17	0.25	19
S026	QH18	0.5	16
S018	QH19	0.5	6
S028	QH20	0.25	3
S033	QH21	0.25	6
S035	QH22	0.25	8
S037	QH23	0.25	2
	QH24	1.23	19
S038	QH25	0.25	6
S039	QH26	0.5	8
S040	QH27	0.25	5
S044	QH28	0.88	7
S049	QH29	0.5	4
S050	QH30	0.25	3
S053	QH31	0.25	4
S056	QH32	0.25	8
S057	QH33	0.25	3
S058	QH34	0.25	3
S059	QH35	0.25	5
	QH36	0.25	4
S060	QH37	0.25	1
S066	QH38	0.25	4
S067	QH39	0.5	6
	QH40	0.25	3
	QH41	0.25	5
S069	QH42	0.25	6

S070	QH43	0.5	9
S071	QH44	0.25	3
S073	QH45	0.25	3
S075	QH46	0.25	3
S076	QH47	3.1	7
S081	QH48	0.25	4
S082	QH49	0.25	11
S084	QH50	0.25	6
	QH51	20	1
S088	QH52	0.25	3
S090	QH53	0.25	3
S092	QH54	0.25	3
S093	QH55	0.25	2
S094	QH56	0.25	4
S095	QH57	0.25	3

k. The Tangsong components

Site no.	Component	Size	Sherd no.
S001	TS1	0.5	24
	TS2	1.6	104
S004	TS3	0.25	23
S006	TS4	0.25	8
S008	TS5	0.25	6
S009	TS6	0.25	1
S012	TS7	0.25	6
S013	TS8	0.25	19
S017	TS9	0.6	20
S020	TS10	0.25	5
S021	TS11	0.25	7
S022	TS12	0.5	30
	TS13	0.25	9
	TS14	0.25	2
	TS15	0.8	24
S018	TS16	0.25	3
S030	TS17	0.25	10
S035	TS18	0.25	5
S037	TS19	0.25	9
	TS20	0.25	3
S038	TS21	0.9	17
S044	TS22	0.25	5
S055	TS23	0.6	7
S064	TS24	0.25	9
S065	TS25	0.25	4
S067	TS26	0.25	5
S068	TS27	0.25	5
S069	TS28	0.6	6
S076	TS29	0.25	1
S084	TS30	0.25	2
S090	TS31	0.25	7
S091	TS32	0.25	5
S096	TS33	0.25	4

l. The Post-Tangsong components.

Site no.	Component	Size	Sherd no.
S001	PTS1	0.5	26
S005	PTS2	0.5	32
S015	PTS3	0.25	9
S017	PTS4	0.25	7
S019	PTS5	0.25	4
S022	PTS6	0.25	8
	PTS7	0.25	9
S044	PTS8	0.25	3
S046	PTS9	0.25	7
S048	PTS10	0.25	10
	PTS11	0.25	3
S052	PTS12	0.25	6
S053	PTS13	0.25	23