LINGJIATAN SOCIAL ORGANIZATION IN THE YUXI VALLEY, CHINA: A COMPARATIVE PERSPECTIVE

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The Lingjiatan site with a plethora of exquisite jades and public works in the Yuxi River valley of Anhui, China has been suggested as a ritual and ceremonial center of the middle Neolithic (c. 7000-5000 BP) Chaohu region. Based on an extremely fine-grained regional-scale complete-coverage survey covering an area of 400 km^2 revolving around the Lingjiatan site, this dissertation documents patterns of social organization in this region from the middle Neolithic to historical Zhou (c. 5700-2500 BP). More specifically, this research reconstructs the trajectory of social changes and the nature and population of communities at local and supra-local scales, and examines the social differentiation in the Lingjiatan households and communities.

Building on these analyses, this dissertation research also compares Lingjiatan with Hongshan society, another visible example of "jade culture" in middle Neolithic China, to explore the factors leading to variations or similarities of the trajectories and activities in the formation of larger-scale and more complex societies. Comparative analysis focuses on different dimensions of social complexity, including ceremonial architecture complexes, developmental trajectories, demographic scale, and nature and organization of activities in local and supra-local communities.

Results of this analysis indicate that rather than focusing on larger-scale political integration, economic power and wealth differentiation, elites of both societies accomplished their domination through ritual authority. The Lingjiatan society in the Yuxi region and Hongshan

society in the Upper Daling region showed a very similar pathway to develop larger-scale complex societies. Both regions were characterized by ceremonial structures and elaborate burials with symbolic jade artifacts. Both regions emerged in a context of substantial population growth and were on the same track toward demographic growth and formation of supra-local communities. Both regions were characterized by numerous, relatively autonomous supra-local communities and lacked political integration at the larger regional scale. Both regions organized their community activities around strong ritual differentiation and modest prestige differentiation.

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1.0 SOCIAL INEQUALITY AND DIFFERENT TRAJECTORIES TO EARLY COMPLEX SOCIETY

Human beings lived as mobile hunter-gatherers in small, egalitarian bands and tribes without leaders for most of our history (Harris 1989). If people have a natural desire for autonomy and freedom, how did social inequality arise and spread all over the world? Why did it happen in some places and only thousands of years later in others, or not at all? Why did some societies come to demonstrate prominent social differentiation but others did not? Why did some leaders maintain unequal power relations through ideological control but others achieved power through wealth accumulation or physical coercion? Archaeologists have explored these questions for many decades by addressing various of models for understanding the trajectories and activities through which unequal power relations were maintained.

Hierarchical social organization varies considerably. Some scholars see control over the production and distribution of staples and prestige goods, or associated technologies, that is, control over the economy, as the main reason for the development of chiefly polities (Brumfiel and Earle 1987; Costin and Earle 1989; Earle 1997; Hayden 1998; Underhill 1991, 2002). Some suggest population pressure is the fundamental force that promotes the emergence of chiefly societies (Boserup 1965; Cohen 1977). Some scholars (Carneiro 1990, 1998) see conflicts produced by environmental circumscription and population pressure on resources as the essential conditions for the formation of supra-local communities. Others see control over the surplus labor that comes from population increase as crucial to the development of chiefly societies (Drennan and Uribe 1987; Feinman 1995). Some argue that the individual competition for prestige, power and authority between “aggrandizers” through competitive feasting or ritual and religious activities is one way to transform surplus into debts or obligations that foster the development of early complex societies (Clark and Blake 1994; Dietler and Hayden 2010; Hayden 1995; Hayden and Villeneuve 2010). Others consider that risk moments or resource scarcities are vital opportunities for elites to gain power (Spencer 1993, 1994). Some see “ritual and belief define the rules, practices, and rationale for much of the production, allocation, and consumption” (Spielmann 1998; 2002:203). Potter (2000) argues that ritual knowledge can be successfully manipulated by elites, and the controlling of ritual will be translated into the controlling over people's perception of risk and survival, which in the end creates social inequality. Some scholars approach the issue of hierarchical organization by distinguishing “corporate” and “network” modes (Blanton et al. 1996; Blanton et al. 1982; Feinman 2000, 2010). In addition to those models focusing on qualitative differences of inequality in early complex societies, others focus on heterarchy, to study those social organizations that were not hierarchical (Rautman 1998).

The archaeological reconstruction of the socio-political trajectories of intermediate level societies in different parts of the world has already highlighted different paths cited above taken by prehistoric societies in the formation and development of socio-political inequalities (e.g. Drennan and Peterson 2005; Drennan and Peterson 2006; Drennan et al. 2010; Earle 1997; Kirch 1984; Peterson and Drennan 2012). These studies have also been conducted in different parts of China (e.g. Chifeng 2011; Chifeng 2003; Dai 2006; Linduff et al. 2004; Liu 2004; Liu et al. 2004; Underhill et al. 1998; Underhill et al. 2008). Hongshan society of northeastern China is among the earliest complex societies in East Asia, known largely from elaborate burials with carved jades in ceremonial platforms (Figure 1-1). Current research, including burial and household excavations, regional and community/household scale analysis indicate that Hongshan society probably fits the ritual authority mode proposed by Earle (1997) and Mann (1986), which argues that ritual and religion can be a source of power for elites to maintain the unequal relationship. Drennan and Peterson argue that Hongshan social hierarchy, clearly indicated by elaborate burials with jade and ceremonial facilities, is based on religious beliefs and ritual activities (Chifeng 2011; Peterson 2006; Peterson et al. 2014a).

The Lingjiatan site, located in the Yuxi River valley, in the middle-to-lower reaches of the Yangzi River in southern China (Figure 1-1), has yielded burials that share some characteristics with those of Hongshan society. Large amounts of jade objects and quite few ceramic vessels make Hongshan and Lingjiatan distinguished from other chiefly polities in Neolithic China that feature with large amounts of pottery as burial goods (Figure 1-2 and Figure 1-3). For example, Middle Yangshao culture (6000-5500 BP) in the middle reaches of the Yellow River and Qujialing culture (5500-4600 BP) in the middle reaches of the Yangzi River are such two polities featured with pottery as the principal kind of offerings in burials (Zhongguo 2010; Zhou 1993). The meaning and theoretical contribution of reconstruction and comparisons of developmental trajectories of these early complex societies in China have already been suggested (Drennan and Dai 2010; Li 2009). And the comparison of the characteristics of jade shape associated with Hongshan and Lingjiatan has also been proposed by some scholars (Tao and Zhang 2007). The comparison of the development trajectories of Hongshan and Lingjiatan societies, thus, is interesting and makes a contribution to understanding the different paths taken by early complex societies in the formation and development of socio-political inequality. However, current research tells us the social differentiation and potential chiefly power at Lingjiatan only through the way in which elites were buried. We do not know to what extent the emergence and development of Lingjiatan could be explained by differences in terms of bases of power, the sizes of their populations, and the nature of communities in this area. A very fundamental contribution of my research, thus, is to fill these blanks with analysis of data from regional settlement study and from household/community scale analyses. In addition, this research also sets out to explore the factors that led to variations, if exist, of the development trajectories between Lingjiatan and Hongshan societies, as well as other Neolithic societies in China. Identifying and comparing these paths not only contributes to our understanding of how early complex societies developed within these specific sociocultural contexts, but to our broader understanding of how they developed in various (or similar) ways around the world.

1.1 LINGJIATAN SITE AND OBSERVED INEQUALITY

Scholars (Li 2009) believed that 5500 to 4500 BP was a crucial stage, as well as a big social transformation phase for the development of early complex societies in China. The emergence of multiple chiefly polities all around China (e.g. Hongshan society in the northeast, Yangshao society in the Central Plain; Liangzhu society in the southeast) suggests that social organization was under intense transformation during this period, and this transformation was widespread and severe. However, the emergences of these hierarchical social organizations were triggered by various factors and the forms these hierarchical organizations took were various, leading to their different developmental trajectories. The Yangshao system was "successful" in term of its ability to expand and continued to become a “state”, while Hongshan and Liangzhu “failed” - they collapsed after they developed into chiefly polities. The social differences expressed in the different treatment of individuals at death through the placing of valuable goods (jade) in their tombs at the Lingjiatan site, might suggest that supra-local scale social formations had developed in this region. Thus, identifying the way in which hierarchical organization at Lingjiatan is organized is vital for understanding the different paths taken by early complex societies in the formation and development of socio-political inequality.

The Lingjiatan site is on the north side of the Yuxi River, 20 km from Chaohu Lake in the west and 35 km from the Yangzi River in the east, and in the modern district of Hanshan county, Anhui province, China (Figure 1-1). Five excavations by now have been conducted at this site revealing a large amount of fancy jade in the burials (Anhui 2006; Anhui and Hanshan 2015). What we know about Lingjiatan society so far is almost entirely based on the inferences from elaborate burials at this site (Anhui 2006, 2008; Liu and Chen 2012). The current radiocarbon data dates the Lingjiatan site to 5700-5300 BP. Occupation remains have been documented nearby across an area measuring about 5 km long north to south and 200 m wide east to west in low rolling terrain (Anhui 2006:3; Liu and Chen 2012:204). According to the excavation reports, the central part of the site, which is on the highest spot, revealed a "platform", *hongshaotu* (红烧土) remains, burials, white stone circles and sacrificial pits (Anhui 2006:19). *Hongshaotu* is a term in Chinese specifically referring to burned daub fragments commonly found in the remains of residential structures. It is very helpful for understanding the distribution and potential function of settlements. The 1,200 m² (suggested original area) rectangular "platform" with 30 m width and 40 m length, consisting of three layers of soil and rubble, located on the upland, inclined gradually upward from south to north (Anhui 2006:29) (Figure 1-4 and Figure 1-5). According to the excavation report, the upper layer of the "platform" was made of a very compacted mixture consisting of different size of pebbles, quartz chips, rubble, clay, and mingled with *hongshaotu* particles and sherds, with a thickness of 10 to 36 cm. The middle layer of the platform was rammed earth, made of adhesive clay mixed with big pebbles, big quartz and yellow sand, with a thickness of 0 to 25 cm and no sherds. The final bottom layer was made of pure and compacted earth and has a thickness of 10 to 35 cm (Figure 1-6). On top of the first layer of the "platform", were three sacrificial pits and four white stone piles (the excavation report considered them as "altars") (Anhui 2006:30) (Figure 1-7). The sacrificial pits are rectangular, and one of them contained four broken ceramic vessels and the fragments of animal bones (Figure 1-8). The white stone piles are either round or oval, with diameters of 50 to 110 cm (round) or 140 to 160 cm (oval). The *hongshaotu* remains were located in the southeast of the "platform", in an area 90 m long and 30 m wide (Anhui 2006:35) (Figure 1-4). The "platform" contained some burials, but the "platform" and the burial occupations were not identical (Figure 1-9).

The burial area is approximately 175 m from south to north, 80 m from east to west; the total area is around 14,000 m². The highest spot of the burial occupation is 26 m (above sea level) in the north, and the lowest spot is around 20 m in the south. Forty-eight burials have been revealed (in addition to 25 burials about which no information has been published) through five seasons of excavation. The burials contained burial goods in various quality and quantity, and were clustered into several groups, suggesting conspicuous stratification in burial customs. Burials in the north yielded few goods; those with the greatest quantity of jade production debris were in the northwest (98M20); burials containing the higher-quality and larger quantities of goods were grouped in the south (87M15, 87M4, 87M8 and 07M23). 07M23 is an earthen tomb in a rectangular shape, with a length of 3.45 m, a width of 2.1 m, and a depth of 0.3 m, located in the southeast direction of the "platform" (Figure 1-10). A stone pig, with a length of 72 cm and width of 32 cm, weighing 88 kg was revealed at the top layer of the tomb. Human bones were no longer preserved in the tomb. The burial goods of 07M23 included 185 jade objects, 97 stone objects, 31 ceramic vessels, bone fragments and a piece of turquoise. The jade objects are rendered in various forms, including the following whole or fragmentary objects: 1 pig, 71 *huan* (环), 34 *jue* (玦) discs, 38 bangles, 2 *bi* (璧) discs, 2 *yue* (钺), 12 *huang* (璜) pendants, 1 tube, 9 axes, 1 *ben* (锛), 3 turtles attached to 5 tubular piles, 2 miscellaneous decorative items, 1 core, and 3 pieces of production debris. Objects of other stones numbered 97, and included *yue*, *zao* (凿), *ben*, and axes. There were 31 ceramic vessels, including *ding* (鼎), *guan* (罐), *dou* (豆), *gui* (簋), *hu* (壶), *pen* (盆), *qigai* (器盖), *gang* (缸), and *bei* (杯). Some scholars argue that this site possibly had a special status within this region, perhaps as a ritual and ceremonial center (Anhui 2006; Liu and Chen 2012; Shuo 2000). They see the public works and elaborate jades as an indication that the elites might have held special ritual power, and the jade objects were used by the elites as ritual paraphernalia through which the power was enabled.

1.2 HONGSHAN SOCIETY AND OBSERVED INEQUALITY

Hongshan society (6500-5000 BP) was the first complex society to develop in northeastern China. The complex construction of public architecture for ritual performance was revealed, as well as the emergence of elites whose social status was expressed by the presence of elaborate jades interred in their burials. During the past few decades, archaeological excavations have focused on Hongshan monumental and ritual architecture (e.g. Barnes and Guo 1996; Chaoyang and Liaoning 2004; Li 1986; Liaoning 1986; Liaoning 1997; Liaoning 2012; Zhang et al. 2013). In the “core” zone of Hongshan culture (Liaoning 2010; Peterson and Lu 2013; Peterson et al. 2010, 2014a) remains of monumental and ritual architecture occur substantially across the landscape. Two concentrations of these Hongshan public structures were found at the site of Niuheliang and Dongshanzui in Liaoning province (Figure 1-1) (Guo and Zhang 1984; Liaoning 2012; Yu et al. 1984).

Niuheliang site is located along the middle and upper reaches of the Laoha River (in modern districts on the border of Chaoyang and Jianping County) in Liaoning province, China (Figure 1-1). It is an especially large concentration of monumental construction at more than 16 "localities" scattered through a hilly area of some 50 km^2. These ritual sites were constructed during the late Hongshan period, and formed a spectacular ritual landscape. The "goddess temple" (Locality 1) was a semi-subterranean structure 20-50 cm deep, with remains as deep as 80 cm. It was a wood and clay structure without any stone materials, and has multiple chambers in the north and a single chamber in the south (Figure 1-11), with a total area of 75 m^2, across 18 m from south to north and 2 to 9 m from east to west. Fragments of a human statue were revealed in the temple, which included human head, nose, ear, hand, arm, breast and other parts, all made of a mixture of grass and clay. The human head has a length of 22.4 cm, a width of 21 cm and a thickness of 14 cm, with jade beads inserted as eyes. Fragments of other animal figures and ceramic vessels were also revealed. Each locality consists of several *jishizhong* (积石冢 mounds). *Jishizhong* is one of the ancient burial forms in China, with chamber built underground with slabs and stones, and topped with stones as a cap, which can be permanently preserved on the ground. Substantial level area, which is ideal for carrying out ritual activities for crowds, is delineated by boundary within the *jishizhong*. Some *jishizhong* have sacrificial pits inside, which are round, 70 to 100 cm in diameter and 10 to 50 cm deep. These pits have *hongshaotu* in the bottom, a layer of rocks on top and are covered by fine white sand, with ceramic vessels and stone objects inside. Burial

N2Z1M21, as an example, is located inside the Mound 1 (*Jishizhong* 1) in "Locality 2" (Figure 1-12). Six mounds, made of a mixture of stones and earth were revealed in Locality 2, across an area of 5,850 m², measuring 130 m from east to west, 45 m from south to north. Mound 1 (Z1) was conjectured as a rectangular shape with a total area of 750 m² and a height of 1.5 m, measuring 34 m from east to west, 22 m from south to north based on the remains. The body of the mound consists of a "platform" (*zhongtai* 冢台), "wall" (*zhongbi* 冢壁) and "boundary" (*zhongjie* 冢界), surrounded by around 60 painted *tongxingqi* (筒形器 cylinder jar) with a diameter around 28 cm and a height around 28.5 cm, and was made of stones directly built on the natural earth. The stones used for building the "wall" have a height of 65 to 90 cm, a width around 30 cm and a thickness around 20 cm (Figure 1-13). The stones used for building the "boundary" are relatively thin with a length of 25 to 30 cm and a thickness of 12 to 14 cm. The "boundary" was only preserved in the north and east. For example, the "boundary" in the south is as long as 23.8 m and consists of 70 blocks of stones. Twenty-five burials were revealed in Mound 1 (Z1), and M21 is located in the southwest of Mound 1. M21 is a stone-built tomb inside a rectangular earthen pit. The border of M21 is as long as 2.66 m and as deep as 1.2 m (Figure 1-14). The walls of the chamber were made of 5 to 6 layers of stones, with a length of 2.1 m, a width of 0.5 m and a depth of 0.37 m. An adult male, covered by several stones slabs, and loose soil mixed with few sherds, lay in the chamber, with his head facing to the west. M21 contains 20 jade objects, covering the whole skeleton, which included one zoomorphic figure, one *tongxingqi*; one turtle shell; one cloud-shape plaque; one cylinder shape object; ten *bi* discs; two conjoined jade; one bead, one bangle, and one *bi* shape object (Liaoning 2012).

About 30 km southeast of Niuheliang is the site of Dongshanzui which also had Hongshan public structures but on a smaller scale (Figure 1-1). The Dongshanzui site is located on a flat hill, 1 km from the west side of the Daling River in Kazuo, Liaoning province of China, covering an area of 2,400 m^2. A C14 sample places Dongshanzui public structures in the middle and late Hongshan period (Peterson et al. 2014a). Excavations in 1979 and 1984 revealed Hongshan ceremonial architecture which included a rectangular platform, a circular platform, three roughly circular platforms, a house foundation and stone walls (Figure 1-15)(Guo and Zhang 1984). Unlike the Niuheliang ceremonial site of the Hongshan period, no platforms containing burials (*jishizhong*) were found at the Dongshanzui site. The ceremonial architecture consists of the rectangular platform in the north and the multiple circular and roughly circular platforms in the south. The rectangular platform is 12 m from east to west and 10 m from north to south. The bottom of the platform is flat and dense-packed yellow earth, and on top of which was built of stone blocks - the main body of the platform. On top of the stone blocks were placed piles of conically-shaped stones. Two stone walls were erected at a distance of 6 m on the east side and 8 m on the west side of the platform. One circular platform 2.5 m in diameter was located 15 m to the south of the rectangular platform. The circular platform was built on the 50 cm thick yellow earth on top of which are pebbles surrounded by white stone slabs. Three roughly circular platforms were located 4 m to the south of the circular platform, built on the yellow earth with small stones and surrounded by river cobbles. The construction of the three roughly circular platforms was earlier than the circular platform according to the stratigraphy. A rectangular house foundation was uncovered under the stone wall on the west side of the rectangular platform, measuring 7.4 m from south to north and 2.5 m from east to west for the revealed part. The inside wall was daubed with a layer of fired mud and straw. A polished stone axe was excavated from the pit in the east wall. An adult human skeleton was excavated from the northeast of the circular platform. Two large stones were placed at the head and the feet respectively and large ceramic sherds covered the chest and abdomen. The

goods contained in the ceremonial architecture included ceramic figurines and statues, jade pedants and ceramic sherds. Twenty or more fragments of ceramic figurines and statues were uncovered, and most of them are body parts without heads. Two small ceramic figurines (6 cm high) characterized as nude pregnant females were excavated from the northeast of the circular platform. Scholars believed that the ceremonial activities at Dongshanzui were associated with fertility as suggested by these figurines (Childs-Johnson 1991). A large statue broken in two parts was excavated from the southeast of the circular platform. The hand position of the statue is the same as that of human statues found in Niuheliang with hands crossed in front of the abdomen and one hand grasping the wrist of the other arm (Liaoning 2012). A large fragment of decoration on the human waist was excavated from the southwest of the circular platform. A 4 cm long jade pendant with double dragon heads and a turquoise pendant were excavated from the rectangular platform. Ninety percent of the materials recovered from the Dongshanzui site were ceramic sherds (Guo and Zhang 1984).

1.3 OBSERVED VARIABILITY AMONG LINGJIATAN, NIUHELIANG AND DONGSHANZUI SITE

The tombs and public architecture excavated from Lingjiatan, Niuheliang, and Dongshanzui, do share some similarities, but they also have lots of differences (Table 1-1). Unlike Lingjiatan and Niuheliang, no platforms containing burials were found at Dongshanzui. Burying the dead with elaborate artifacts beneath the platform was only present in Lingjiatan and Niuheliang, although some of the ceremonial platform structures at Niuheliang, as at Dongshanzui, did not have burials underneath. In terms of burial goods, both Lingjiatan and Niuheliang sites feature jade as primary burial objects. Burial goods in both Niuheliang and Lingjiatan have a bias toward the inclusion of jade objects over ceramics. For example, in Lingjiatan, among 45 burials for which complete information has been reported, 39 contain jade as grave goods, which is 86.7% of the total. In Niuheliang, among 71 burials for which complete information has been reported, 41 contain jade, which is 57.7% of the total. This tendency is opposite of what was found in most of the Neolithic cemeteries excavated in China. Several physical characteristics of the jade objects are present in both sites. For example, the posture of the standing Lingjiatan human figurines is similar to that of their Niuheliang counterparts (both standing with arms folded on the chest); jade dragons, owls, and turtles are also present in both regions. The differences included the following: first, the number of jade objects from the burials in Lingjiatan is much larger than that from Niuheliang. The average number of jades per tomb (with jade) is 25.8 in Lingjiatan, which is 7.4 times larger than that of Niuheliang (3.5). The most elaborate tomb at Lingjiatan (07M23) itself contains around 200 pieces of jade, and the most elaborate tomb at Niuheliang (N2Z1M21) has 20 pieces of jade. However, Lingjiatan jade is lower in quality, and most objects are very small. Instead, most Niuheliang jade is of extremely high quality and in very large pieces. The vast majority of Lingjiatan jade appears to be ornamental items, for example, *jue* or *huan* earrings or bracelets, although there are also a few human figurines, turtles, and plaques, which account for 2.6% of the total jade objects. However, a much higher proportion of Niuheliang jade is shaped into animal or geometric shapes (29.7% of total), with likely specific religious symbolism. The jade at Lingjiatan was probably obtained from local places nearby, while that from Niuheliang probably came from far away (Anhui 2006; Liaoning 2012). The way of burying goods at Dongshanzui is unique by comparison to the other two sites. The goods were buried directly beneath the platforms at Dongshanzui instead of inside the burials associated with platforms. Ceramic figurines, statues and a few jade artifacts were excavated from platforms at the Dongshanzui site, as well as a house foundation and an adult human skeleton.

In terms of burial structures, the Niuheliang and Lingjiatan sites are different from each other, though both have elite tombs included into the design of some kind of platforms. Elaborate Niuheliang burials had elaborately prepared stone-laid tombs chambers built inside rectangular earthen pits and capped with stones, creating a permanent monument on the landscape, and surrounded by *tongxingqi* (cylinder jar). These structures can remind people of these ancestors in a very useful way to sustain political power. Similar cases can be found in other parts of the world, for example, the long barrows and henges in Wessex in prehistoric Europe (Renfrew 1973). However, Lingjiatan burials entirely lack this characteristic. In Lingjiatan, the burials are in rectangular earthen pits without any inside slabs or above ground stone features.

In terms of public architecture, "platforms" were present in all three regions but in different forms. "Platform" refers to a stage or a spot higher than surrounding areas in all three regions. In Niuheliang and Dongshanzui the “platforms” (whether they have burials in or under them or not) are almost always structures only 20 to 30 m across, raised 1 to 2 m above a surrounding naturally level area, with clear circular or rectangular shapes whose edges are frequently crisply demarcated by stones and/or *tongxingqi*, and this substantial level area is ideal for people to assemble and carry out ritual activities. This whole structure complex is called *jishizong* (mound complex). While the Lingjiatan “platform” covers a much larger area without clearly defined edges at all and consists of fill that is very deep in some places and very shallow in others, placed for the purpose of leveling a large area rising naturally above the floodplain.

The construction sequence of these three kinds of “platform” is different. In Niuheliang, the tombs were built underground first and then the platform was constructed on top with stones.

However, in Lingjiatan, the platform was built earlier then the burials were excavated into it. In Dongshanzui the platforms were built alone without any burials. Sacrificial pits were found within "platforms" in Niuheliang and Lingjiatan, but not in Dongshanzui. The sacrificial pits in Niuheliang sites are more elaborated, with *hongshaotu* in the bottom, a layer of rocks on top and covered by fine white sands, with ceramic vessels and stone objects inside; while the ones in Lingjiatan have a few fragments of pottery and animal bones inside. The Lingjitan site and Dongshanzui site did not reveal temple features, like those found in Niuheliang, but *hongshaotu* remains were found at Lingjiatan.

The labor investment for burials and public architecture in Lingjiatan was also calculated to compare with that in Niuheliang and Dongshanzui (Drennan et al. 2010; Drennan et al. 2017b). The labor estimates of work involved in constructing these burials and public architecture were made based on ethnographic research (Abrams 1994; Erasmus 1965; Lekson et al. 1984). At Niuheliang, there are 91 tombs in the four localities where tombs have been excavated, which is 1.9 times the number of tombs at Lingjiatan (48 tombs), and Dongshanzui has no tombs. The labor investment of public architecture in Niuheliang is nearly 200,000 person-days, and at Lingjiatan the total public architecture labor investment is about 11,000 person-days, while at Dongshanzui the ceremonial complex required less than 7,000 person-days. The labor investment of grave goods excavated up to now at Lingjiatan is nearly six times greater than that at Niuheliang. In terms of individual burial, the labor investment of structure and above-tomb architecture of N2Z1M21 (Niuheliang) is nearly 200 person-days; while that of 07M23 of Lingjiatan is around 11 person-days. The labor investment of burial goods of 07M23 is around eight times greater than that of N2Z1M21.

A comparative conclusion can be derived: at Lingjiatan, as at Niuheliang, elites were buried with jade as primary objects, but there were both similarities and differences in the nature of the jade objects. At Niuheliang labor was also invested in what most interpret as ritual and ceremonial architecture, sometimes including those elaborate graves. At Lingjiatan there is much less evidence of labor investment in ceremonial architecture. However, the labor invested in manufacturing burial goods (primarily jade) at Lingjiatan was significantly larger than at Niuheliang. At Dongshanzui, labor, though less, was all invested in what is commonly considered ritual and ceremonial architecture. It has long been suggested that religion and ritual were the principal integrating mechanisms of Hongshan societies (Chifeng 2011; Li 2009; Peterson et al. 2014a). Although the evidence for this is not as conclusive at Lingjiatan, the same is now being suggested for it (Anhui 2006; Liu and Chen 2012; Zhang 1991; Zhang 2000).

1.4 HONGSHAN REGIONAL ORGANIZATION AND NATURE OF COMMUNITIES

It has been argued that studying human communities is vital to understand the forces that produced social change (Peterson and Drennan 2005:5). In past societies, without modern technology and convenient transportation, the choices that people made to locate their residences are limited by their daily activities, which means they would choose to live closest to the people they interacted with most frequently. Thus, the patterns of spatial distribution of settlement can reflect the patterns of interaction and communication between different communities. Regional settlement pattern study, thus, can help us delineate communities of social interactions; analysis at household and community scale can help us understand the activities within communities, as well as the forces that produce the interactions between different communities (Peterson and Drennan 2005:5-6, 28).

Regional settlement study conducted in the Upper Daling region around the Dongshanzui site documents the nature of Hongshan core zone communities (Peterson et al. 2014a). The emergence of Hongshan society coincides with substantial regional population growth. The Hongshan core zone features many large platforms, several unique ceremonial facilities, and well-known burials with elaborate jade objects, including the sites of Niuheliang and Dongshanzui discussed before. Spatial distribution analysis of settlement revealed four regional-scale clusters of local communities, or districts, each a few kilometers across (Figure 1-16). District 2 is internally highly integrated, with an estimated population of 450 to 900. Platform structures and *tongxingqi* sherds were recovered in the demographic center in District 2, suggesting that belief, ritual and ceremony are vital forces in integrating this small but highly centralized Hongshan district (Peterson et al. 2014a:55). In addition, the presence of four clearly delineated supra-local communities indicates that interactions between districts was much less than interactions within districts and the absence of one larger supra-local formation controlling other districts (Peterson et al. 2014a:50-60).

Household and local community scale studies focus on a 16 ha high-density occupation area documented in three locations (that is Dongshanzui, Sanjia, and Erbuchi) in the Upper Daling region survey, focusing on the activities within Hongshan core zone households and communities (Drennan et al. 2017b). Based on dense artifact concentrations on the ground, individual households were delineated, and artifact assemblages were collected from each household to compare with each other. The results indicate that modest prestige differentiation was present in Hongshan society of Upper Daling region, but no wealth accumulation and very minimal productive differentiation and political power were detected. Thus, the interaction and integration of Hongshan communities in Upper Daling revolved around ritual and belief instead of other bases of power (Drennan et al. 2017b:69-70).

1.5 EARLY COMPLEX SOCIETY DEVELOPMENT IN COMPARATIVE PERSPECTIVE

These characteristics of Hongshan societies could not be found out from burials and ceremonial structures alone. It is argued that Hongshan culture, across hundreds of thousands of square kilometers, representing a group of people who shared ritual and burial beliefs, as well as techniques of making pottery and building houses and ceremonial constructions, cannot be taken to indicate “real sociopolitical or economic integration of social units” at this macro-regional scale (Peterson et al. 2014a:59). From the Hongshan case, we see how regional settlement pattern analysis and community scale analysis can help to explore the nature of socio-political interaction and communication of supra-local communities, and this kind of research is lacking for Lingjiatan so far.

Until now except for the excavated burial complex, we know nothing about the social organization and nature of communities at Lingjiatan. We know nothing about the spatial distribution, demography, and organization of communities at Lingjiatan. We do not know whether people lived in dispersed farmsteads or more nucleated local communities. Assessment of what proportion of populations were living in small local communities, and what proportion occupied more dispersed forms of settlement, for example, farmsteads, is important to understanding patterns of interaction at the local scale. We do not know whether supra-local communities emerged in this region or when they emerged if they did. The only evidence suggesting that supra-local communities had developed in this region is the social difference expressed in the different treatment of individuals at death through the placing of valuable goods (jade) in their tombs at Lingjiatan, but the meaning represented by these goods is not clear. It is not certain whether those objects reflect individual possessions or social prestige. In the Hongshan society of the Upper Daling region, the locations of ritual structures are extremely close to the demographic center in supra-local communities; we do not know whether Lingjiatan followed a similar pattern or not. If Lingjiatan site itself was a center around which a supra-local community was organized, then we wonder how large (both spatially and demographically) the supra-local community was and how centralized and integrated the supra-local community was. Hongshan society emerged with substantial regional population growth; we do not know whether Lingjiatan followed a similar pattern or not. In Hongshan society, we can clearly see that the larger-scale sociopolitical or economic integration above supra-local community level was absent. We do not know whether there was any supra-local community enough larger than others to suggest a higher tier of larger-scale political integration in Lingjiatan society. In Hongshan, cultural factors instead of economic exchange mainly account for the integration suggested by the exchange of a very few elaborate jades or other symbolic objects; we do not know whether Lingjiatan followed a similar pattern or not. Wealth, prestige, ritual and productive differentiation are the essential indicators of how complex networks of interaction can be organized in social developments (Drennan and Peterson 2012:75-80). We do not know whether the interaction within communities of Lingjiatan were organized in a similar way to that of Hongshan, which was characterized by strong ritual differentiation, slight prestige differentiation and no wealth differentiation. Understanding these perspectives of Lingjiatan is important in this comparative study.

In Hongshan society, religion and ritual were the principal integrating mechanisms. Although the evidence of ritual authority for Lingjiatan has not been proved, it has been suggested. Understanding the nature of communities in Lingjiatan could make it possible to explore the possibility of this suggestion. If it is true, does this ritual authority represent a similar nature of community and social trajectory in Lingjiatan to that in Hongshan? If different, what were these communities and trajectories like? How do the similarities and differences in burial and ceremonial structures reflect on the nature of communities? If ritual authority was not playing a role in Lingjiatan, what was the force fostering the formation of supra-local communities in Lingjiatan? Do the nature of communities and the developmental trajectories in Hongshan and Lingjiatan differ from other Neolithic complex societies in China? To pursue these prospects, the proposed research sets out to address the following questions:

1) Did people in the Yuxi region live in dispersed farmsteads or more nucleated local communities? How did these patterns change through time?
2) Was the Lingjiatan site a central place in a supra-local community? If so, when did it emerge? Was it there before the Lingjiatan local community? How big (both spatially and demographically) was that supra-local community? How centralized and integrated were the supra-local community?
3) Did Lingjiatan emerge in a context of substantial regional population growth like Hongshan?
4) Is the nature of the supra-local community in Lingjiatan the same as that in Hongshan? Is there a supra-local community enough larger than others so as to suggest a higher tier of larger-scale political integration in Lingjiatan society?

5) How much intra/inter-community wealth, prestige and ritual differentiation was present? To what extent were these activities associated with elites?
6) How do the Lingjiatan patterns resemble or differ from other Neolithic complex societies in China?

An extremely fine-grained regional-scale complete-coverage survey has been carried out around the Lingjiatan site in the Yuxi River valley by the Anhui Province Institute of Cultural Relics and Archaeology, China, in the winter (December to February) from 2008 to 2013, including fieldwork of eight seasons and covering an area of 400 km^2 (Figure 1-17). The materials collected from the survey make it possible to conduct a lab analysis to answer the research questions proposed above. The analytical methods are the same as those used in the regional and household/community scale analyses in Hongshan societies so as to get comparable results for Lingjiatan society (Chifeng 2011; Drennan et al. 2017b; Peterson et al. 2014a). The Hongshan core zone represented by the Upper Daling multi-scale research (including regional survey and household study) are the primary target for comparison. The artifacts collected from this full-coverage, systematic survey of the Yuxi region provide crucial data for identifying the local and supra-local communities and estimating population in this region, which are vital to addressing issues related to prehistoric patterns of human interaction. If the Lingjiatan site was a ritual center as suggested, it does not necessarily mean it played a direct role in organizing patterns of human settlement. Ceremonial structures and burials may have been at the center of supra-local communities, as was the case in Hongshan; or they may have been offset from major concentration of human settlement. The materials from the survey make it possible to explore where humans settled in relation to these ceremonial burials, and make it possible to assess how ritual activities might have structured interaction within supra-local communities. The long time span of the artifacts (from 5700 to 2500 BP) makes it possible to explore the developmental trajectory in the Yuxi region and the role Lingjiatan played in this process. The regional-scale study lays a foundation for the community scale analysis. The small collection units (no bigger than 0.01 ha) that the survey adopted make the resolution high enough to conduct a smaller-scale analysis of both communities and their constituent households. If Lingjiatan site was in a central place in a supra-local community, the local community that Lingjiatan site was in can be identified and explored in greater detail. Based on the sherd density in each 0.01 ha collection unit, it could be possible to delineate individual domestic clusters and to compare the artifact assemblages recovered from each. These comparisons may reveal a similar level of differences of wealth and of prestige associated with different households as was the case in Upper Daling region of Hongshan society (Drennan et al. 2017b), or they may not.

Table 1-1 Comparisons of burial and ceremonial architecture in Lingjiatan, Niuheliang and Dongshanzui.

		Lingjiatan	**Niuheliang**	**Dongshanzui**
Burial goods		Jade as primary burial objects		N/A
	Jade characteristics	Standing human figurines, jade dragon, owls and turtles		N/A
	Burials with jade	86.7%	57.7%	N/A
	Quantity	Average number is 25.8	Average number is 3.5	N/A
	Quality	Low	High	N/A
	Size	Small	Large	N/A
	Jade categories	Ornamental items	Religious symbolism (animal or geometric shapes)	N/A
	Material source	Nearby	Far away	N/A
Burial structure		Burial associated with platform		N/A
	Tomb size	Large	Small	N/A
	Tomb structure	Rectangular earthen pits	Rectangular earthen pits with prepared stone-laying tombs chambers, and surrounded by cylinder jar	N/A
Ceremonial Architecture	*Platform shape*	Near rectangular	Rectangular, round	Rectangular, round
	Platform size	Around $1200m^2$	Multiple	Rectangular: $120m^2$; Round: 20 - $30m^2$
	Platform material	Three layers of earth	Earth, stone, and *tongxingqi*	Yellow earth, stone blocks and stone piles made of conically-shaped stones
	Platform construction sequence	Before the burial	Build after the burial	Built alone without burials
	Goods in Platform	N/A	N/A	House foundation; Adult human skeleton; Ceramic figures; One jade pendant; One turquoise pendant
	Platform function	Not clear (maybe for communal activities)	Ritual activities for crowds	
	Sacrificial pits	Within the platform		N/A
	Sacrificial pits structure	*Hongshaotu* remains	More elaborated (bottom: *hongshaotu*; middle: rocks; top: fine white sands	N/A

Figure 1-1 The location of Lingjiatan, Niuheliang and Dongshanzui site, and the survey region of Yuxi and Upper Daling.

Figure 1-2 Hongshan jade (from Liaoning 2012).

Figure 1-3 Lingjiatan jade (from Anhui 2006 and Anhui 2008).

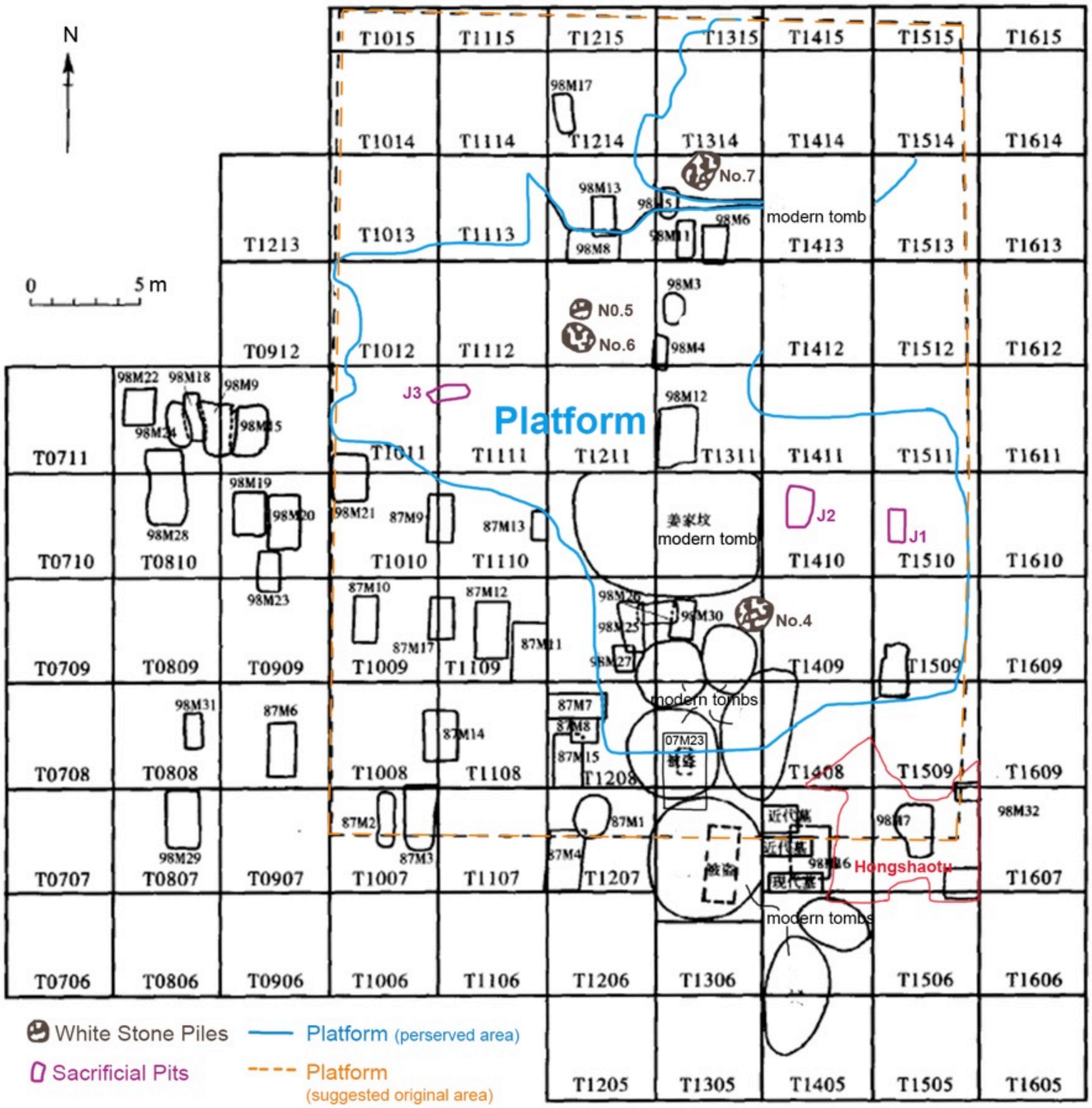

Figure 1-4 The layout of platform with burials at Lingjiatan (modified from Anhui 2006:217).

Figure 1-5 The Lingjiatan platform (modified from Anhui 2006:color plate 10).

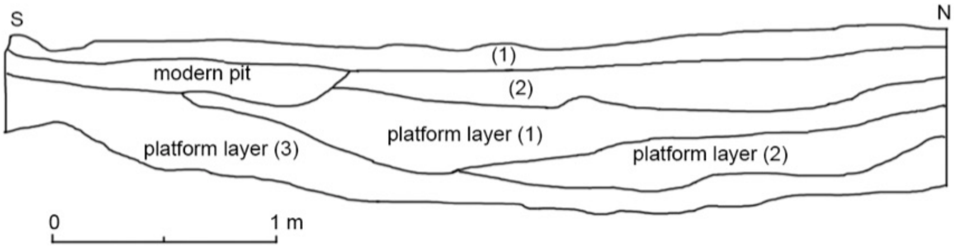

Figure 1-6 Stratigraphy of the platform at Lingjiatan (from Anhui 2006:30).

Figure 1-7 Plan view of the white stone piles (from Anhui 2006:34).

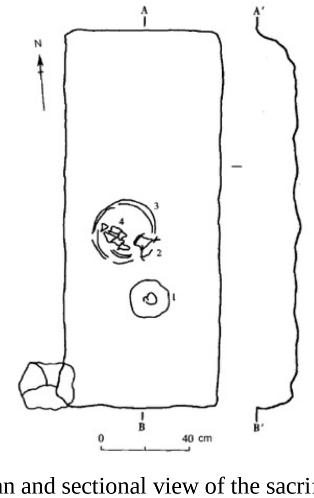

Figure 1-8 Plan and sectional view of the sacrificial pit (from Anhui 2006:33).

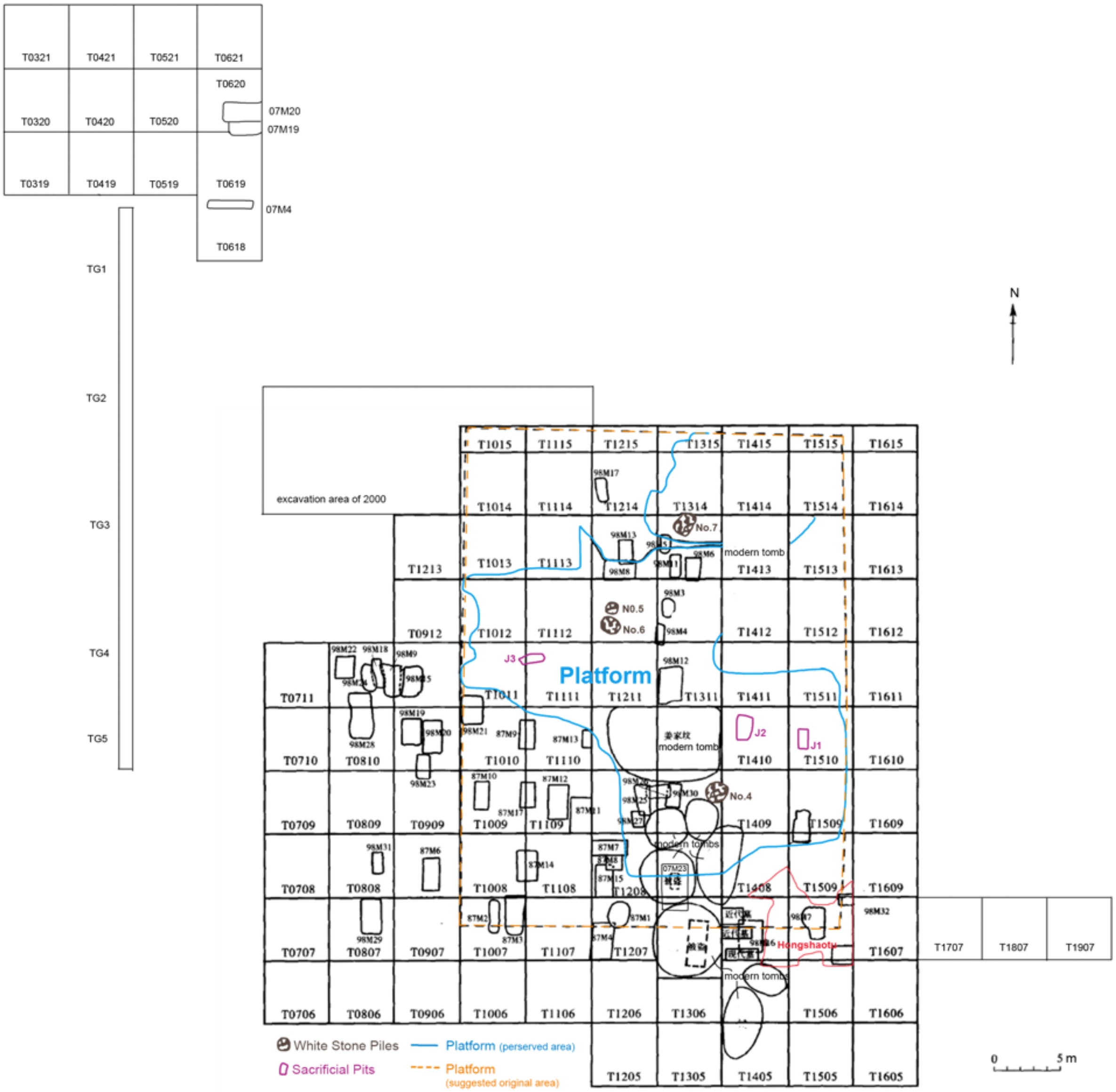

Figure 1-9 Layout of burials at Lingjiatan (modified from Anhui 2006:217 and Anhui 2008:8).

Figure 1-10 Plan and sectional view of 07M23 (from Anhui 2015:11).

Figure 1-11 Plan view of the Goddess Temple (from Liaoning 2012:19).

Figure 1-12 Distribution of the *Jishizhong* at Locality 2 (from Liaoning 2012:56).

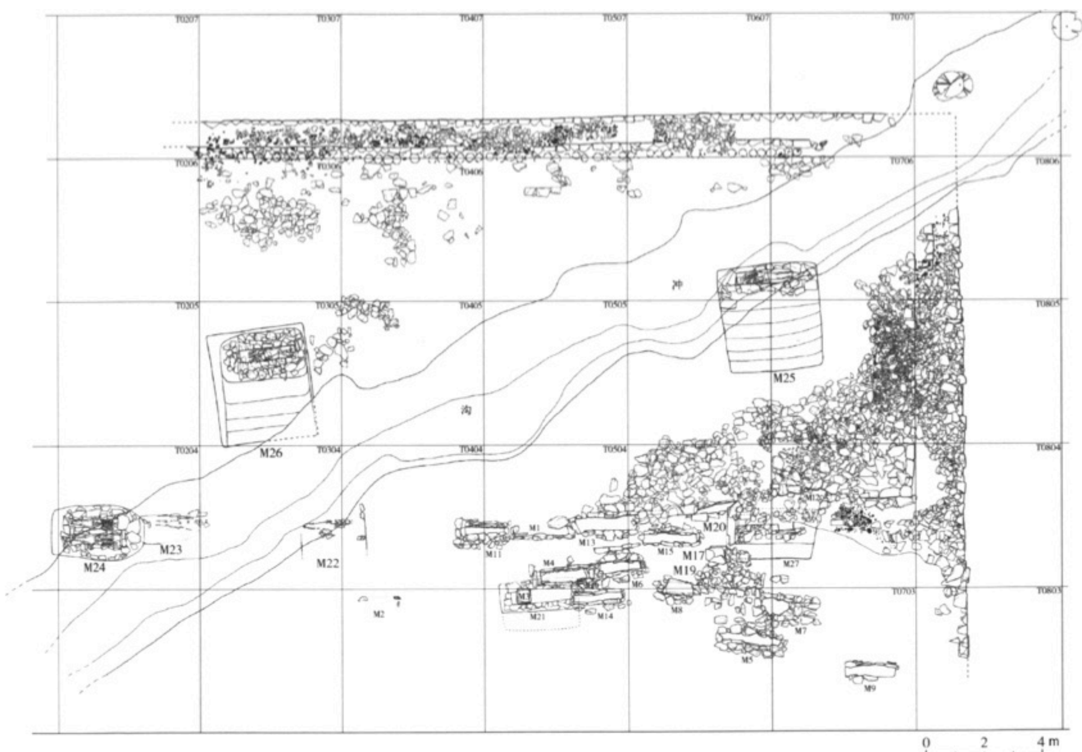

Figure 1-13 Plan view of N2Z1 (from Liaoning 2012:58).

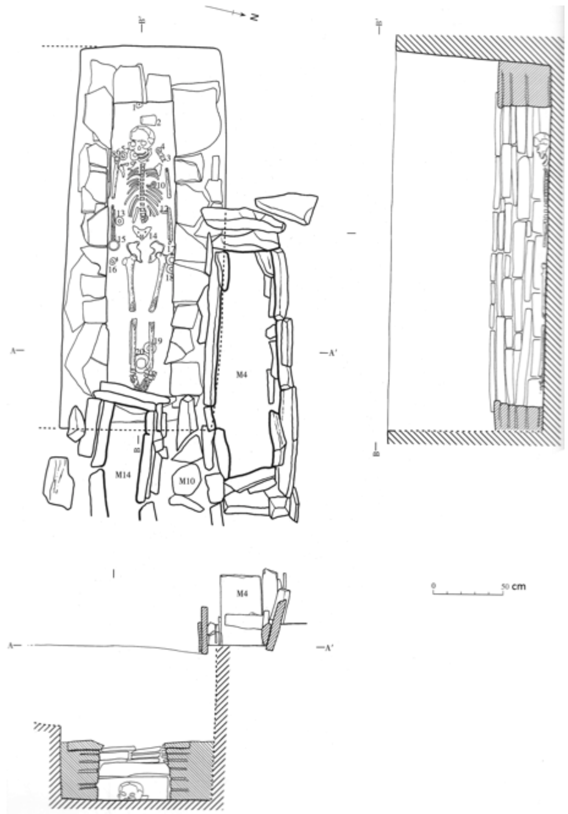

Figure 1-14 Plan and sectional view of N2Z1M21 (from Liaoning 2012:98).

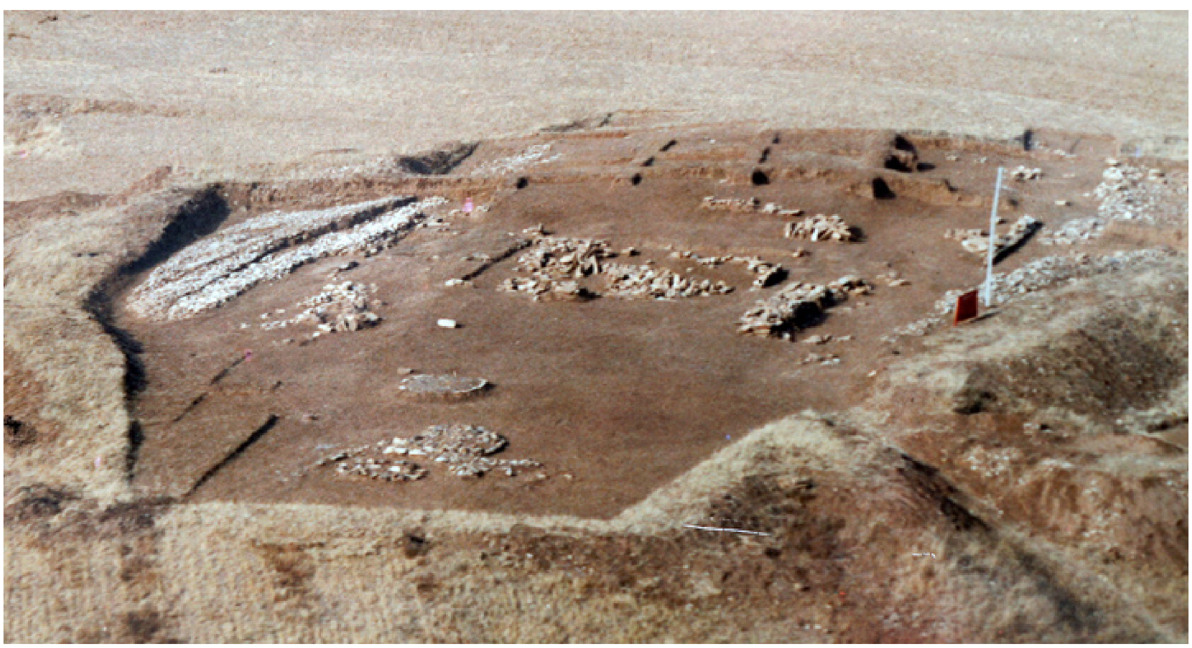

Figure 1-15 The Dongshanzui ceremonial site (from Peterson et al. 2014b).

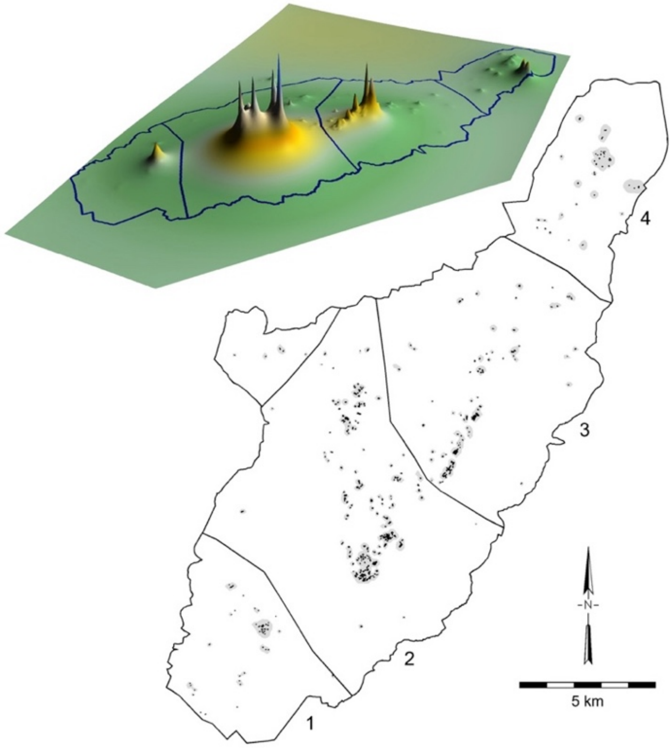

Figure 1-16 Smoothed surface representing Hongshan occupation and map of supra-local communities or districts in the Upper Daling region (from Peterson et al. 2014b).

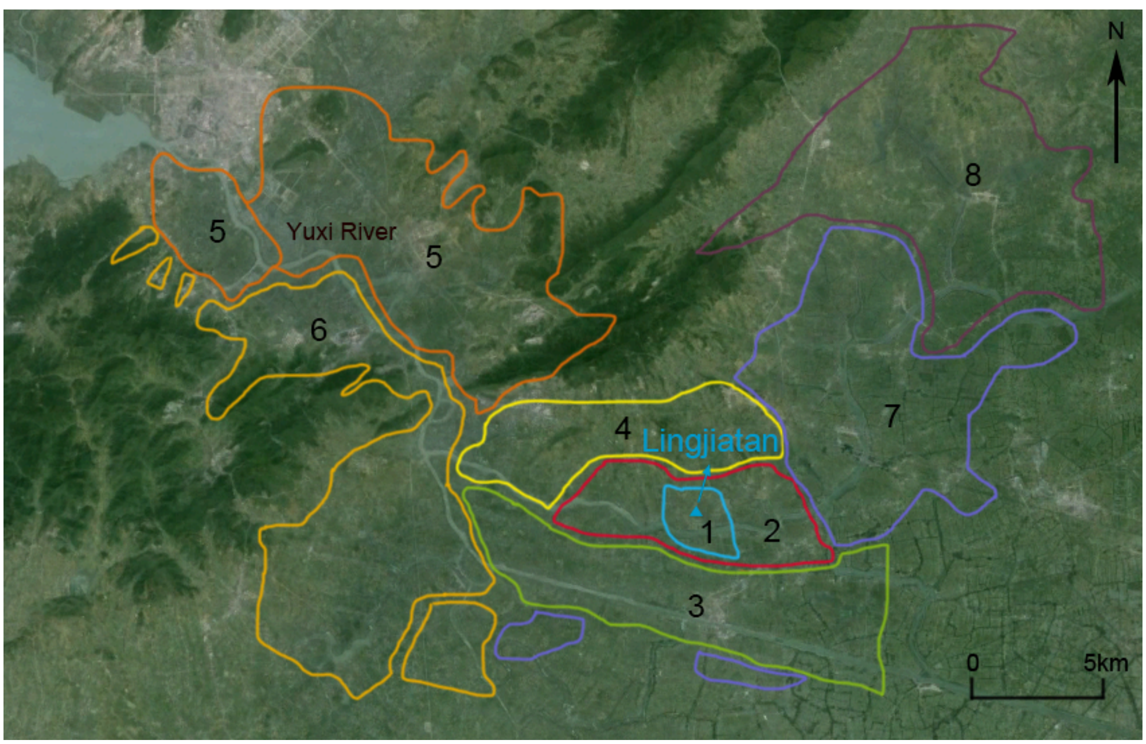

Figure 1-17 Lingjiatan survey region of eight seasons (redrawn from the survey map of Anhui Province Institute of Cultural Relics and Archaeology, Map data: Google, Landsat).

2.0 STUDYING REGIONAL DEMOGRAPHY IN THE YUXI REGION

Systematic regional-scale survey was introduced to China at the end of the twentieth century (Chifeng 2003; Linduff et al. 2004). Such research has moved from the general investigation of individual sites to more systematic and full-coverage regional surveys. A systematic full-coverage regional survey is new in the Yuxi region and can help reconstruct the regional demography and answer the anthropological questions related to social complexity. This chapter introduces the survey zone and its environment, regional survey methods, demographic analysis methods, and the chronological frameworks in the region.

2.1 THE SURVEY ZONE AND ITS ENVIRONMENT

A systematic regional survey zone was delineated around the Lingjiatan site, running southeast to northwest along the Yuxi River towards the east side of Chaohu Lake, covering an area of 400 km^2. The north boundary of the survey zone reaches the Taihu Mountain, and the south stretches to the Yuxi River valley (Figure 2-1). This area covers portions of Hanshan county, Chaohu county and Wuwei county. Lowlands with dense water networks and agriculturally productive soils characterize the natural environment of this zone (Figure 2-2). The climate of the survey zone features a subtropical monsoon and four clearly differentiated seasons. Summer is hot and rainy, and winter is cold and dry. The mean annual temperature is 15.6℃. The average daily temperature is 2.4℃ in January, and 38.8℃ in July. The region averages 220 days without frost each year and receives an average of 1035.7 mm of annual rainfall, 43.4% of which concentrates in June, July, and August (Anhui 2006). The survey area is intensively cultivated today with paddy field agriculture (Figure 2-2). Rice is the key crop; cotton, mulberry, rape, and tea are also widely cultivated. Pigs, cattle, goats, chicken, ducks, and geese are commonly raised.

While located in a flat lowland, the Yuxi survey zone clearly has substantial geographic variation inside the survey boundary. A Digital Elevation Model (DEM), representing the terrain of the region, was created. Figure 2-3 shows the elevation within the survey boundary. The Yuxi river valley floor, of which the elevation is from 0 to 40 m, constitutes a large part of the survey zone land, while small hills, the elevation of which is from 100-200 m dominate the north and west. Overall, the altitude is lower in the south, and higher in the north and the west. Most surveyed landscape lies between 0 and 40 m. The east portion of the zone features many small lakes, indicated in blue in Figure 2-3. Figure 2-4 illustrates the slope variation within the survey boundary. Slopes of most surveyed landscapes are less than 15 degrees, except those in the north, the northwest, and the west can reach 50 degrees. The elevation and slope of the region where the Lingjiatan burial site is located is higher than the surrounding area. Figure 2-5 shows the Yuxi River and its branches running through the survey region. The Yuxi River originates on the east side of Chaohu Lake and runs through the surveyed landscape from the northwest to the southeast, then flows into the Yangzi River in the east. Overall, three distinct geographic zones constitute the variability within the survey zone: flat and paddy fields, hilly wheat fields, and barren land with dry grass (Figure 2-6, Figure 2-7, and Figure 2-8).

2.2 METHODS OF DATA COLLECTION

An extremely fine-grained regional-scale survey was carried out around the Lingjiatan site by the Anhui Province Institute of Cultural Relics and Archaeology. Eight seasons of pedestrian, complete-coverage surface surveys were conducted in the winter (December to February) from 2008 to 2013, covering an area around 400 km^2. December and January present favorable conditions for the survey: sunny weather provides maximum effective work days; wild vegetation is relatively sparse; plowing and cultivation are not intensively conducted. In other seasons, either planting or crop growth interferes with both surface visibility and mobility; rain increases during spring and summer and interrupts the survey very often.

Different methods of data collection were adopted in different seasons. The survey in the first season started adjacent to the excavated Lingjiatan burial site, which is marked in Figure 2-9. The first survey was conducted from December of 2008 to January of 2009 in the survey zone marked "1" in the map (Figure 2-9); the excavated area is included in the first survey. A crew of five members walked zigzag patterns along transects 10 to 15 m apart and collected all artifacts and marked all the *hongshaotu* (红烧土) particles they could see on the surface. Centered on the find spot of the first *hongshaotu* particle found by team members, a square with side length of 2 meters was laid out, and the location, the approximate quantities, and measurements of *hongshaotu* particles were recorded. Once an artifact was seen, it was collected, placed in a bag, and assigned a number. Its coordinates were recorded with a hand-held GPS unit. If two or more artifacts occurred close together, or less than 20 cm apart, they were bagged and recorded together with a single coordinate location. This method of data collection is called “mapping the surface”. The mapping method did not work well in the area of sharp slope, which was usually more densely covered by artifacts than the flat area. Thus, a square of 2 by 2 m was defined in such area, and the GPS coordinates of the find spot of the first artifact were taken as the southwest corner of the collection unit. Everything from the collection unit was collected, placed in a bag, and assigned a number.

The transect spacing of crew members was increased to 30 to 50 m at the beginning of the second survey (January of 2010). This survey zone is marked “2” in the map (Figure 2-9). Crew members still walked zigzag paths along their assigned transects. The rule was that, when an artifact was spotted, the transect spacing was decreased to 10 m (estimated), and a collection unit of approximately 10 by 10 m was laid out with its southwest corner at the location of the artifact. The person alone who was responsible for that transect inspected that collection unit carefully. All artifacts in this collection unit were collected, placed in a bag, and assigned a number. The coordinates of the southwest corner were recorded. Other members continued to walk in their transects, carefully examined the surrounding area on transects at 10 m intervals, and defined additional squares 10 by 10 m as necessary for collections of additional artifacts. In this way, all artifacts visible on the surface were collected across a surface scatter. When members reached territory without artifacts, they resumed walking with zigzag paths along transects 30 to 50 m apart. If artifacts on the surface were very dense, a 2 by 2 m square was laid out quickly by estimate within the 10 by 10 m collection unit. Crew members informally selected random locations within 10 by 10 m units for the 2 by 2 m squares so as to avoid subconsciously placing them where artifacts were most dense. Everything from the collection unit was collected, placed in a bag, and assigned a number. The coordinates of the southwest corner of the collection unit were recorded. The "very dense" region was usually located on a small mound rather than a flat area, and the artifacts on the surface usually were scattered across the whole 10 by 10 m collection units. Initially, teams attempted to collect everything from a 10 by 10 m collection square in these areas. However, it was too difficult for them to carry these bags while continuing their survey. Even just the artifacts from a 2 by 2 square could easily fill at least half of a gunny bag. Also, these artifacts were primarily dated to Zhou dynasty, and few Neolithic artifacts were seen on these small mounds.

This method of data collection which combines 10 by 10 m squares and 2 by 2 m squares continued to be used after the second season of the survey. The survey zone of the third season (January of 2011), the fourth season (February and March of 2011), the fifth season (from December of 2011 to January of 2012), the sixth season (February and March of 2012), the seventh season (from December of 2012 to January of 2013), and the eighth season (December of 2013) are marked “3”, “4”, “5”, “6”, “7”, and “8” respectively in the map (Figure 2-9). The surveyed area of each season is defined in the map as well: 5 km^2, 25 km^2, 40 km^2, 36 km^2, 73 km^2, 80 km^2, 70 km^2, and 70 km^2 respectively (Figure 2-9).

Basic information about each collection unit was recorded in the field, including the location, the collection method, the type of collection, the landscape condition, the surface visibility, and the materials that were collected. At the end of the day, bags of materials were transported to the fieldwork station and were washed and stored. The boundaries of the surveyed area covered in that day were depicted precisely on the map.

The methods of data collection in the Yuxi region were a combination of different survey methods adopted in other parts of China (e.g. Chifeng 2011; Dai 2006; Peterson et al. 2014a; Underhill et al. 1998; Underhill et al. 2002; Underhill et al. 2008), and were initially developed in the Basin of Mexico (Sanders et al. 1979) and the valley of Oaxaca (Blanton et al. 1982; Kowalewski et al. 1989). In the Yuxi survey, occupation was found always to be clustered rather than continuously distributed. Thus, each surface cluster was assigned a site name. However, it is the collection unit, rather than the site that serves as the basic unit of data collection and analysis. The use of "site" as collection unit has always been controversial in the regional survey (Chifeng 2003:122-151; Peterson and Drennan 2005). The “site” is considered as a meaningless unit of analysis in many regions where the distribution of settlement is quite continuous.

The effect of surface visibility on survey results is well known in regional surveys, but how and to what extent surface vegetation affects surface visibility is worth exploring before conducting a regional survey. An experimental surface visibility test was conducted on sunny day with good atmospheric visibility in the winter of 2008. Three landforms - flat and plowed paddy field (Type A, Figure 2-6), hilly wheat field with young crop (Type B, Figure 2-7), and barren land with dry grass (Type C, Figure 2-8) - which can best represent the landscape variability in all seasons of survey, were chosen for the test. Eight crew members, familiar with survey methods and with normal vision, participated in this test. The experiment used 100 sherds, which primarily are red or grey and of the similar size. This made the probability of spotting each sherd the same. Serial numbers were written on the back of each sherd from 1 to 100 so as to make sure the recovered sherds were those prepared for this test (Figure 2-10).

Eight crew members constituted three groups (3,3,2) and worked separately. Three 10 by 10 m collection units were laid out; ten sherds were randomly thrown out in each collection unit. One member of each group started looking for sherds; the others were responsible for timing and recording. The numbers of sherds recovered at 3, 5 and 10 minutes were recorded. When the experiment was finished in the first landform, crew members moved to the second and the third, continuing the same experiments. The results of each experiment were recorded in Table 2-1, Table 2-2, and Table 2-3. The data was used to adjust surface sherds density in the demographic analysis, as discussed below.

2.3 THE CHRONOLOGICAL FRAMEWORK

The chronological framework used for this dissertation research is based on the regional chronology developed by the Anhui Province Institute of Cultural Relics and Archaeology. This original chronological scheme was based largely on physical, morphological, and decorative characteristics of sherds excavated from Lingjiatan site (Figure 2-11) and neighboring sites such as Weigang (Anhui 2015), Xuejiagang (Anhui 2004; Yang 1982), Yandunshan (Ye 2004), Zhangsidun (Beijing 2004), and Guangfulin (Shanghai 2002; Shanghai 2008), as well as C-14 data. This ceramic sequence constitutes seven periods which span the time from 5700 BP to 2500 BP. Period 1, or the Early Lingjiatan period, is dated from 5700 to 5500 BP; Period 2, or the Late Lingjiatan period, is dated from 5500 to 5300 BP; Period 3 (5300 – 4700 BP), 4 (4700 – 4300 BP), and 5 (4300-4000 BP) principally recovered Post-Lingjiatan artifacts; Period 6 (4000-2900BP) is a long gap that no artifacts can be dated to; and Period 7, or the Zhou period, is dated from 2900 to 2500 BP. This sequence has fine chronological resolution but cannot be entirely applied to this region. The proportion of sherds that can be unequivovally assigned to each single period is too low, especiallly for Periods 3, 4 and 5, to build the demographic reconstruction in this research. The morphological and decorative characteristics of sherds that were assigned to Period 1 and Period 2 are similar; it is hard to completely distinguish them. The chronological framework used for this research, thus, is adjusted based on the scheme developed by the Anhui Province Institute of Cultural Relics and Archaeology. For the principal analysis part of this research, Periods 1 and 2 were combined into a single period, so were Periods 3, 4 and 5, to provide a coarser, but more conservative and convincing chronological resolution. Thus, the new chronological sequence applied to this research is Period 1 (or the Lingjiatan period, from 5700 to 5300 BP), Period 2 (or the Post-Lingjiatan period, from 5300 to 4000 BP), Period 3 (the Gap, from 4000 to 2900 BP), and

Period 4 (or the Zhou period, from 2900 to 2500 BP). As an exploratory analysis, this research also considered the possibility of Lingjiatan as Early Lingjiatan and Late Lingjiatan and explored its developmental trajectory and community organization in Chapter 3.

Based on paste, temper, surface conditions, morphological, and decorative characteristics, 12,702 sherds were assigned to four periods: 3,939 pieces for Period 1; 314 pieces for Period 2; 0 pieces for Period 3; and 8,449 pieces for Period 4. There are also 395 unclassified sherds, and 76 indeterminate sherds. Among 395 unclassified sherds, 216 are Han period sherds and 58 are modern sherds, both of which were not systematically collected. Thus, these remains cannot be used in the regional settlement pattern analysis. The remaining 121 unclassified sherds are those different from the aforementioned categories based on paste, temper, surface conditions, morphological, and decorative characteristics. Seventy-six pieces are indeterminate sherds because they are extremely small, worn fragments that are difficult to identify.

The development of long-term social trajectory in the Yuxi survey area is built on the foundation of ceramic chronology, which is primarily research on sherds. The characteristics of sherd paste, temper, color, surface treatments, decoration, methods of manufacture, and vessel form used for chronological determinations are described as follow.

2.3.1 Lingjiatan Period (5700-5300 BP)

Lingjiatan period pottery consists of two broad categories: coarse and fine paste. Coarse paste pottery was fired at a relatively low temperature and has a very loose texture. A mix of sand, plants, quartz, and clamshell was used to temper the clay. Lingjiatan fine-paste pottery was fired at high temperature and has a very pure and fine texture without any temper. The colors of Lingjiatan period pottery are very diverse: most are between orange and red, while reddish-brown, grey, yellowish-grey, and black are also common. Most Lingjiatan coarse-paste ceramics are orange or red, and small amounts of reddish-brown and yellowish-green are also seen (Figure 2-12). The outer surface color is commonly mottled. The inner surface with grey and the outer surface with red or reddish-brown are common for Lingjiatan coarse pottery. Most Lingjiatan fine-paste ceramics are grey and yellowish-grey, and some are finished with a clay slip outside (Figure 2-13). Urns (缸 *gang*), basins (盆 *pen*), bowls (杯/钵 *bei*/*bo*), jars (罐 *guan*), pitchers (壶 *hu*), tripods (鼎 *ding*), stemmed cups (豆 *dou*) are the most common vessel forms for Lingjiatan pottery. Among them, urns (*gang*) with very thick vessel wall and tripods (*ding*) used as cooking vessels are the most abundant vessel forms for coarse pottery (Figure 2-14 and Figure 2-15). For fine paste pottery, the most common vessel forms are serving vessels such as *dou* and jars (*guan*); basins (*pen*), bowls (*bei/bo*), and pitchers (*hu*) also occur in a relatively high frequency (Figure 2-16). Most vessels are utilitarian, and only a very few tiny tripod legs discovered indicate that they could be ceremonial vessels. Lingjiatan period ceramics rarely have decoration, and plain surfaces are found on 99.5% coarse-paste and fine-paste vessels. Forms of incising and raised-strip are observed in extremely small quantities (Figure 2-17). Punctate impressions are found in few tripod feet.

Lingjiatan period ceramics can also be split into Early Lingjiatan and Late Lingjiatan. On the one hand, this distinction is very controversial because the Early Lingjiatan and Late Lingjiatan pottery share many features and are difficult to entirely separate. On the other hand, the Early Lingjiatan and Late Lingjiatan pottery is indeed different on several aspects. The Late Lingjiatan pottery was fired at slightly higher temperatures than the Early Lingjiatan pottery and has a finer and more even texture. Several typical vessels also exclusively belong to Late Lingjiatan. One is the urn (*gang*) with extremely thick vessel wall tempered with plants (the Early Lingjiatan urns were often tempered with sand instead of plants). Urns with unrestricted orifices and coil around the rim are typically the Late Lingjiatan pottery. Large and thick sherds from urns in reddish-brown also belong to Late Lingjiatan. Fine-paste pottery in grey color, and fragments of *dou* vessels substantially increased in the Late Lingjiatan period.

In general, Lingjiatan sherds can be easily recognized, except for some extremely small sherds collected from survey which are too severely worn to be distinguished. Lingjiatan coarse-paste sherds, which are very fragile, are normally light and filled with holes. In contrast to them, ceramics after Lingjiatan period are denser and heavier.

2.3.2 Post-Lingjiatan Period (5300-4000 BP)

Post-Lingjiatan pottery collected in the survey is harder and fired at higher temperatures than that of Lingjiatan. The density of the pottery is higher, and the texture is more uniform. Two-thirds of Post-Lingjiatan pottery is coarse paste tempered with sand, and one-third is fine paste. Some of them share the same mottled surface seen on Lingjiatan sherds, but the surfaces are more likely to be reddish-orange or bright orange (Figure 2-18). Orange and reddish-orange is a very popular color for all paste Post-Lingjiatan pottery and only an extremely small amount of pottery is grey or reddish-black. Post-Lingjiatan pottery shares the similar vessel forms seen on the Lingjiatan pottery. In the instances where the feet of tripods (*ding*) and the large piece body sherds with decoration were preserved, tripods (*ding*) and urns (*gang*) used for cooking and storage were the most commonly identified vessel forms. Very few stemmed cups (*dou*), steamers (*yan*), pitchers (*hu*), and jars (*guan*) were also identified. Post-Lingjiatan pottery commonly has a plain surface; vertical incised impressions on the flat triangular tripod feet (Figure 2-19), and horizontal incised impressions on the thick wall sherd from urns (Figure 2-20) are also the two distinctive features in the Post-Lingjiatan pottery. Post-Lingjiatan tripods (*ding*) can be easily distinguished from the

Lingjiatan period tripods (*ding*). In Lingjiatan times, tripod feet are thin and long and sometimes cone-shaped with plain surfaces or punctuate impressions. Tripod feet in Post-Lingjiatan times are extremely flat and triangular in shape, and some are decorated with vertical incised impressions (Figure 2-19). Post-Lingjiatan urns (*gang*) with finer texture and decorated with horizontal incised impressions can also be easily distinguished from those Lingjiatan period urns commonly with plain surfaces (Figure 2-14). For these large sherds, surface decoration can provide the most accurate way to identify them. For smaller sherds undecorated or heavily worn, the surface color and pottery quality is the most useful information. Although at first sight, these small sherds look very similar to those of Lingjiatan period, the reddish-orange surface color (in contrast to the reddish-brown in the Lingjiatan period), the denser paste tempered with sand, and the firm texture still make them distinguishable from those of Lingjiatan period (Figure 2-21).

2.3.3 Gap Period (4000-2900 BP)

The period dated from 4000 to 2900 BP is very special in the Yuxi River valley. No evidence at all of settlement dated to this period was recovered by the Yuxi survey. Excavations conducted in this region revealed a similar pattern. The excavation of Weigang site in 2013, located 2.7 km away to the northeast of the Lingjiatan burial complex, covering an area of 233 m^2 and sharing the same archaeological culture as Lingjiatan site suggested that none of the excavated remains is dated to 4000 to 2900 BP (Anhui 2015). The excavation of some locations (Figure 2-11) within the Lingjiatan site also indicated the absence of remains dated to this period (these excavated materials are not yet published). The excavation of Ma'anshan site in 2003, located 24 km away to the northeast of Lingjiatan, covering an area of 950 m^2 also supported the indication that remains dated to 4000 to 2900 BP are absent in the Yuxi survey zone (Ye 2004). Based on the evidence known so far, this dissertation agrees with other research and believes that human occupation was not present in this region from 4000 to 2900 BP. Thus, this dissertation research considers Period 3 as “the Gap” in all analyses.

2.3.4 Zhou Period (2900-2500 BP)

Zhou period pottery is significantly different from that of Lingjiatan period and Post-Lingjiatan period in many respects. It was fired at much higher temperatures and had harder and more uniform texture. The colors of the vessel surfaces are more even, and the decorative patterns of the vessels are well standardized. Many decorations on vessels are made in molds. Zhou period consists of 35% coarse-paste and 65% fine-paste pottery. Zhou period pottery has very diverse surface colors, with a considerably high proportion of reddish-brown, brown, grey and black, and a low proportion of yellowish-grey. Fine-paste pottery is principally black or grey, and coarse-paste is largely reddish-brown or brown. Many sherds have smoothed outside surfaces, and only a few have unsmoothed outside surfaces. Vessels sometimes are finished with a fine black clay slip on the outside surface (Figure 2-22). Typical vessels include a large number of tripod caldrons (鬲 *li*), steamers (甗 *yan*) used as cooking vessels; urns (翁 *weng*), jars (罐 *guan*) used as storage vessels; and a small number of basins (钵/盆 *bo*/*pen*) and a few stemmed cups (*dou*) as serving vessels. The most common decoration of Zhou period pottery is cord and incised impressions; stamped impressions are also frequently seen; appliqué strips and punctate impressions are not unusual, though few in number. Coarse-paste Zhou pottery is commonly decorated with cord and incised impressions, sometimes accompanied with punctate impressions or appliqué strips (Figure 2-23). Fine-paste pottery is thicker and harder than coarse-paste pottery and is frequently decorated with stamped impressions made with the aid of molds (Figure 2-24). Another feature of Zhou fine-paste pottery is that its inside surface is very smoothed. Feet of tripod caldrons (*li*) with cord impressions is the most distinctive pottery in the Zhou period (Figure 2-25).

2.4 METHODS OF DEMOGRAPHIC ANALYSIS

The primary focus of this research is to reconstruct regional population and document population changes in regional levels, explore the scale and nature of human communities and regional integration and centralization. The methods used to investigate these patterns are listed as follows.

2.4.1 Population Reconstruction

Population estimates are fundamental to understand how early complex societies were organized and developed. It is vital in this research to understand the regional demography from 5700 to 2500 BP. Archaeologists use various types of evidence and have developed different means to reconstruct ancient population. In the Yuxi region, where architecture and other permanent structures did not preserve on the surface, the way to reconstruct population is largely based on the density and the area of sherd scatter. The essential assumption behind population reconstruction is that - larger numbers of people produce more garbage: when more people live in a particular place for longer times they leave more garbage (Chifeng 2011:57-79). Ceramic sherds, as the most well-preserved household garbage, provide the most useful and consistent evidence for population reconstruction. The Yuxi region population reconstruction followed the same approach to population estimates developed for the Chifeng region (Chifeng 2011; Drennan et al.

2015), which is also the method used for the Upper Daling valley (Peterson et al. 2014a). To make the population estimates for the Yuxi region compatible to those of Upper Daling valley, several conversions were applied to the original survey data, including correcting surface sherd density based on the results from the experimental surface visibility test.

The results generated from the experimental test of surface visibility were applied to correct the sherd density in the regional survey. In the Yuxi regional survey, the average time spent on each collection unit was 4 to 5 minutes; therefore, the number of sherds recovered in 5 minutes in the test was considered a reference for correcting the sherd density. The mean of numbers of sherds recovered in 5 minutes in the test for different types of lands with error ranges at 90% confidence level were calculated by Systat (Table 2-4), and these numbers gave a strong confidence in using them as "correction factors".

The surface sherd density (in sherds per m^2) is equal to the total number of sherds on the surface divided by the area from which they were collected. For example, a collection unit which has an area of 100 m^2 with 3 sherds in Period 2 and 8 sherds in period 4 has a density of 0.03 sherd per m^2 in Period 2 and 0.08 sherd per m^2 in Period 4. If a collection was made from a square of 4 m^2 within a collection unit of 100 m^2 with the number of 4 sherds in Period 1 and 24 sherds in Period 2, then the density should be 1 sherd per m^2 in Period 1, and 6 sherds per m^2 in Period 2. The survey recorded the land type of each collection unit. The flat and paddy fields (type A), the hilly wheat fields with young crops (type B), and the barren land with dry grass (type C) constitute the land types in the regional survey. The results from the experimental test of surface visibility indicate that in the same amount of time, the number of sherds collected from the type B land is 1.6 times and 1.7 times more than that from the type A and type C land, respectively. Considering that the negative effect that the paddy fields and dry grass might bring to the surface visibility, densities from all type A land and type C land were multiplied by 1.6 and 1.7 respectively, to bring them up to equivalence with land type B, which is the one most comparable with the Upper Daling valley.

AutoCAD Map 3D was used to process the survey data. The GPS coordinates recorded in the survey were imported into AutoCAD Map 3D to make closed polylines that represent individual collection units. Squares representing collection units surveyed by different methods were drawn in different layers, therefore, four layers were created: a layer with all 1 by 1 m squares that represent all "mapping" artifacts; a layer with all 2 by 2 m squares; a layer with all 10 by 10 m squares that were fully surveyed; and a layer with all 10 by 10 m squares that were only partially surveyed with an area of 4 m^2. Due to the errors of the GPS units and the fine resolution of the survey, some squares were slightly overlapped in the map. These squares were carefully moved and adjusted so as to obtain a clean base map for the regional and community scales analysis. One layer containing point entities that provide locations where *hongshaotu* was observed, and another containing text information that represents sequence numbers of collection units was also drawn. A database with complete information for all collection units was attached to this drawing. Densities of different periods were added to the squares as "elevation". In the end, four layers were prepared for analysis: a layer of 277 point entities that provide locations where *hongshaotu* was observed; a layer of 505 squares with non-zero values for Period 1 (the Lingjiatan period); a layer of 63 squares with non-zero values for Period 2 (the Post-Lingjiatan period); a map of 1,020 squares with non-zero values for Period 4 (Zhou period). Two additional layers for Early Lingjiatan and Late Lingjiatan were also generated for analysis. With the help of Idrisi and Surfer, these layers generated smoothed surfaces of distribution of population demonstrated in Chapter 3.

Area-density index which utilizes the data of the specific area of each collection unit was used for reconstructing population at the Yuxi region. The essential principles of the area-density index can be found in the regional settlement study of Chifeng (Chifeng 2011:64-65). The introduction of this concept helps to avoid the problems of only counting sites or collection units without considering how large they are. When densities are multiplied by areas, the density of the surface garbage and the area of the surface garbage are intertwined together to represent the surface occupation. For the Yuxi region, due to the different collection methods applied and for a better comparison to the Upper Daling valley, the area-density index also needs to be converted so as to estimate absolute population.

The complexity arises in the different ways of dealing with the areas these surface sherds densities are taken to characterize. With collection units of 50×50 m in the Upper Daling survey, there are places within the calculated areas of sherd scatter where sherds might often not be seen in multiple patches as large as 10×10 m. Whether there are sherds in those patches that could be found with enough careful looking is not the issue. The fact is that such places are included in the calculation of occupied areas in the Upper Daling survey but not included in the calculation of occupied areas in the Yuxi survey. Thus, the areas as measured by the two surveys cannot be compared directly. This can be allowed for in calculating the area-density index for Yuxi to produce an area-density index that is directly comparable to the one from the Upper Daling survey, and this makes it possible to convert the Yuxi area-density index into absolute population estimates using the same conversion factor as in the Upper Daling survey.

First, it is vital to look at how the 10×10 m collection units from the Yuxi survey would combine within 50×50 m cells in a raster layer, schematically representing hypothetical 50×50 m collection units like those used in the Upper Daling survey. There are 305 10×10 collection units with Period 1 sherds. These would add up to a total of 30,500 m^2. These occur in 199 different 50×50 m cells, which total 497,500 m^2. Scaling the Yuxi area up by this kind of factor (30,500 becomes 497,500) would, however, be too much. If, for example, only a single 10×10 falls in a 50×50 m cell, it seems likely that the Upper Daling survey would measure this very small sherd scatter as less than 50×50 m. On average, such a place might get measured as a sherd scatter 25×25 m on average (625 m^2). Similarly, if two 10×10 m collections fall in a 50×50 m cell, the Upper Daling survey would usually measure this sherd scatter as less than 50×50 m—probably about 40×40 m on average (1,600 m^2). If three or more 10×10 m collections fall in the same 50×50 m cell, this would probably get measured by the Upper Daling survey as a "full" 50×50 m collection unit (2,500 m^2). Thus, counting for the Yuxi survey, Table 2-5 was generated. For the 10×10 m collection squares in the survey that total 30,500 m^2, the Upper Daling survey would have calculated some 343,075 m^2 of occupied area. This is a ratio of 11.25. That is, the Upper Daling survey would have counted about 11.25 times more area than the Yuxi survey (30,500 m^2 × 11.25 = 343,125 m^2). Information of this correspondence can be used by multiplying the Yuxi area-density index by 11.25. It can then be divided by the four centuries of Period 1 (the Lingjiatan Period). And the result can be multiplied by the same 750 and 1,500 used in the Upper Daling survey to produce minimum and maximum population estimates. For example, the area-density index of Period 1 for the Yuxi survey area is 0.6056, multiplied by 11.25 is 6.662, and then divided by four centuries is 1.665. This number multiplied by 750 and 1,500 gives a population estimate of between 1,250 and 2,500 for the Yuxi survey area in Period 1. The same procedure was applied to Period 2 and 4. For Period 2 the area of 10×10 m collection units in the survey is total 5,700 m^2, then the conversion factor is 38,275/5,700, that is 6.71 (Table 2-6). Period 2 area-density index for the Yuxi survey area is 0.1171, multiplied by 6.71 is 0.7857 and divided by the 13 centuries of

Period 2 is 0.06. This number can be multiplied by 750 and 1,500 to produce the estimated population for the surveyed area in Period 2, that is between 45 and 90. For Period 4 the area of 10×10 m collection units in the survey is total 57,900 m^2, then the conversion factor is 524,750/75,900, that is 6.9 (Table 2-7). The area-density index of Period 4 for the survey area is 7.1375, multiplied by 6.9 is 49.24 and divided by the four centuries (2900-2500 BP) of Period 4 is 12.31. This number can be multiplied by 750 and 1,500 to produce the estimated population for the surveyed area in Period 4, that is between 9,000 and 18,000.

2.4.2 Delineating Communities

The population reconstruction that was made for the Yuxi region was not only significant for estimating the scale of regional populations but also vital for understanding the scale and nature of human communities. Communities are created in the interaction between households - the key elements to daily life in many societies. Reconstructing the nature of the human communities and the patterns among their interactions is an essential part of understanding the trajectories of change of early complex societies (Chifeng 2011:80). It is believed that patterns of interaction among communities can be revealed from forms of spatial distribution of the population.

The approach used to delineate communities follows the approach developed by Peterson and Drennan (2005). The concept of "community" here does not refer to a specific spatial scale but rather to centrally focused social interaction across space. The basic principle is that for people in premodern contexts without modern transportation facilitating interaction is an important concern in deciding where to live. According to distance-interaction principles people who live in close proximity to one another interact more frequently than those who live farther apart (Peterson and Drennan 2005:5-6). Thus, the delineation of spatial clusters as interaction communities in the

Yuxi region is through understanding how remains are distributed across the landscape, to answer the question of how people choose where to live across the landscape.

With the help of AutoCAD 3D Map, Idrisi, and Surfer, the density of human occupation represented by ceramic sherds in the Yuxi region as a topographic surface with the z-value as elevation was produced. The spatial clusters of density dots were delineated as local communities; the spatial clusters of local communities at a supra-local scale were delineated as supra-local communities based on a mathematical smoothing of the GIS layer (Peterson and Drennan 2005).

2.4.2.1 Local and Supra-local Communities

To delineate local communities, the collection units for each period and their area-density index discussed above were first represented as a grid of z-values at the resolution of 0.25 ha (50 m by 50 m) GIS cell. The z-value for each square 50 m cell in the grids is the sum of each surface sherd density of collection units, each multiplied by the portion of the 0.25 ha cell among which the collection units covers. This layer of 0.25 ha grid cells represented by a surface of different z-values is the essence for delineating local communities in the Yuxi region. For delineating supra-local communities, a new value is assigned to each cell for each period to mathematically smooth the values in the original grids for the Yuxi survey area. This new value is calculated with the interpolation method of Inverse Distance Weighting, in which "Distance" is raised to some power. That is, in determining the z-value for any point in the interpolated grid, all data points are averaged, but data points far from a grid point count less in the average for that grid point because the z-value for a data point is multiplied by 1/Distance and Distance is raised to some power. If Distance is raised to a very high power (e.g. 4 or greater), then smoothing is negligible because only very nearby data points count much in the averaging. If Distance is raised to a very low power (e.g. 0.001) then smoothing is strong because it depends much less on just nearby points. If Distance is raised to the 0 power, then all data points count equally (Distance raised to the 0 power is always 1) and the result is a surface smoothed completely flat (Chifeng 2011:81-82). It is clear to see local communities grouping into larger supra-local communities after the mathematical smoothing of the density surface. These supra-local scale communities are especially significant because “the structure that is revealed depends not just on separation distance between collection units or local communities, but also reflects the higher levels of interaction produced by larger concentrated populations” (Chifeng 2011:83). These smoothed surfaces produced for each period of human occupation are presented in Chapter 3.

2.4.2.2 Settlement Ranking and Regional Centralization

The regional settlement analysis in Chapter 3 follows the approaches developed in the regional settlement study in the Chifeng and Upper Daling region (Chifeng 2011; Peterson and Drennan 2005, 2012; Peterson et al. 2014a) which include site-size histograms, rank-size graphs and centralization analysis aiming at studying the nature and the scale of local communities and their interactions. Site-size (sites refer to local communities in clusters) histograms are used to demonstrate the frequency distributions of local communities and the estimated populations in different size.

Rank-size graphs are used for demonstrating the hierarchy and degree of integration of settlements. The rank-size graph is a plot of settlement size against the ranking of settlement size in logarithmic scales. In the case that the second-ranked settlement is half the size of the largest, the third-ranked settlement is one-third the size of the largest and so on then this pattern is taken to be “normal” for a well-integrated centralized settlement system. When the second-ranked settlement and after are larger than expected, then the pattern is taken to represent a loosely integrated system (Chifeng 2011:86-87). The level of integration is expressed through *A* coefficient, which was developed by Drennan and Peterson (2004) and calculated through a rank-size program. Positive values of *A* suggests that settlements ranking after 1 are larger than expected, which represent a "convex" pattern. While negative values of *A* indicate concave or primate pattern, in which case the system is strongly integrated under the governing of a central settlement (Chifeng 2011:87).

The centralization analysis is another way to look at regional centralization which stresses the actual distribution of the population in the region. By graphing the proportion of the estimated population in the 12 equal-area rings around the demographic center of a polity, the degree of demographic centralization in the polity can be represented by the value of *B* coefficient. When all the population concentrates in the central ring, the value of *B* would reach 1, indicating maximum centralization. A *B* value of 0 would show exactly opposite patterns, indicating that the distribution of the population in each ring is completely equal and the centralization is minimum (Drennan and Peterson 2008).

The site-size histograms, rank-size graphs of settlements with 90% confidence zones, and the centralization graphs with 90% confidence zones in the Yuxi survey area are all presented in Chapter 3.

Table 2-1 Results from experimental test of surface visibility in the flat and paddy fields (type A).

Group Number	*Serial No. of sherds*	*No. of sherds recovered by 3 min*	*No. of sherds recovered by 5 min*	*No. of sherds recovered by 10 min**
1	1~10	4	5	N/A
1	11~20	5	5	N/A
1	21~30	7	7	N/A
2	1~10	7	7	N/A
2	11~20	5	6	N/A
2	21~30	0	0	N/A
3	21~30	6	6	N/A
3	1~10	5	6	N/A

** The data of 10 min is missing.*

Table 2-2 Results from experimental test of surface visibility in the hilly wheat fields with young crops (type B).

Group Number	*Serial No. of sherds*	*No. of sherds recovered by 3 min*	*No. of sherds recovered by 5 min*	*No. of sherds recovered by 10 min*
1	31~40	4	6	9‘25"*
1	41~50	5	7	8
1	51~60	8	8	8’20"*
2	31~40	7	4‘37"*	N/A
2	41~50	4	7	9
2	51~60	9	9	6'34"*
3	31~40	9	3‘35"*	N/A
3	51~60	2’58"*	N/A	N/A

** Represent recovered all 10 sherds by that time.*

Table 2-3 Results from experimental test of surface visibility in the barren land with dry grass (type C).

Group Numbr	*Serial No. of sherds*	*No. of sherds recovered by 3min*	*No. of sherds recovered by 5min*	*No. of sherds recovered by 10min*
1	61~70	3	4	5
1	71~80	4	6	6
1	81~90	2	3	6
2	61~70	1	3	5
2	71~80	3	5	6
2	81~90	4	6	8
3	81~90	7	7	7
3	71~80	5	5	6

Table 2-4 Mean with error range at 90% confidence level for three land types.

Land Type	*Mean of Numbers of Sherds recovered by 5 mins*	*Error Range at 90% confidence level*
A	5.25	±1.508
B	8.375	±1.070
C	4.875	±0.975

Table 2-5 Steps for calculating Period 1 conversion factor of area-density.

	Counting for Period 1 of Yuxi
Step1	43 50×50 m cells contain 1 10×10 m collection (or part of 1); 43×625 m^2 = 26,875 m^2
Step2	82 50×50 m cells contain 2 10×10 m collections (or parts of 2); 82×1,600 m^2 = 131,200 m^2
Step3	74 50×50 m cells contain 3 or more 10×10 m collections (or parts); 74×2,500 m^2 = 185,000 m^2
Step4	Total area that would have been counted in the Upper Daling survey: 343,075 m^2
Step5	305 10×10 collection units with Period 1 sherds; so the area is 30,500m^2
Step6	343,075/30500=11.25

Table 2-6 Steps for calculating Period 2 conversion factor of area-density.

	Counting for Period 2 of Yuxi
Step1	39 50×50 m cells contain 1 10×10 m collection (or part of 1); 39×625 m^2 = 24,375 m^2
Step2	4 50×50 m cells contain 2 10×10 m collection (or part of 2); 4×1600 m^2 = 6,400 m^2
Step3	3 50×50 m cells contain 3 or more 10×10 m collection (or parts); 3×2500m^2 = 7,500 m^2
Step4	Total area that would have been counted in the Upper Daling survey: 38,275 m^2
Step5	57 10×10 collection units with Period 2 sherds; so the area is 5,700 m^2
Step6	38,275/5700=6.71

Table 2-7 Steps for calculating Period 4 conversion factor of area-density.

	Counting for Period 4 of Yuxi
Step1	202 50×50 m cells contain 1 10×10 m collection (or part of 1); 201×625 m^2 = 126,250 m^2
Step2	60 50×50 m cells contain 2 10×10 m collection (or part of 2); 60×1600 m^2 = 96,000 m^2
Step3	121 50×50 m cells contain 3 or more 10×10 m collection (or parts); 121×2500m^2 = 302,500 m^2
Step4	Total area that would have been counted in the Upper Daling survey: 524,750 m^2
Step5	759 10×10 collection units with Period 4 sherds; so the area is 75,900 m^2
Step6	524,750/75,900=6.9

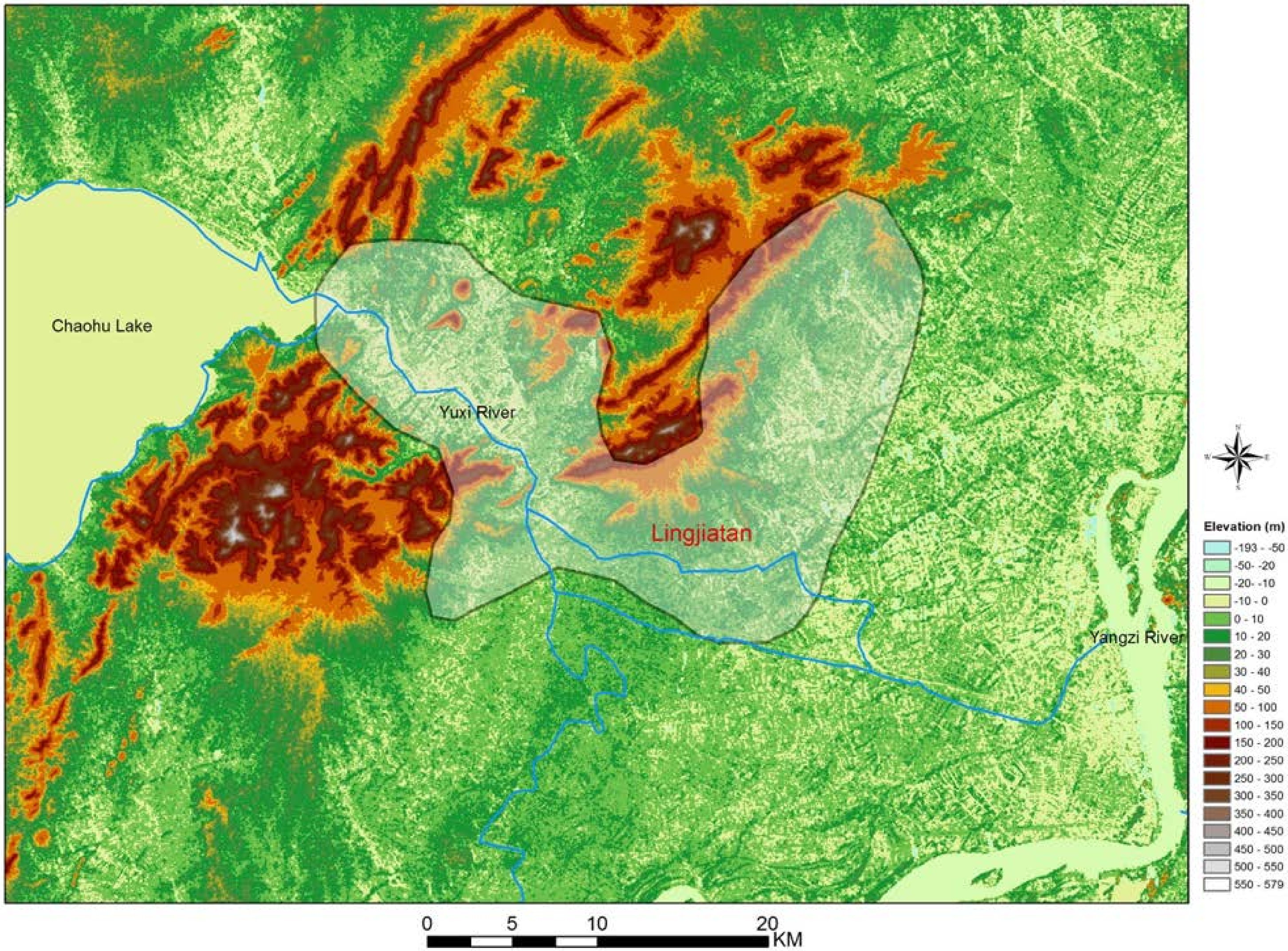

Figure 2-1 The Yuxi survey area and the location of the Lingjiatan cemetery (from ASTER GDEM).

Figure 2-2 Landscapes of the Yuxi survey area (Photos courtesy of Wu Weihong).

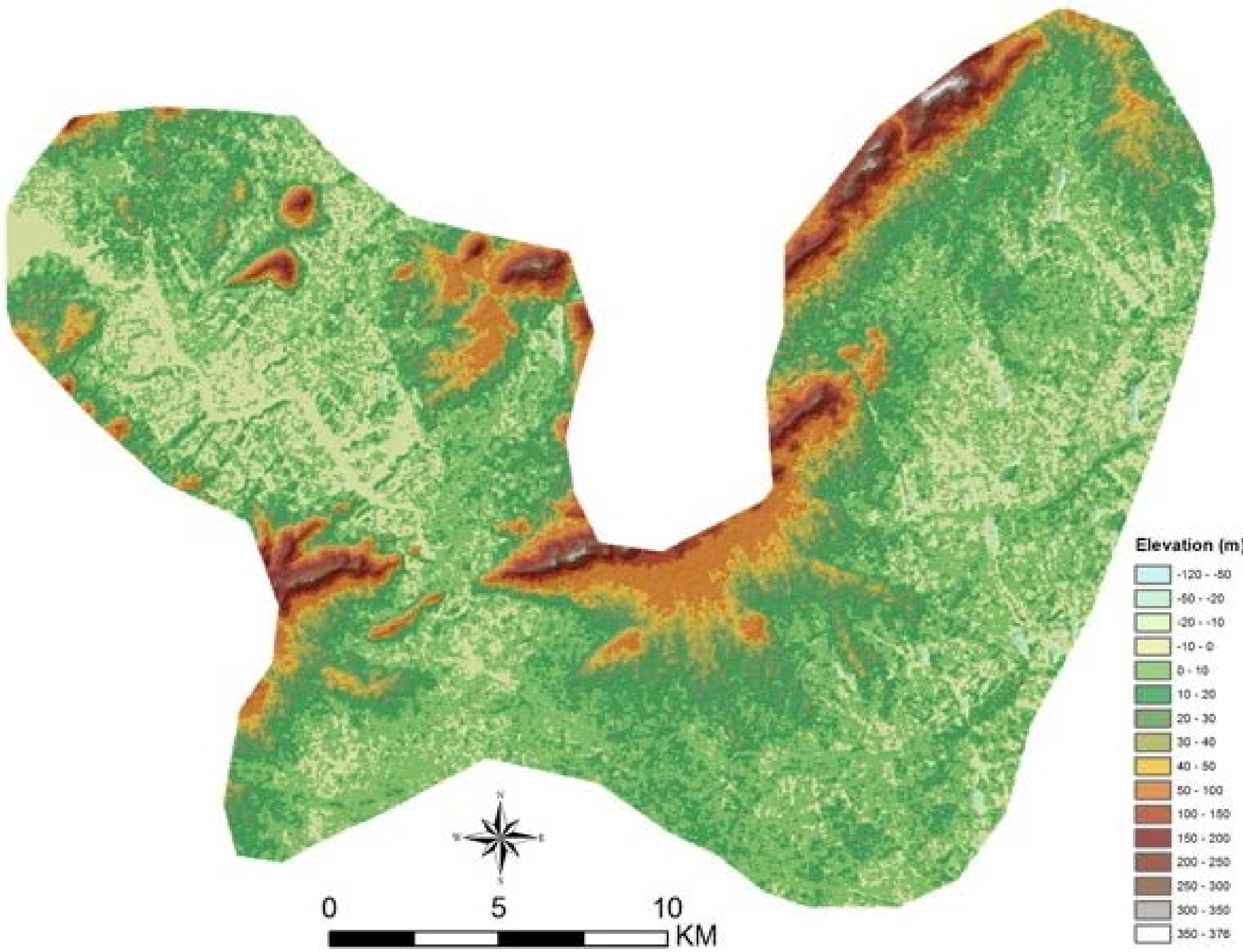

Figure 2-3 Elevations of the Yuxi survey area (from ASTER GDEM).

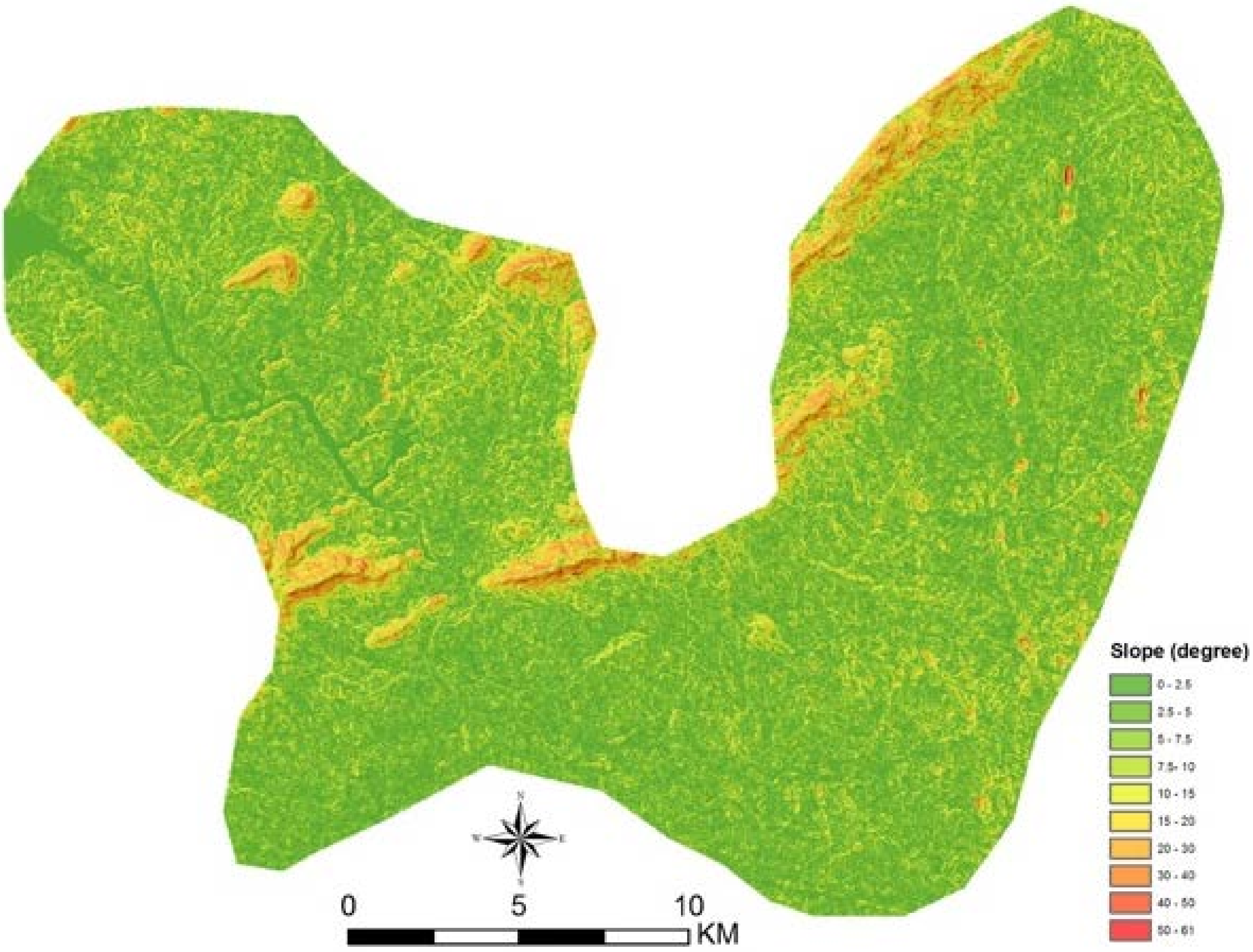

Figure 2-4 Slopes of the Yuxi survey area (resolution is 30 m, from ASTER GDEM).

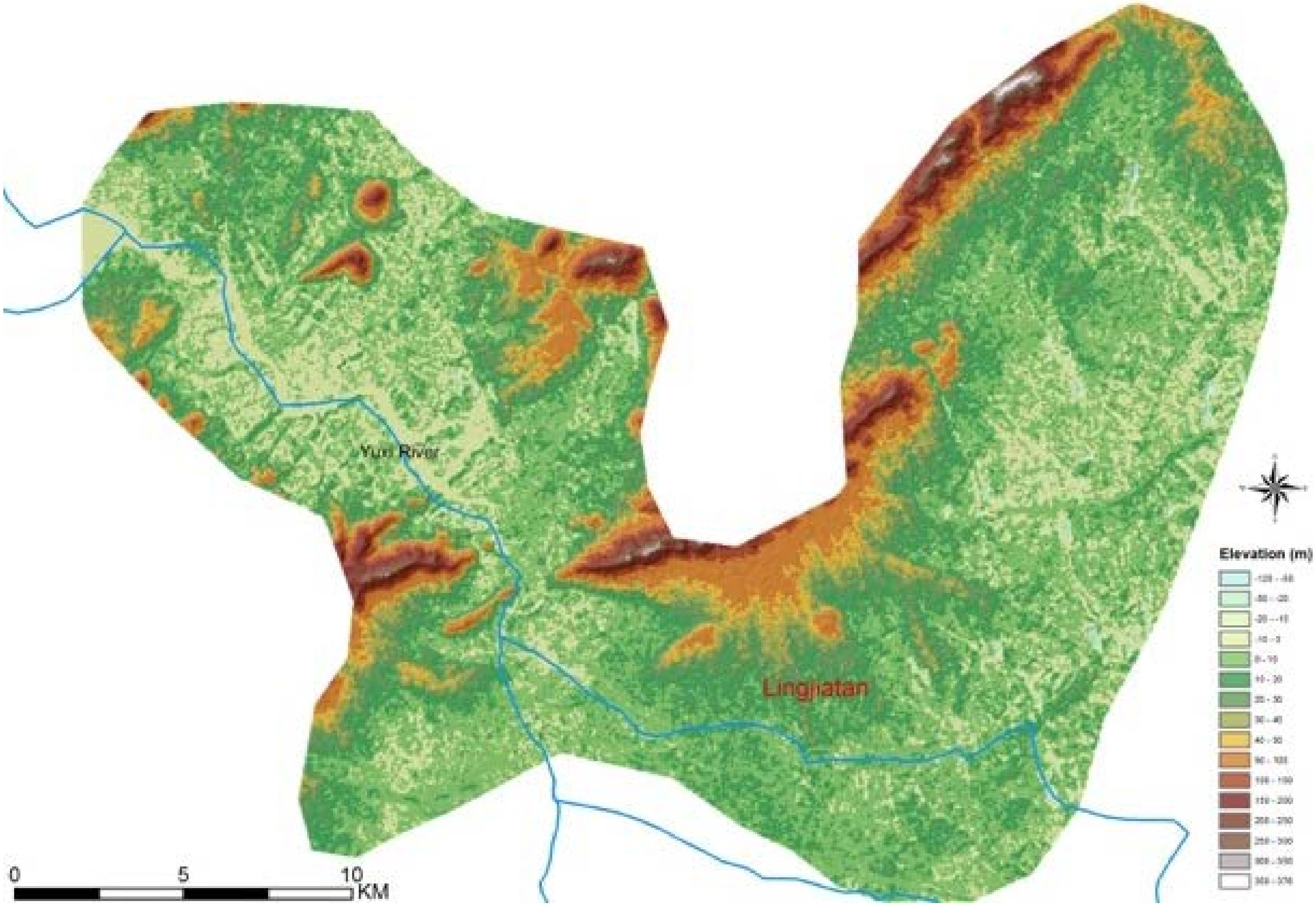

Figure 2-5 Rivers of the Yuxi survey area (from ASTER GDEM).

Figure 2-6 Experiments in the flat and paddy fields (Photo courtesy of Wu Weihong).

Figure 2-7 Experiments in the hilly wheat fields with young crops (Photo courtesy of Wu Weihong).

Figure 2-8 Experiments in the barren land with dry grass (Photo courtesy of Wu Weihong).

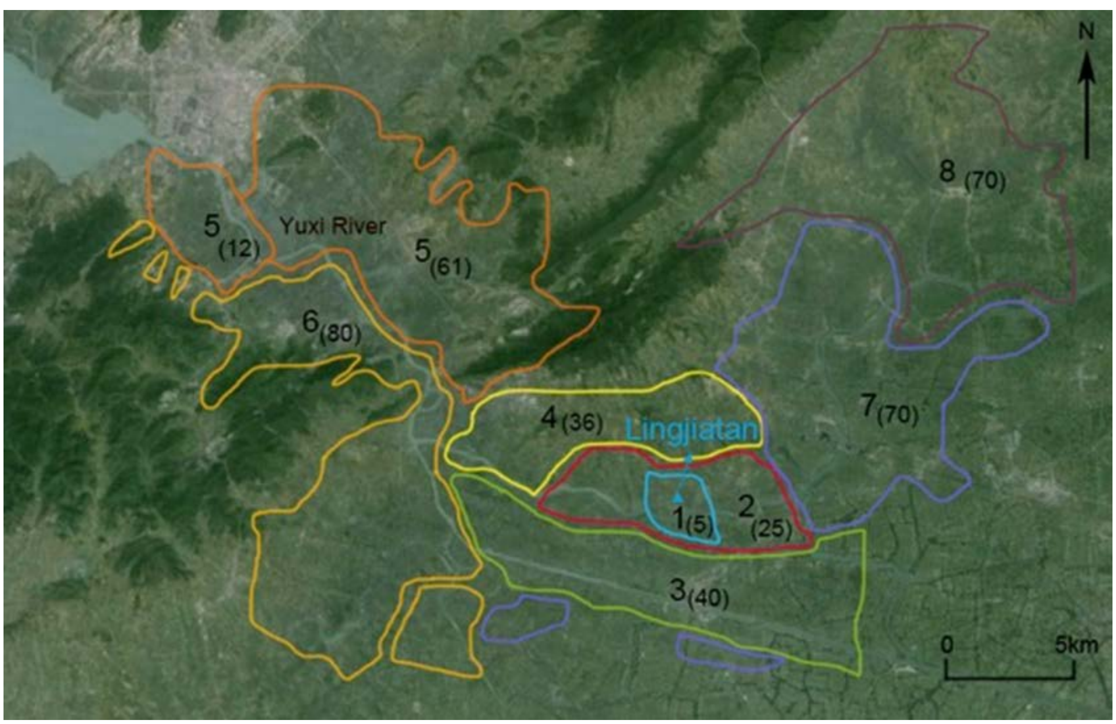

Figure 2-9 Survey boundaries and areas for each season in the Yuxi region (redrawn from survey map provided by the Anhui Province Institute of Cultural Relics and Archaeology, Map data: Google, Landsat).

Figure 2-10 One hundred sherds with serial numbers.

Figure 2-11 Location of the Shitouwei and Nanbankan excavated within the Lingjiatan site (Map data: Google, DigitalGlobe).

Figure 2-12 Lingjiatan coarse-paste sherds.

Figure 2-13 Lingjiatan fine-paste sherds.

Figure 2-14 Lingjiatan urn (*gang*) sherds.

Figure 2-15 Lingjiatan tripod (*ding*) feet sherds.

Figure 2-16 Lingjiatan *dou* sherds.

Figure 2-17 Lingjiatan *dou* stem with incised impressions.

Figure 2-18 Post-Lingjiatan sherds: with horizontal incised impressions (left) and with plain surfaces (right).

Figure 2-19 Post-Lingjiatan sherds of flat triangular tripod feet: with plain surfaces (left) and with vertical incised impressions (right).

Figure 2-20 Post-Lingjiatan sherds of thick wall of urn with horizontal incised impressions.

Figure 2-21 Post-Lingjiatan small fragments of sherds.

Figure 2-22 Zhou sherds with black clay slip outside.

Figure 2-23 Zhou coarse-paste sherds with cord, incised, punctate impressions or appliqué strips.

Figure 2-24 Zhou fine-paste sherds with stamped impressions made by molds.

Figure 2-25 Zhou sherds of feet of tripod caldrons(*li*) with cord impressions.

3.0 EARLY COMPLEX SOCIETY GROWTH IN THE YUXI REGION

This chapter follows the classic pattern of regional settlement analysis through documenting the estimated population, and the nature and scale of community interactions from the earliest Neolithic remains to the historical Zhou period in the Yuxi survey area.

3.1 THE EMERGENCE OF CHIEFDOMS IN THE YUXI REGION

The trajectory of social change in the Yuxi region stretches across 3200 years. No early Neolithic remains (before 6000 BP) at all were encountered. Since early Neolithic occupation is known for the lower reaches of the Yangzi River valley, a larger area of which the Yuxi survey is a part, it seems likely that there was a little, but not very much, utilization of the Yuxi area during early Neolithic times. The remains would be recovered if there had been very much early Neolithic occupation of the area. If early Neolithic occupation was very slight, then it is possible that it could escape detection. It is possible that during the early Neolithic, a very small population was spread through the Yuxi region and settlements shifted frequently which makes it very hard to recover traces of where they were.

3.1.1 Period 1, or the Lingjiatan Period (5700-5300 BP)

Altogether 3,939 Lingjiatan sherds were recovered in the Yuxi survey area from 505 separate collection units covering a total area of 4 ha. The distribution of these sherds is quite uneven. Sherds clustered in some locations, indicating the distribution of population and formation of local communities created by the force of social interaction (Figure 3-1). The approach to local communities by cluster analysis was explained in Chapter 2. In the unsmoothed density surface (Figure 3-2), high peaks stand for tight clusters of collection units with high densities of Lingjiatan period sherds. These clusters are normally no more than a few hundred meters across. According to Chifeng (2011:109), clusters at such scales fit the classic definition of local communities. In the Lingjiatan period, the spatial cluster analysis reveals 64 local communities spread widely across the region. These local communities range from single-family farmsteads to a substantial village with a population estimated at 350-700 inhabitants (Figure 3-1). The largest local community of 350-700 inhabitants is where the Lingjiatan burial site is located. Two other local communities are estimated at more than 100-200 inhabitants; another four local communities are estimated at more than 50-100 inhabitants. More than half of the local communities are single-family farmsteads (Figure 3-3), however, they only consist of a very small part of the Lingjiatan regional population. Over half of the regional population resided in the larger local communities estimated at more than 50-100 inhabitants (Figure 3-4).

Spatial clustering at supra-local scales was delineated through a mathematically smoothed occupation density surface based on the principles developed by Peterson and Drennan (2005). Larger villages are in the center around which local communities revolve, forming clusters that can be evidently separate from other centrally focused clusters by sparse occupation between them (Figure 3-5). These clusters appear as high peaks in the smoothed occupation density surface. The tallest peaks represent spatial clusters of smaller local communities gathering around the largest village in the center. These clusters are defined as supra-local communities (Chifeng 2011; Drennan and Peterson 2008; Peterson et al. 2014a) and can be visibly delineated by a cut-off contour on the smoothed surface (Figure 3-5). At least three settlement clusters, separated from each other by very sparsely occupied space, are visible on the surface (Figure 3-5). Their emergence in Lingjiatan indicates the most crucial social transformation that occurs during the Neolithic. These regional-scale clusters, referred to as supra-local communities or districts, indicate the centripetal social interaction that attracts the local communities together into larger social units. The supra-local community towards the southeast (District 2) is 11-15 km across with a population estimated at 640-1,280. It is also the largest supra-local community and forms around the Lingjiatan burial site. The supra-local community in the northwest (District 1) and northeast (District 3) are both 8-10 km across with a population estimated at 200-400. Two small spatial clusters sparsely occupy the territory between District 1 and District 2.

A rank-size pattern of the most populous District 2 and a corresponding *A* value of -0.611, suggest that this district is highly integrated around a central community that is larger than the second largest communities (Figure 3-6). Communities of one or two inhabitants were omitted from the rank-size analysis. Since population estimates made in this way are averages for the entire period, a local community had a population of one or two is to say that at least one family lived there but for only a short period. It is reasonable for excluding them from the rank-size analysis since they were one or two families that were not there for very long periods of time. The largest local community includes the Lingjiatan burial complex area where the intensive excavations were carried out, and it forms a major demographic center in this district as well as in the whole survey region. The burial complex lies about 310 m west of the major demographic center. Surroundings of the largest local community include three or four much smaller communities separated from the largest one by a short distance. The pattern that tall demographic peaks surrounded by much smaller communities may suggest intensive patterns of internal interaction in District 2.

Centralization analysis is another way to look at the degree of centralization (Drennan and Peterson 2008). Figure 3-7 graphs the distribution of the estimated population in each of the 12-concentric equal-area rings around the demographic center of District 2. The *B* value of 0.671 indicates a relatively high degree of centralization (Figure 3-8). Thus, it is safe to say that the estimated population is relatively strongly centralized in the region of District 2.

It is suggested that religion and ritual were the principal integrating mechanism in Lingjiatan society, and the Lingjiatan site possibly assumed a special status within the Yuxi region, perhaps as a ritual and ceremonial center. The public works and plethora of exquisite jades are seen as an indication that the elites may have held unique ritual power (Dai 2002; Li 2004; Liu and Chen 2012; Shuo 2000; Zhang 1991; Zhang 2006; Zhang 2000; Zheng 2014). Figure 3-7 graphs the locations of the remains of the public works and *hongshaotu* (红烧土). The rectangular "platform," along with *hongshaotu* remains, burials and sacrificial pits were all recovered within the central ring in District 2. The "platform" and burials were about 310 m west of the highest peak in the smoothed density surface (Figure 3-5). It is very clear that the location of the burials coincides with the centralization of the population in space in District 2. The public works are not located far away from the residential system; instead, they are extremely close to the demographic center. This pattern supports the idea that participation in the ritual activities attracted people from all directions and ritual activities played an important integrative social role in creating a strong centralized Lingjiatan community.

District 1 in the northwest and District 3 in the northeast show similar patterns. A rank-size graph (Figure 3-9) of District 1 shows a concave pattern (*A* = -1.718), with a broad error range due to the small numbers of local communities (communities of one or two inhabitants were omitted from the rank-size analysis). The high *A* value suggests that District 3 is a social unit with even stronger integration than District 2. A rank-size graph (Figure 3-10) of District 3 shows a regional-scale social unit, less strongly integrated than District 2 and District 1, but still well-integrated with the *A* value of -0.522. The error zone for 90% confidence, however, is wide enough that the rank-size line could stray into the positive area and still remain within the error zone. In terms of the actual distribution of the population in space, two districts show similar patterns again. Centralization graphs (Figure 3-11, Figure 3-12, Figure 3-13, and Figure 3-14) of District 1 and District 3 indicate relatively strong centralization with the *B* value of 0.579 and 0.573, respectively, although not as strong as those seen in District 2. No such correspondences between population distribution and ritual facilities in District 1 and District 3 were found as it is in District 2. No such public works or ritual facilities, or even pieces of *hongshaotu* were detected outside District 2.

The occupied territory between District 1 and District 2 is hard to be defined as a supra-local community. Two villages separated far from each other are visible on this surface. Some scattered farmsteads occupied the zones between the villages (Figure 3-5). Again, none of these villages has evidence of ritual facilities recorded.

It has been suggested that sociopolitical integration is a different thing from other kinds of communication and interaction that can occur at very large scales. When a group of people, though distributed spatially across thousands of square kilometers, shared similar customs, beliefs, and techniques of making and decorating pottery, and practices of building houses and burying the dead, they are considered sharing a same archaeological culture (Peterson et al. 2014a:59).

However, cultural interactions do not necessarily indicate sociopolitical or economic integration. Sociopolitical units are not the same as cultural units. Lingjiatan culture across the Yuxi survey area, thus, does not necessarily indicate sociopolitical integration at that scale. The nature of these supra-local communities and the sociopolitical relationship between them need to be further explored.

In the Yuxi region, District 2 has the largest estimated population, which is even larger than the total of the rest supra-local communities. The largest local community in District 2 has the largest estimated population of any local community in the survey zone. The excavated burial complex and the public works are all located inside the largest local community in District 2. This raises the possibility that District 2 represents the central focus of sociopolitical integration on a larger scale.

A rank-size pattern of the entire survey area (Figure 3-15) with the *A* value of -0.122 suggests that the Yuxi survey area is fairly integrated around a central supra-local community. However, the error zone for 90% confidence is still so wide that the statistical confidence in this result is weak. Compared to District 2 alone, the whole survey region shows a much weaker sociopolitical integration. Furthermore, the centralization graph (Figure 3-16 and Figure 3-17) with the *B* value of 0.191 indicates that the survey region as a single system has very little centralization. The Yuxi survey zone does not seem to be a sociopolitically or economically integrated single system. Instead, each district seems a relatively independent and self-integrated social unit.

Although overall sociopolitical integration seems not to have existed in the Yuxi survey zone, the inhabitants of the three separate Lingjiatan supra-local communities of the Yuxi survey zone would clearly have interacted with each other to some degree. The presence of individual villages or farmsteads in the zones between the supra-local communities, especially between

District 1 and District 2 (Figure 3-5) suggests such peaceful interaction and lack of conflict. Compared to interactions within districts, these interactions between supra-local communities would have been less intensive. As the zone between District 2 and District 1 was occupied by more settlements than between District 2 and District 3, it is likely that District 2 interacted more with District 1 than with District 3.

Most scholars believe that the Lingjiatan site possessed a special status, perhaps as a ceremonial or ritual center in the Yuxi region. The jade artifacts in special figures and with geometric patterns are seen as ritual paraphernalia indicating that the elites might have held unique ability to communicate with other realms (Liu and Chen 2012; Shuo 2000). This unique ritual power attracted people from all directions in the Yuxi survey area to participate in ceremonial activities held in the Lingjiatan site. It is the District 2 alone that had public works and elaborate burials. This pattern reflects ritual functions uniquely served within District 2. It is doubtful, though, that the unique public facilities indicate that District 2 headed a larger scale social formation through controlling other neighboring districts by the organization of ritual activities. The *A* value from the rank-size analysis and the *B* value from the centralization analysis both indicate that the entire region had little integration or centralization as a social unit (Figure 3-15, Figure 3-16, and Figure 3-17). The patterns observed in the Yuxi region are more consistent with multiple independent, supra-local social units of similar scales across the zone covered by the Lingjiatan culture. Ritual facilities and elaborate burials might indicate some degree of ritual power. However, this kind of power was restricted within District 2 and did not act as a centripetal force to create a strongly integrated and centralized social unit at a larger regional scale beyond District 2. Ritual interactions between districts at the larger regional scale undeniably existed. The rectangular probable platform and burials containing jade artifacts and *hongshaotu* remains present everywhere at Lingjiatan site indicate a possible open space for people gathering together for ritual and ceremonial activities. These public features are unique among excavated and Lingjiatan culture sites in the Yuxi region, suggesting that people from neighboring districts traveled across the region for ritual interaction on occasion. However, given the discussion of the distribution of settlements above, this kind of ritual interaction was much weaker than that seen in District 2.

It has been argued that prestige goods exchange plays a crucial role in the formation of sociopolitical complexity (Brumfiel and Earle 1987; Earle 1991, 1997, 2002). Jade artifacts, as prestige goods in Lingjiatan, are less likely to have such a role. Research focusing on prestige goods exchange often overlooks what quantities of what goods were moved when a major role is suggested for prestige goods exchange in the development of complex societies. The existence of prestige goods exchange does not necessarily indicate its major impact on society and economy, unless these goods were moved in sufficient quantities (Drennan 1984, 1985). Exchange of small quantities of luxury or symbolic commodities, like jade artifacts, even if moved over a long distance and across multiple independent supra-local communities, does not require sociopolitical integration of the entire Yuxi survey area. This exchange of luxury goods in the Lingjiatan archaeological culture while important for displaying ritual and religious power would not have had a major economic impact on these early complex societies.

It is then, accurate to describe the Yuxi survey area in the Lingjiatan period as small chiefly polities with populations in the hundreds across some tens of square kilometers that were separated by sparsely occupied zones. District 2, despite having a larger population than others, is not enough larger to suggest a higher-level center of sociopolitical integration and centralization of multiple supra-local communities. Nevertheless, the extreme elaboration of burial complex along with *hongshaotu* remains in the center of District 2 does indicate that the ritual activities and religious power acted as an integrating force gluing population together in District 2. This ritual force might be absent in District 1 and 3, though the pattern associated with the emergence of regional integration did exist as suggested by clustering of settlements. The population of District 1 primarily concentrated in a single central community, suggesting an intensification of interaction among the inhabitants living in these communities of District 1. Such dense settlements might be connected to productive specialization or economic interdependence among the inhabitants (Peterson and Drennan 2005). This possibility would need to be further explored through community and household scale analyses.

3.1.2 Period 2, or the Post-Lingjiatan period (5300-4000 BP)

Post-Lingjiatan materials are much less abundant in the Yuxi survey area than those of Lingjiatan period. In the Yuxi survey zone, Post-Lingjiatan sherds recovered total 314 (out of 13,173 sherds). These sherds came from 63 separate collection units that covered a total area of 0.57 ha. This small amount of remains produces an estimated population of 45-90 inhabitants for the Yuxi survey area. The distribution of inhabitants is quite sparse, and occupation is almost absent except for the middle area of the survey zone. Most collection units are isolated from each other, and only a few collection units close together can be clustered as a single local community (Figure 3-18). Only 29 local communities, or settlement units can be delineated on the surface. All of them are composed of one or two families except for the largest one. The largest local community has an estimated population of 35-70, which means more than 70% of the inhabitants lived in the largest community (Figure 3-19). There is no indication of the existence of supra-local communities in the Post-Lingjiatan period. A single major population center is noticeable in the right-central portion of the survey zone, representing the largest single village in the survey zone (Figure 3-20 and Figure

3-21). Given the very small estimated population that the number of sherds in the Post-Lingjiatan period suggests, it is meaningless to carry out rank-size and centralization analysis.

It is challenging to interpret such scarce remains identifiable to the Post-Lingjiatan period in the Yuxi region. The limited ceramic remains constituted two groups. Among 314 sherds, 285 sherds are as same as the remains excavated from the Late Xuejiagang site (5300-4300 BP), 200 km away from the Lingjiatan site to the southwest. The remaining 30 sherds are as same as the remains excavated from the Guangfulin site (4300-4000 BP), 400 km away from the Lingjiatan site to the east, of which the remains are identifiable to the Late Liangzhu archaeological culture.

On the face of it, the very sparse remains identified to Post-Lingjiatan period implied a devastating population decline. It has been suggested that a deterioration of climate in the Late Neolithic period contributed to the abandonment of many settlements across a large area of China (e.g. Liu and Feng 2012; Wu and Liu 2001; Xu 1998; Yasuda et al. 2004; Zhang et al. 2007a; Zhang et al. 2011; Zhang et al. 2007b). However, there appear to be many inconsistencies in these arguments. In North China, the specific date suggested for this climate fluctuation is not clear at all. Some argued that the beginning of this fluctuation was around 6000 BP, but there were also other studies suggesting that it occurred around 5000 BP, 4000 BP, or 3500 BP (e.g. Huang et al. 2004; Li et al. 2003; Peng et al. 2005; Wu and Liu 2001; Wu and Liu 2002; Zhang et al. 2004). Besides, although most studies suggested that a colder and drier climate was present during this period, a few studies based on pollen argued for the presence of warmer and wetter conditions during this period (Li et al. 2003; Liu 1988). In South China, studies indicate a climate change around 4000 BP, but the pollen data suggesting drying climates contradicts the geologically documented rising water levels and flooding in the middle and lower reaches of the Yangzi River indicating much wetter climates (Liu and Feng 2012; Wu and Liu 2001). It is not at all clear what the true temperature and precipitation patterns were like in the Yuxi region. Moreover, it is vital to notice that, even if such climate fluctuation did occur around 4000 BP in South China, it still cannot account for the supposed collapse of Lingjiatan, which started around 5300 BP, more than 1000 years earlier than the suggested date of the climate catastrophe.

Another possible explanation to the sparse remains is that current knowledge of ceramic typology from 5300 to 4000 BP is incomplete to fully recognized Post-Lingjiatan sherds. The typology of the Post-Lingjiatan period sherds was primarily based on the excavated data of two neighboring sites: Xuejiagang in the southwest and Guangfulin in the east. The principal way to distinguish Post-Lingjiatan sherds from those of Lingjiatan period is telling in the differences of the shape and decoration patterns of tripod feet. For small, severely worn sherds from surface survey, it is difficult to accurately date them due to the similarity between Lingjiatan and Post-Lingjiatan sherds. Thus, it is possible that a portion of Post-Lingjiatan sherds were mislabeled as Lingjiatan period sherds.

Among the total 13,173 sherds from the survey, 471 (3.5%) sherds are unclassified or indeterminate since they are too tiny and worn to be correctly recognized. Even if all of them belong to the Post-Lingjiatan period, it still represents a very tiny population. Adding this population to the Post-Lingjiatan period would not change the appearance of a devastating population decline in this period. Current knowledge is insufficient to understand the pattern revealed in the Post-Lingjiatan period of the Yuxi region. A better chronological framework is essential for clarifying this issue in the future.

3.1.3 Period 3, or the Gap Period (4000-2900 BP)

The Gap period dated from 4000 to 2900 BP almost overlapped with the Shang period in the Central Plain of China. No evidence of settlements dated to this period was found in the Yuxi survey area except for a few fragmentary sherds whose characteristics cannot be discerned. The lack of remains in the Yuxi survey area does not signify that no one ever lived here during the Gap period. It is likely that settlements were few and moved around from 4000 to 2900 BP and their remains are difficult to encounter on the surface. This gap period is not a single event, for other archaeological surveys or excavations in the middle and lower reaches of the Yangzi River valley revealed similar patterns during this period (Anhui 2004; Anhui 2006; Anhui 2008; Anhui 2015; Guo 2005; He 2004; Lu 2011). For instance, a full-coverage systematic regional survey covering an area of 58 km^2 conducted in the Jianghan Plain, in the middle-reaches of Yangzi River, revealed that the population during this period is estimated at 5 to 10, if any at all (Li 2016).

3.1.4 Period 4, or the Zhou Period (2900-2500 BP)

A total of 8,449 Zhou sherds were recovered in the Yuxi survey area from 1,020 separate collection units covering an area of 7.6 ha. The distribution of these collection units is extremely uneven, with pronounced clusters towards the east of the survey region. The significant increase in the number of sherds discovered in the Zhou period suggests quite substantial population growth from the Lingjiatan and Post-Lingjiatan periods. Zhou population of the survey area is estimated at 9,000-18,000. The unsmoothed occupation density surface is the basis for cluster analysis of collection units with Zhou period sherds (Figure 3-22). Totally 102 local communities were delineated (Figure 3-23), with the largest local community reaching a population estimated at

3,000-6,000 and three other large communities of populations over 500-1,000. Nine local communities have populations above 100-200; four local communities have more than 50-100 inhabitants, and a total of twenty local communities have fewer than 50-100 inhabitants. The vast majority were again only farmsteads of one or two families (Figure 3-24). However, this large number of farmsteads only accounts for a very small proportion of the population (Figure 3-25). More than half of the population lived in larger settlements with populations more than 500-1,000 inhabitants.

Different from early periods, only one supra-local community (District 1) 11 kilometers across is evident in the mathematically smoothed surface of Zhou period occupation (Figure 3-26). The tallest peak in the center of District 1 which represents a very compact and nucleated population, could be called a “town” (Peterson et al. 2014a).

District 1 is suggested to be internally integrated around a central place by the rank-size graph and a corresponding *A* value of -0.693 (Figure 3-27). However, the centralization graph indicates that those local communities are fairly dispersed within the district and the *B* value of 0.400 implies that District 1 is moderately centralized (Figure 3-29 and Figure 3-30).

At a much larger regional scale, the settlement pattern is quite different compared to the early periods. Rather than consisting of multiple autonomous districts as those seen in the Lingjiatan Period, the rank-size pattern for Zhou period, with an *A* value of -0.468, implies that the entire Yuxi survey area was well integrated into a single system (Figure 3-28). The centralization graph, with the *B* value of 0.652 shows that around 60% of the population concentrated in the center ring, suggesting that the entire Yuxi survey area was strongly centralized (Figure 3-31 and Figure 3-32). District 1 has a substantially larger population than others and stands out as a principal supra-local community encompassing the entire area. Above this, the degree to which the population of District 1 concentrated into a single central town also increased. The high degree of population nucleation in the town would imply an increase of interaction among the inhabitants (Peterson and Drennan 2005).

The reconstruction of political organization in the Yuxi survey area during the Zhou period is consistent with the historical knowledge of the very large-scale state-level political integration extending far beyond the survey region during this period. Historical records confirm that the Yuxi survey zone was occupied by a polity called "*Nan Huaiyi*" (南淮夷) since 3000 BP, a low-level administrative subunit in the peripheral areas within the large political integration of Zhou dynasty (He 1986; Liu 1983). The Shang and Zhou states in the Central Plain specifically used this name to refer to the "barbarians from the south living in the Huai River valley." Above this, some documents mentioned that the Yuxi region is in the bound of the "watershed of Huai River and Yangzi River" (*Jiang Huai Fenshuiling* 江淮分水岭). *Jiang Huai Fenshuiling* is the southern border of the Western Zhou Dynasty (3000-2500 BP), and the political and ecomonic impact of this very large-scale state-level polity rarely extended beyond this border (Gong 1999; Hsu 1984). Thus, in the Zhou period, the Yuxi survey area, though much more strongly centralized on a larger spatial and demographic scale than earlier social formations, was just a small part of a huge politically integrated state known historically.

3.2 SUMMARIZING PATTERNS OF GROWTH AND DECLINE IN THE YUXI REGION

Regional-scale settlement research in the Yuxi region documented a complex sequence of social change from 5700 to 2500 BP in an area of 400 km^2 in South China. The early Neolithic occupation was extremely slight. Settlements shifted over time, and their remains were not encountered in the survey. Lingjiatan (5700-5300 BP) remains were considerably abundant on the landscape with a population estimated at 1,250-2,500; settlement clusters appeared at both local and supra-local scales. The emergence of true integration and centralization of districts at a supra-local scale is considered as the most crucial social transformation that occurs during the Neolithic in the Yuxi region. While population across the Yuxi region shared a similar archaeological culture, there is no evidence suggesting a strong socio-political integration or centralization present at any larger scale than these districts. Excavated data from Lingjiatan site suggests a strong focus on religious and ritual activities. However, this kind of power did not act as a centripetal force to create a strongly integrated and centralized social unit at a larger regional scale beyond District 2.

Post-Lingjiatan (5300-4000 BP) occupation was very small, sparse, and widely scattered. The population declined drastically, and only a few local communities could be defined.

A new surge of development emerged in the Zhou period (2900-2500 BP) right after the long gap period (4000-2900 BP). The numbers of settlements increased substantially with a total population estimated at 9,000-1,8000 in Zhou times. Historically-documented, much larger-scale, state-level social formations that centered in the north began to impact the settlement system of the Yuxi survey area. A complete reorganization of the settlement system developed in the Zhou period; the Yuxi survey area, though much more integrated and centralized on a larger spatial and demographic scale than ever, was a small part of a huge political integrated state.

3.3 AN ALTERNATIVE EXPLORATORY ANALYSIS: RETHINKING THE LINGJIATAN PERIOD

As discussed above, the original chronological scheme developed by the Anhui Province Institute of Cultural Relics and Archaeology has finer resolution. Based on the survey and excavated data from the Lingjiatan burials and other sites in the Yuxi region (Anhui 2004; Anhui 2006; Anhui 2008; Anhui 2015; Shanghai 2002; Shanghai 2008; Ye 2004), two periods were proposed, that is the Early Lingjiatan period (5700-5500 BP) and the Late Lingjiatan period (5500-5300 BP). Considering that the sherds pertaining to the Early and Late periods are sometimes too similar to be completely separated, this dissertation research applied a coarser and more conservative chronological scheme to most analyses.

The original chronological framework, however, is not useless. Even though it cannot be confirmed at present, it is worth exporing this possibility to guide future research. The fine scheme might provide a chance to "zoom into" the Lingjiatan community to reveal how it rose and fell. In recent years, excavated data and Carbon-14 samples from neighboring sites of Lingjiatan collected by the Anhui Province Institute of Cultural Relics and Archaeology strongly suggest the possibility of separating the Early and Late Lingjiatan periods. According to the unpublished data provided by Anhui Province Institute of Cultural Relics and Archaeology: around 40 Carbon-14 samples had been dated; Carbon-14 samples from the Lingjiatan site were dominantly dated to 5500 to 5300 BP, and Carbon-14 samples dated to 5700 to 5500 BP are from the further northwestern and northeastern part of the survey zone. The excavated materials revealed a corresponding pattern: sherds excavated from the Lingjiatan site itself are more likely dated to 5500 to 5300 BP, based on their morphological and decorative characteristics. In contrast, in the further northwestern area, most of the sherds excavated share similar characteristics to those dated to 5700 to 5500 BP. In this case, it would be worthwhile to reconstruct the community interactions in separate periods and trace how they changed in relation to the locations of the burial complex. The following research investigated the trajectory of social development from 5700 to 5300 BP, with a focus on the changing patterns of community interactions.

3.3.1 The Early Lingjiatan Period (5700-5500 BP)

Altogether 2,366 Early Lingjiatan sherds were recovered in the Yuxi survey zone from 323 separate collection units covering a total area of 2.85 ha. The distribution of these sherds is relatively even. The Early Lingjiatan population of the survey area is estimated at 1,250-2,500. A cluster analysis of collection units with the Early Lingjiatan sherds delineates 57 local communities (Figure 3-33). Only one local community has a population estimated at above 200-400; three local communities are estimated at more than 100-200 inhabitants; the other five local communities have populations above 50-100. Totally 48 local communities have fewer than 50-100 inhabitants, and the majority are more likely to be farmsteads of one or two families rather than large communities (Figure 3-34). These farmsteads only consist of a very small part of the Early Lingjiatan regional population. About 74% of the Early Lingjiatan regional population lived in the local communities over 50-100 inhabitants (Figure 3-35).

Five supra-local communities can be distinguished on the mathematically smoothed surface of the Early Lingjiatan occupation (Figure 3-36). They are separated from each other by very sparsely occupied space. On average, these supra-local communities are spatially in a small size and demographically in a large scale. These settlement clusters are strongly focused on a single very large central community in each of their districts. The population for the Early

Lingjiatan districts is very diverse with the largest one reaching a population estimated at 400-800 and the smallest one reaching a population estimated at 95-190.

The rank-size pattern for Early Lingjiatan with an *A* value of 0.069 (Figure 3-37), indicates that the entire survey zone was not integrated into a single system at all. Most districts are sharply delineated on the surface, internally well integrated, and centered on a large single dense community (Figure 3-36). The largest settlement integrated population over 200-400. This probably suggests a significant intensification of the social interaction that created these dense large single central settlements. The Figure 3-38 graphs the proportion of the estimated population in each of the 12-concentric equal-area rings around the demographic center of the entire survey zone in centralization analysis. The *B* value of 0.0072 indicates an extremely low degree of centralization (Figure 3-39) in the survey zone. The sparsely occupied zones between districts indicate that interactions between those districts were so low that there was no such sociopolitical integration gluing the entire survey area as one social unit.

It is then, safe to describe the Yuxi region in the Early Lingjiatan period as multiple small-scale districts, and separated by sparsely occupied areas, with an indication of extremely low sociopolitical interactions between these districts.

3.3.2 The Late Lingjiatan Period (5500-5300 BP)

In the Yuxi survey area 1,573 Late Lingjiatan sherds were recovered from 250 separate collection units that covered a total area of 0.67 ha (Figure 3-40). The Late Lingjiatan population of the entire survey zone is estimated at 600-1,200, about half of the Early Lingjiatan population. The occupation density surface delineated 23 local communities (Figure 3-40). The largest local community is estimated at more than 350-700 inhabitants (Figure 3-41). One local community is estimated at more than 50-100 inhabitants. Other 21 local communities have fewer than 50-100 inhabitants and most of which are farmsteads of one or two families just like those seen in the Early Lingjiatan period (Figure 3-41). These farmsteads, again only account for a small part (25%) of the Late Lingjiatan population. More than 65% of the regional population concentrated in the single largest local community whose population is estimated at more than 350-700 inhabitants (Figure 3-42). The largest local community of Late Lingjiatan is nearly 1.9 times larger than that of Early Lingjiatan, and it concentrates on a very tight settlement cluster.

A full reorganization of the regional settlements system characterized the entire survey zone in the Late Lingjiatan period. Instead of several separate supra-local communities, a single large settlement formed and revolved around the Lingjiatan burial complex, dominating almost the whole territory except two larger hamlets off to the west (Figure 3-43). This largest settlement occupies a primate position in the Late Lingjiatan rank-size graph, with an *A* value of -0.983, suggesting a strong integration of the survey area (Figure 3-44). The previous supra-local communities in the northeast disappeared, and the district in the northwest decreased dramatically with only a few farmsteads left in the Late Lingjiatan period. While these farmsteads can be delineated on the surface, most of them are so small spatially and demographically compared to the largest settlement, that they are clearly not independent. Thus, the boundary of the Lingjiatan district in the Late period included a single large settlement as well as a few more of the small farmsteads around it. The two larger hamlets off to the west were not included since they were separated by open territory and were not much pulled toward Lingjiatan. With a *B* value of 0.75, the centralization analysis also suggests that the population is strongly centralized with 70% of the population living in the center ring around the demographic center, and that a strong centripetal force of interaction was operating at the regional scale (Figure 3-45 and Figure 3-46).

Archaeological excavations in this region showed that the burial complex of Lingjiatan emerged after 5500 BP (Anhui 2006). The above analysis indicates that the largest settlement rose simultaneously, revolving around the emerging burial complex, and extended its socio-political control over its neighbors out to around 400 km^2 in the Late Lingjiatan period. This pattern, if true, would indicate the vital role of ritual and religious activities in integrating Lingjiatan society.

3.3.3 Explaining the Changes

In the Early Lingjiatan period, neither burials with exquisite jade objects nor public works such as a platform or *hongshaotu* remains were discovered, and the regional settlement pattern was characterized by multiple small-scale and independent supra-local communities. There was no sign of public facilities for religious and ritual activities, or for their role in integrating Lingjiatan society. The sparseness of occupation between districts argues against sociopolitical integration on a large scale. The burial complex, comprising the public works and plethora of exquisite jades, emerged after 5500 BP. These public structures and jades were not located far away from the residential system; instead, they were very close to the demographic center. According to the distance-interaction principles proposed by Peterson and Drennan (2005), if frequent participation in ritual activities is important, participants would be attracted to live close to the location of ritual activities. It seems that the ritual power represented by the burial complex, substantially developed after 5500BP. Participation in the ritual activities acting as an integrating force attracted people from all directions and created a strong centralized Lingjiatan regional community from 5500 to 5300 BP.

On the one hand, the ability to sort the regional settlement data for the Yuxi survey area into two shorter blocks of time facilitates the investigation of how settlement patterns changed in the Lingjiatan community from 5700 to 5300 BP. On the other hand, it also raises several questions which make the above interpretations very unusual. As discussed, the estimated population of Late Lingjiatan (about 600-1200 inhabitants) is only half of the Early Lingjiatan population (1,250-2,500 inhabitants), which means for some unknown reasons half of the population vanished around 5500 BP. This interpretation is extremely unusual. It is expected that population decreases and communities get disperse when a complex society collapses. But usually, the strong centralization of populations is associated with population increase (Dai 2010; Liu et al. 2004; Underhill et al. 2002; Underhill et al. 2008). It is very unusual to see population centralization during a time of rapid population decrease. And, population concentration is often an indicator of the development of sociopolitical complexity. A nucleated population provides elites with a source of labor for aggrandizement strategies, such as constructing public architecture. It is very common that regional population centralization is tied with different lines of evidence of sociopolitical complexity, such as the construction of monumental structures and the increase of wealth or prestige differentiation (e.g. Drennan 1975; Hirth 1993; Renfrew 1973; Smith 1987; Welch 1996). It would be very unusual to see population centralization associated with population decrease. In addition to a major population decrease during a strong centralization period, the population dynamics that have been reconstructed based on the two-periods chronology also indicated a strong discontinuity in settlement location. The settlements shifted dramatically from the Early Lingjiatan period to the Late Lingjiatan period. Settlements were dispersed all over the survey zone and formed several major peaks during the Early Lingjiatan period; however, in the Late Lingjiatan period, inhabitants all concentrated around the excavated burial complex of the Lingjiatan site, and almost all other communities vanished. This substantial settlement shift would have to imply some special reasons that are not understood so far.

Strong evidence would be needed to explain the unusual pattern of population dynamics in the Early and Late Lingjiatan periods revealed by this exploratory analysis, but at this moment, it is hard to find such evidence. Above that, the two-periods chronology is tentative. As discussed above, it is not easy to differentiate sherds from the Early and Late Lingjiatan periods because of their morphological similarities. A clear differentiation between the Early and Late Lingjiatan periods also needs further evidence, such as the details of stratigraphic relations between these ceramics, and full and detailed Carbon-14 data, with contextual associations of all the dates. These data, however, have not yet been published. The interpretation generated from the two-period analysis is thus not well supported as of now.

Figure 3-1 Collection units clustered into Lingjiatan period local community (pink polygon).

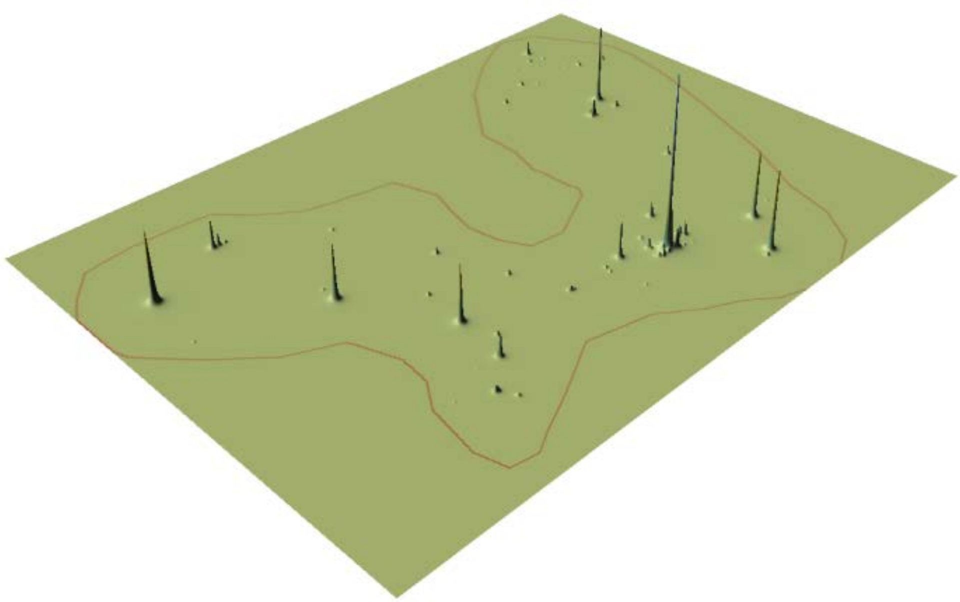

Figure 3-2 Unsmoothed surface representing Lingjiatan period occupation.

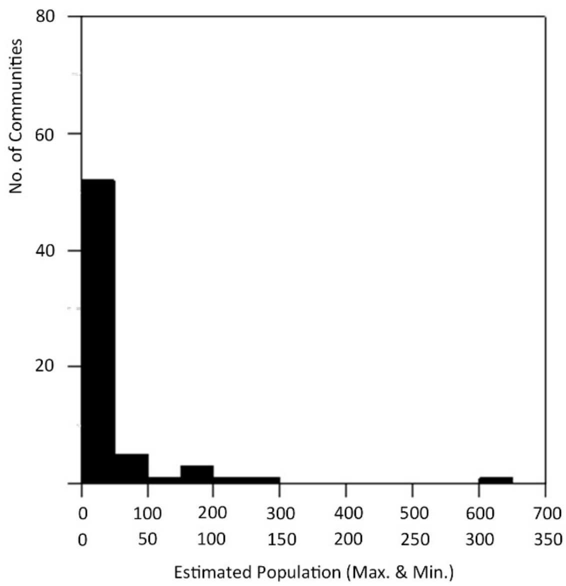

Figure 3-3 Histogram of Lingjiatan period local communities by numbers of communities in each population range.

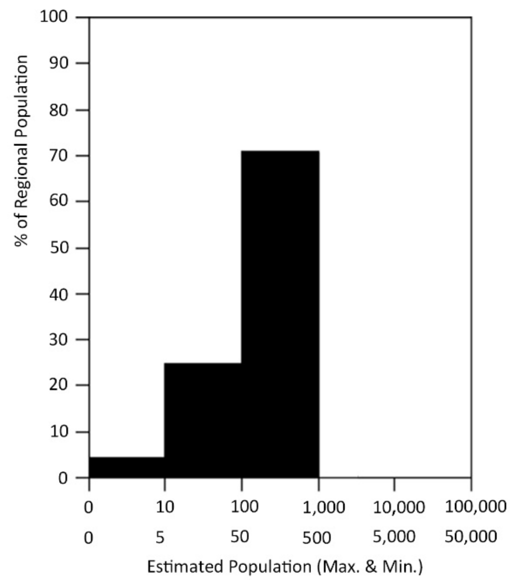

Figure 3-4 Histogram of Lingjiatan period local communities by percent of regional population in each population range.

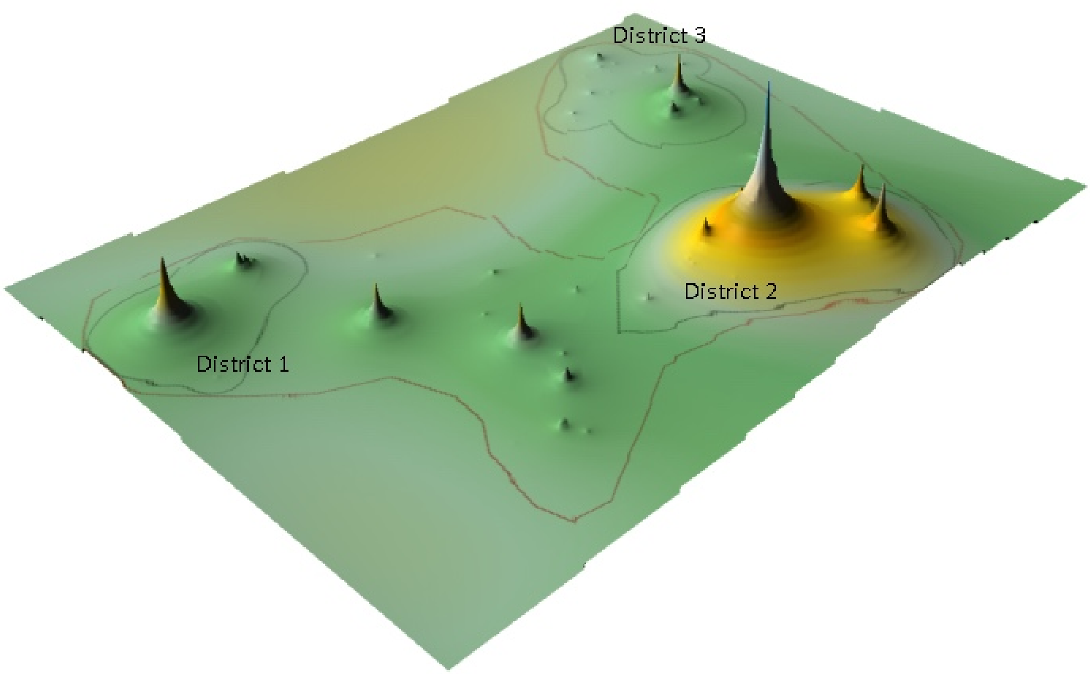

Figure 3-5 Smoothed surface representing Lingjiatan period occupation and supra-local communities or districts.

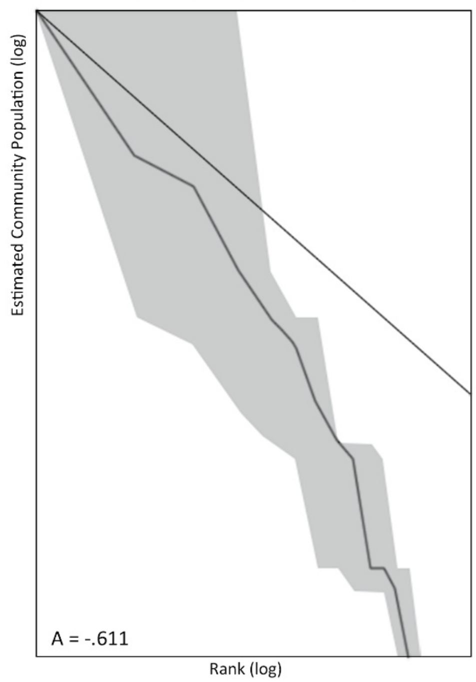

Figure 3-6 Rank-size graph of Lingjiatan period District 2 with error zone for 90% confidence.

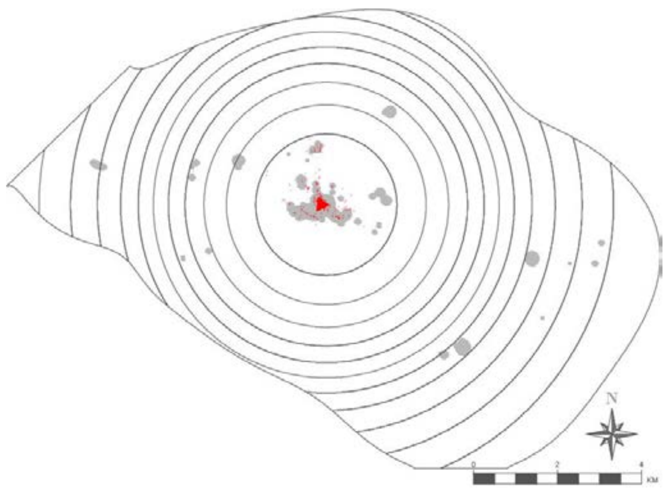

Figure 3-7 Lingjiatan period District 2. Local communities are shown in gray; circles indicate 12 concentric rings for centralization analysis (Figure 3-8); red triangle indicated the location of ceremonial structures; red dots are locations where *hongshaotu* remain were recovered.

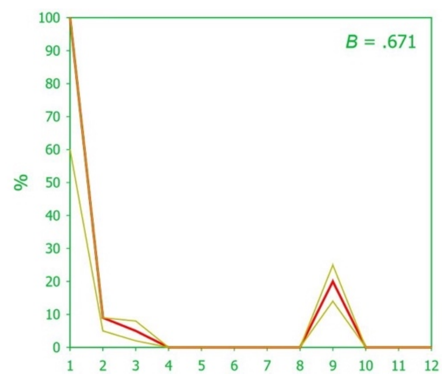

Figure 3-8 Centralization graph of Lingjiatan period District 2 with error range of 90% confidence.

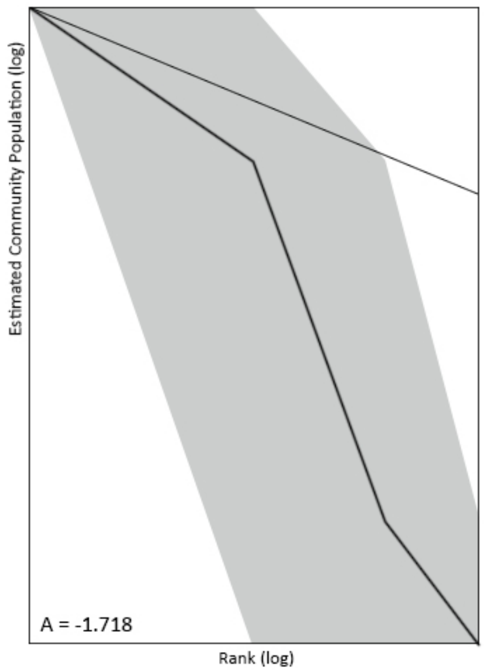

Figure 3-9 Rank-size graph of Lingjiatan period District 1 with error zone for 90% confidence.

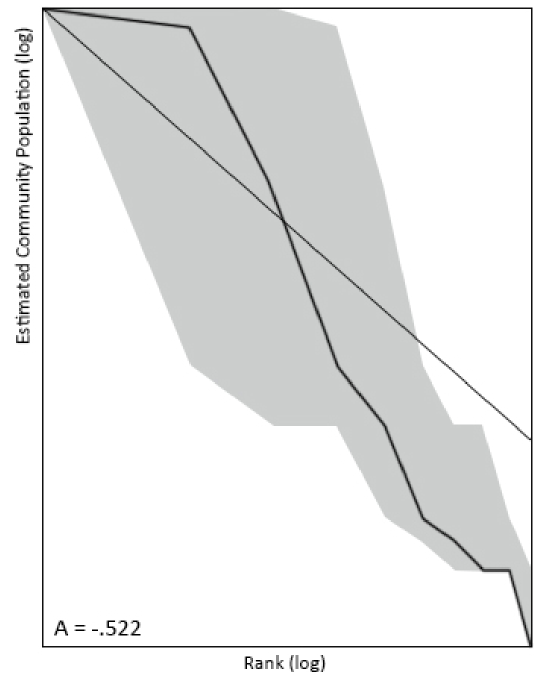

Figure 3-10 Rank-size graph of Lingjiatan period District 3 with error zone for 90% confidence.

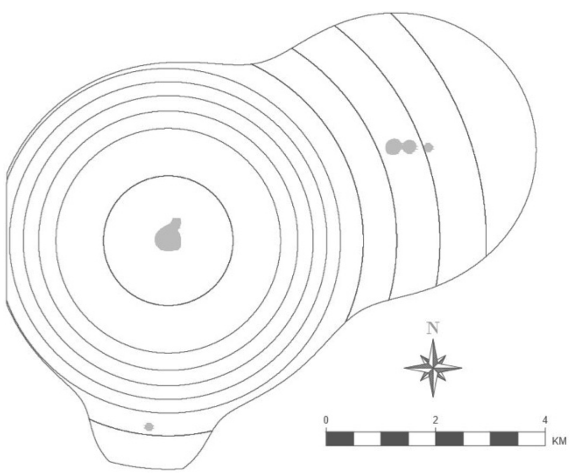

Figure 3-11 Lingjiatan period District 1. Local communities are shown in gray; circles indicate 12 concentric rings for centralization analysis (Figure 3-12).

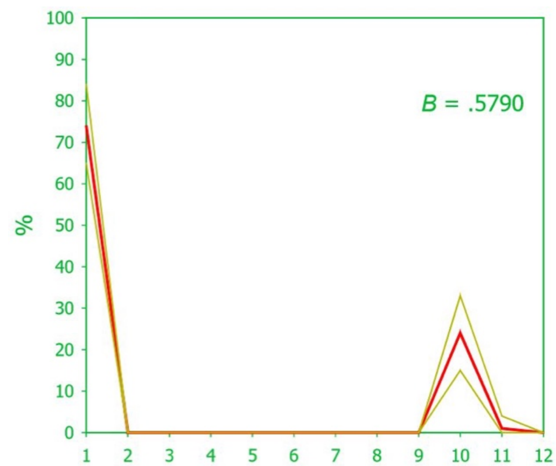

Figure 3-12 Centralization graph of Lingjiatan period District 1 with error range of 90% confidence.

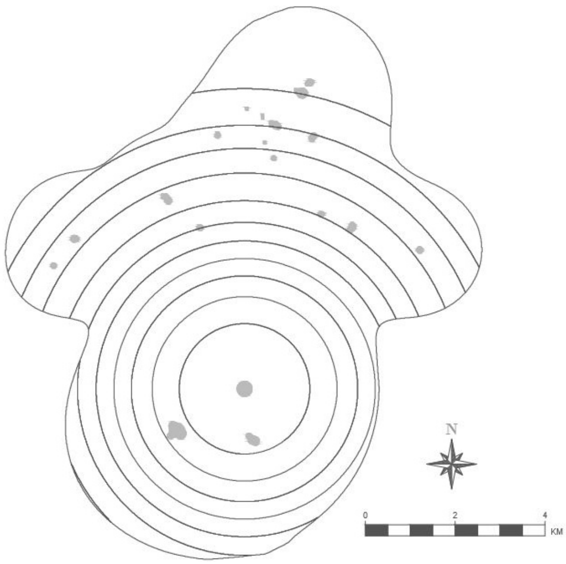

Figure 3-13 Lingjiatan period District 3. Local communities are shown in gray; circles indicate 12 concentric rings for centralization analysis (Figure 3-14).

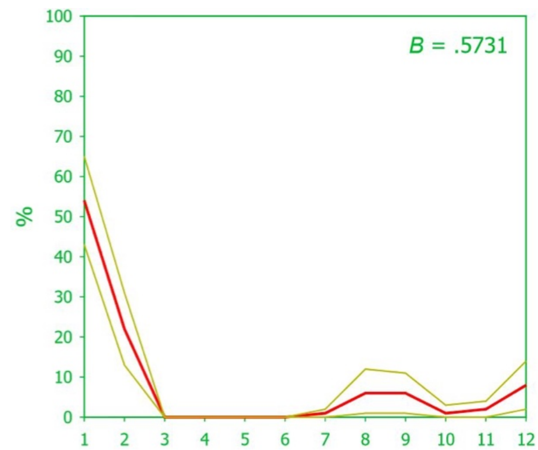

Figure 3-14 Centralization graph of Lingjiatan period District 3 with error range of 90% confidence.

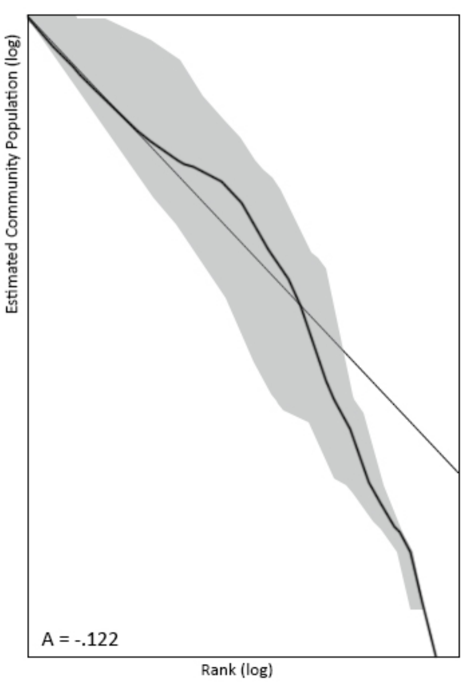

Figure 3-15 Rank-size graph of the entire Yuxi survey area in Lingjiatan period with error zone for 90% confidence.

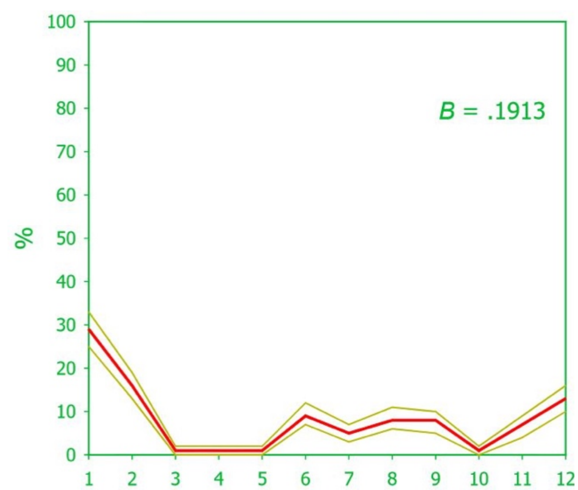

Figure 3-16 Centralization graph of the entire Yuxi survey area in Lingjiatan period with error range for 90% confidence.

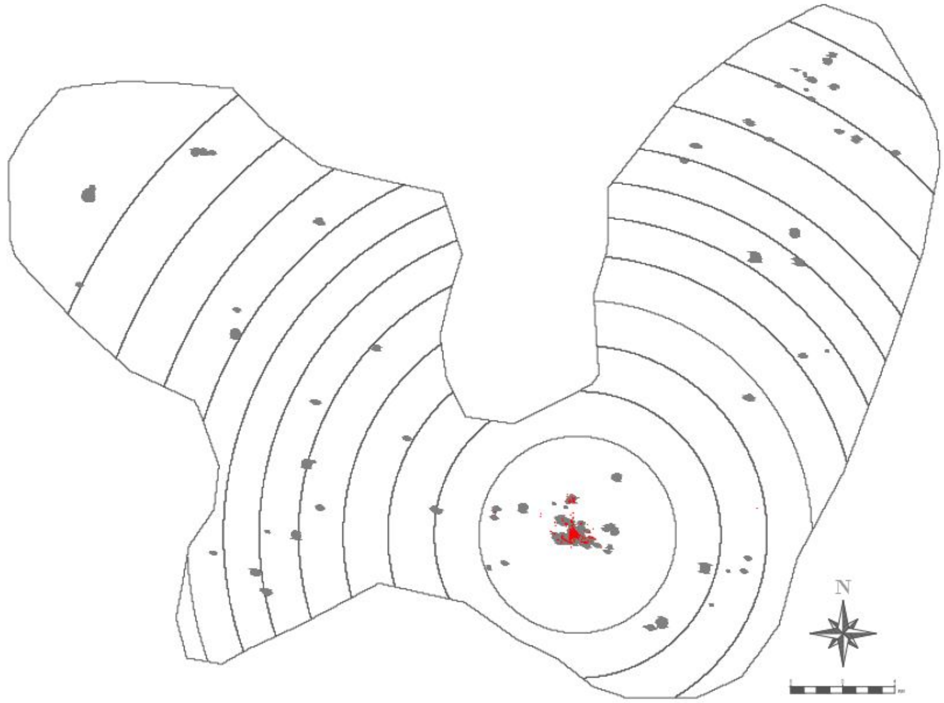

Figure 3-17 Entire Yuxi survey area in Lingjiatan period. Local communities are shown in gray; circles indicate 12 concentric rings for centralization analysis (Figure 3-16).

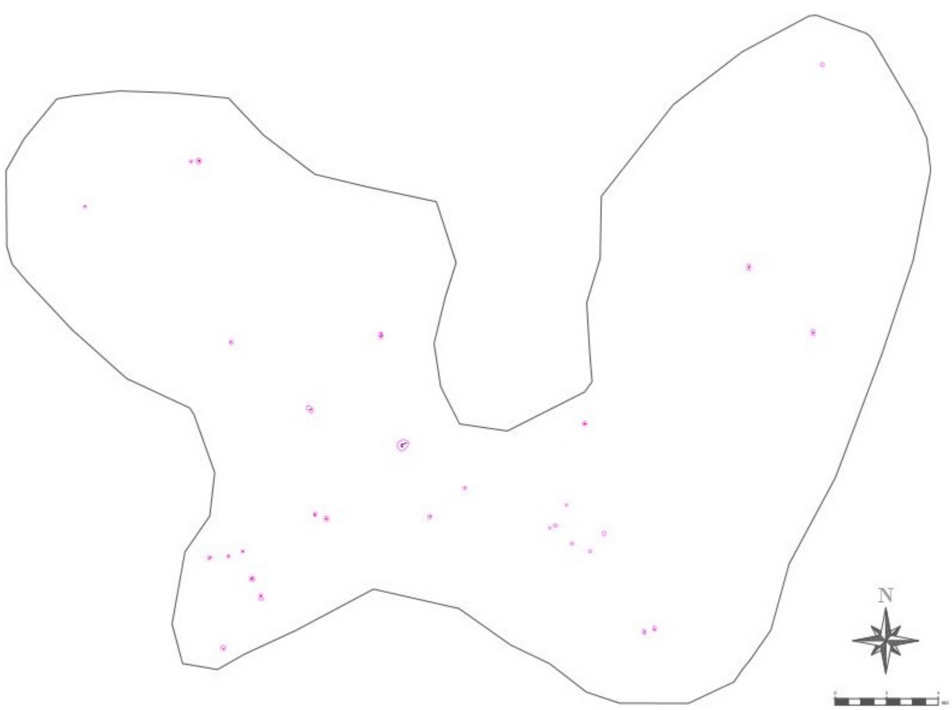

Figure 3-18 Collection units clustered into Post-Lingjiatan period local community (pink polygon).

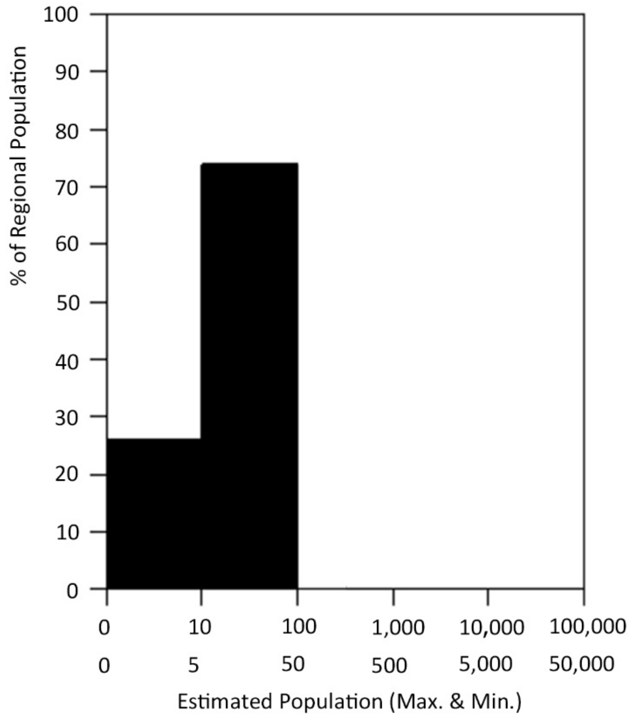

Figure 3-19 Histogram of Post-Lingjiatan period local communities by percent of regional population in each population range.

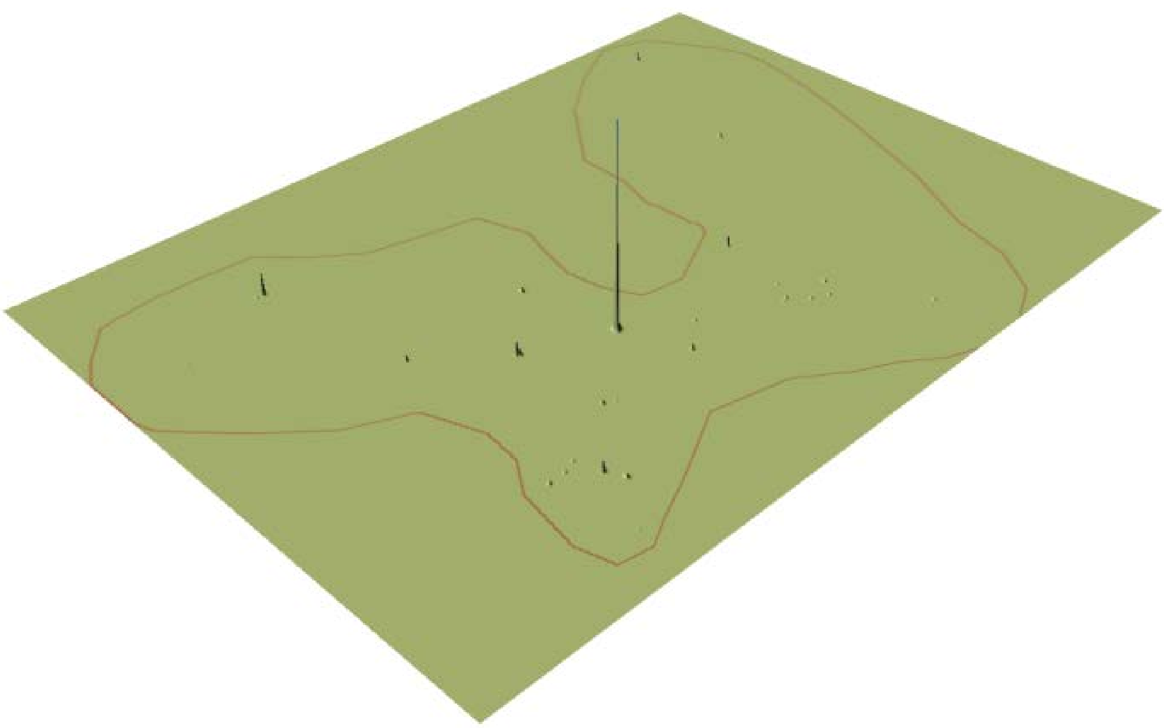

Figure 3-20 Unsmoothed surface representing Post-Lingjiatan period occupation.

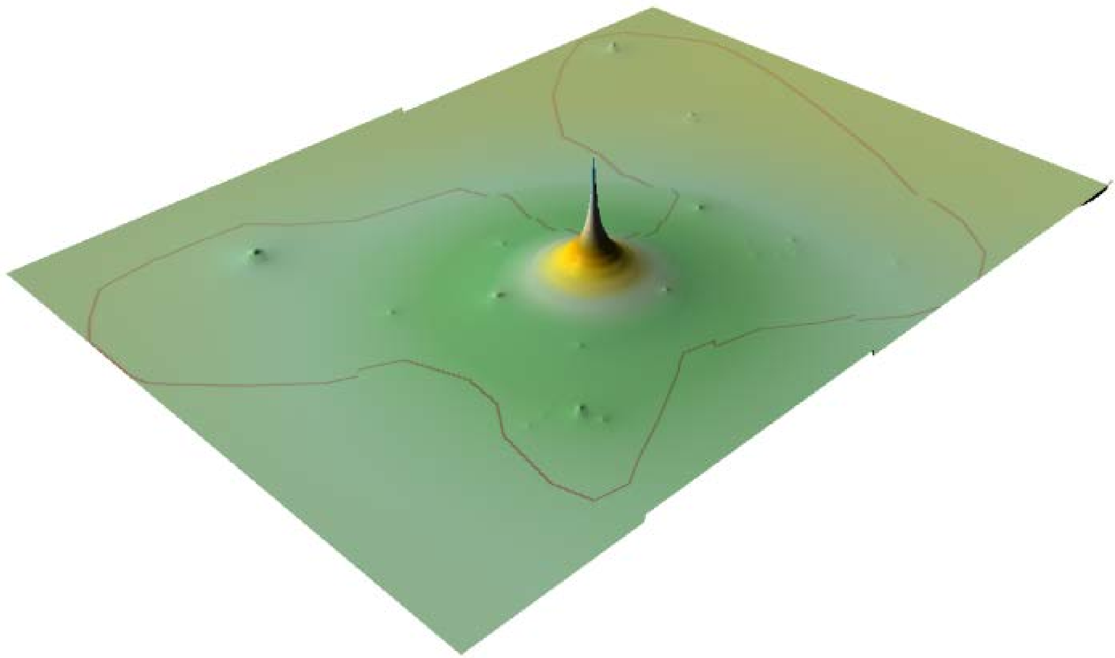

Figure 3-21 Smoothed surface representing Post-Lingjiatan period occupation.

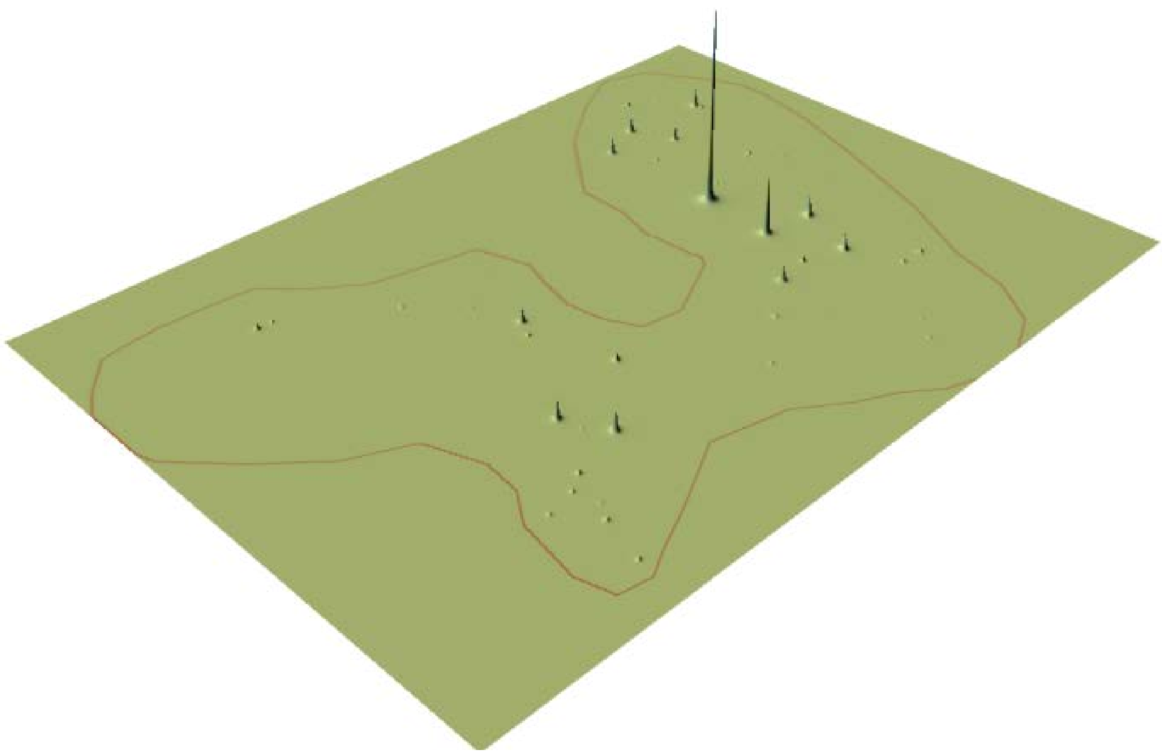

Figure 3-22 Unsmoothed surface representing Zhou period occupation.

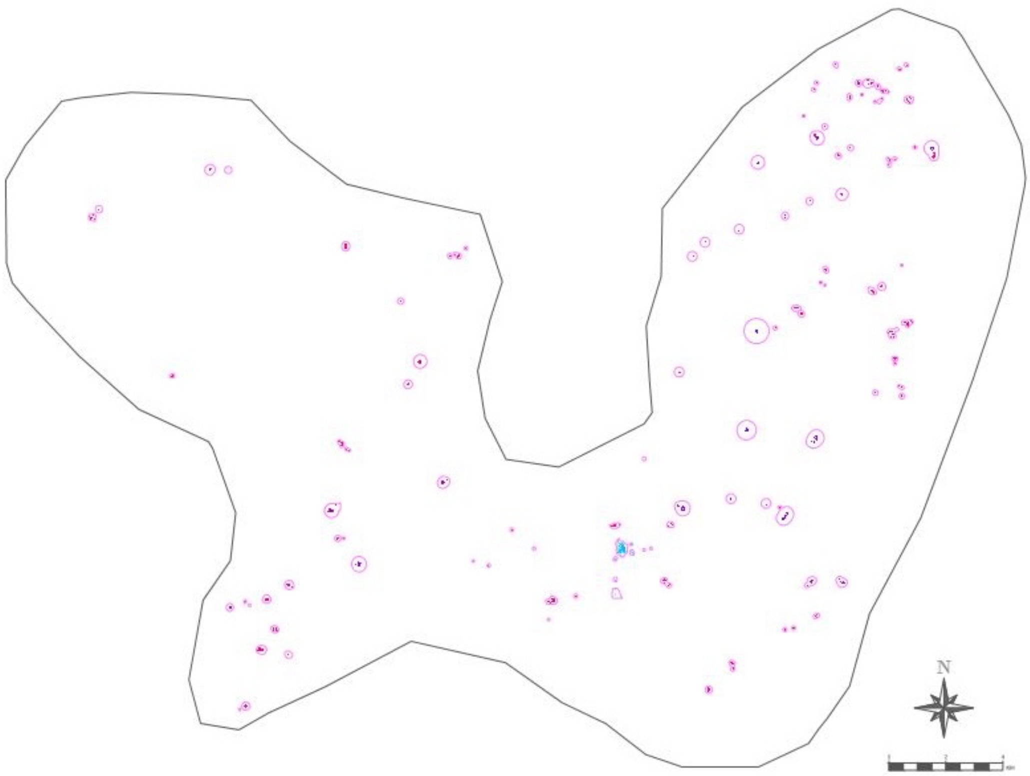

Figure 3-23 Collection units clustered into Zhou period local community (pink polygon).

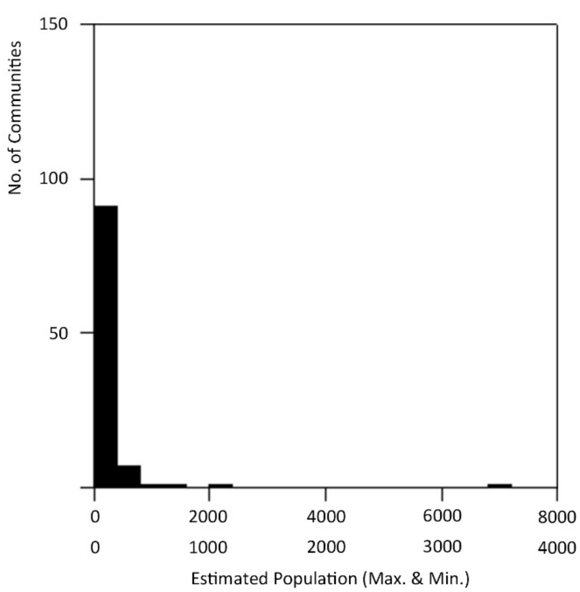

Figure 3-24 Histogram of Zhou period local communities by numbers of communities in each population range.

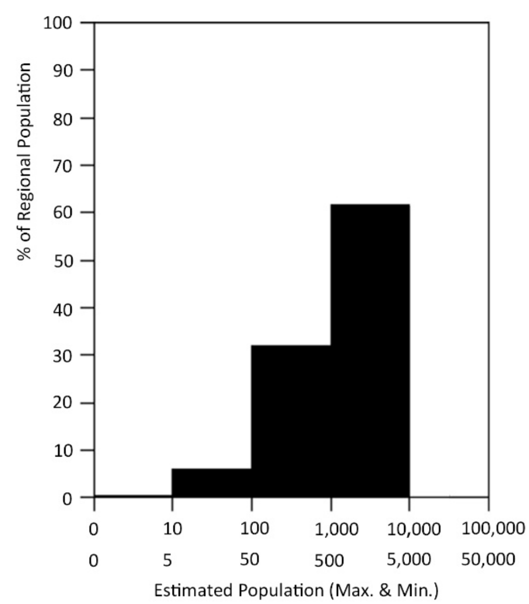

Figure 3-25 Histogram of Zhou period local communities by percent of regional population in each population range.

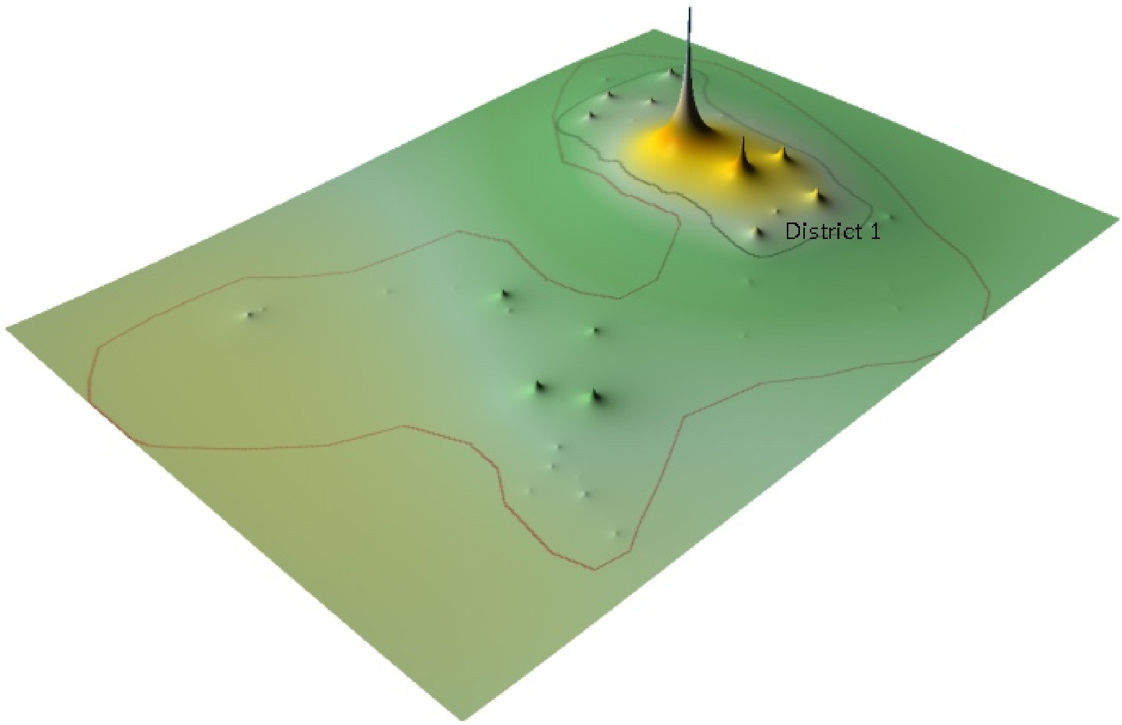

Figure 3-26 Smoothed surface representing Zhou period occupation.

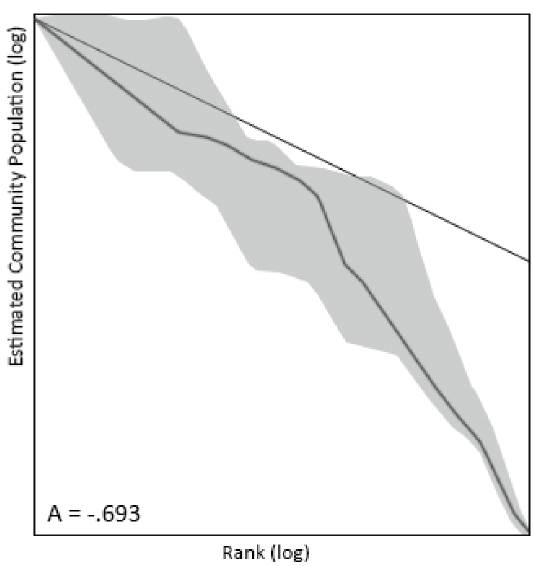

Figure 3-27 Rank-size graph of Zhou period District 1 with error zone for 90% confidence.

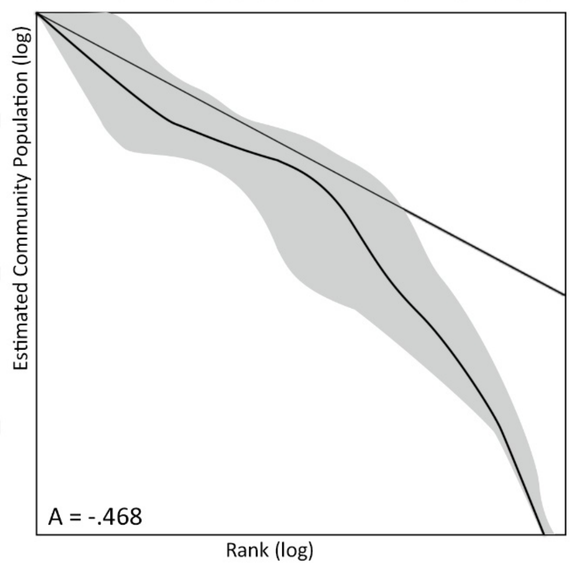

Figure 3-28 Rank-size graph of the entire Yuxi survey area in Zhou period with error zone for 90% confidence.

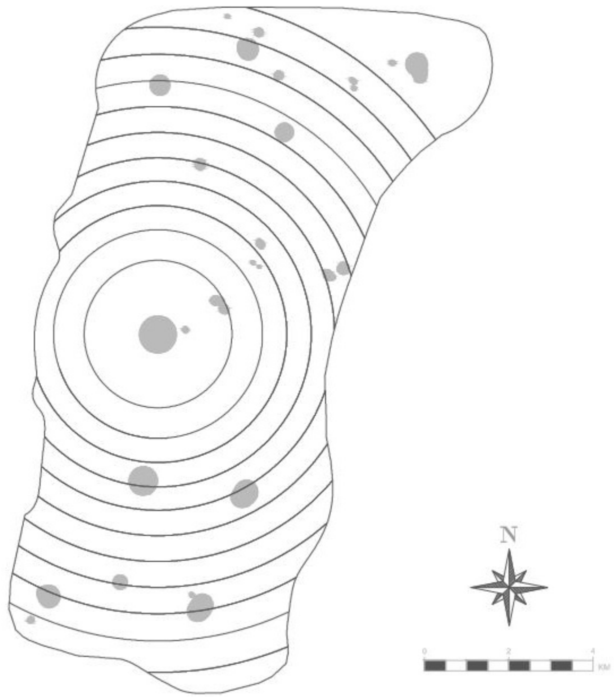

Figure 3-29 Zhou period District 1. Local communities are shown in gray; circles indicate 12 concentric rings for centralization analysis (Figure 3-30).

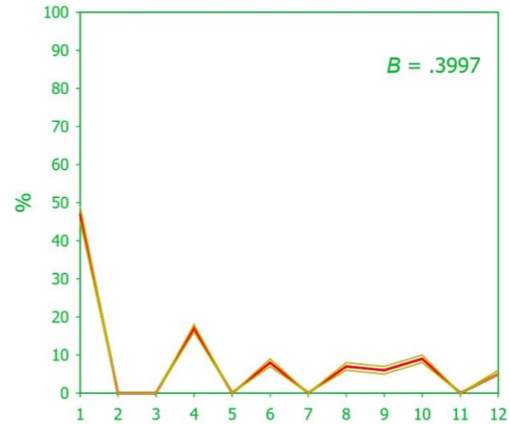

Figure 3-30 Centralization graph of Zhou period District 1 with error range of 90% confidence.

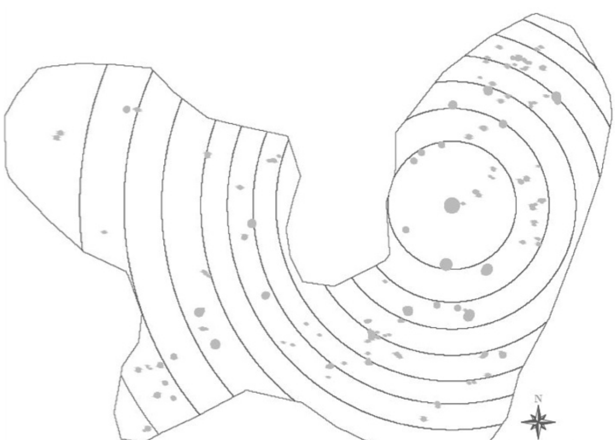

Figure 3-31 Entire Yuxi survey area in Zhou period. Local communities are shown in gray; circles indicate 12 concentric rings for centralization analysis (Figure 3-32).

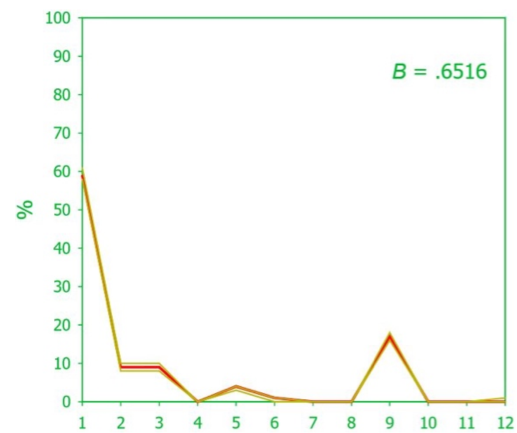

Figure 3-32 Centralization graph of the entire Yuxi survey area in Zhou period with error range for 90% confidence.

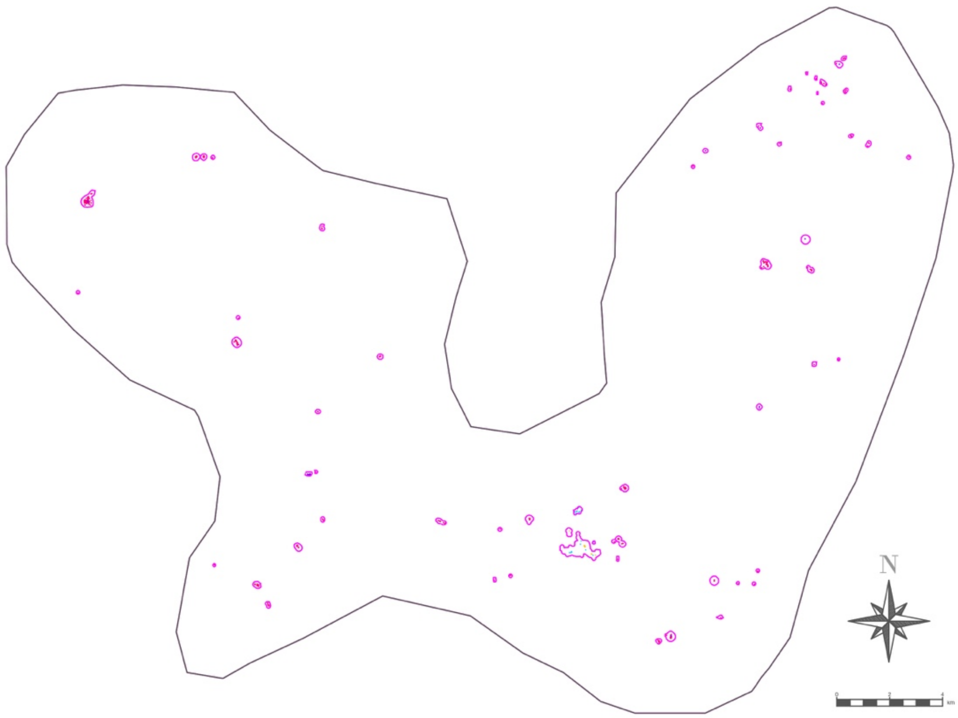

Figure 3-33 Collection units clustered into Early Lingjiatan period local community (pink polygon).

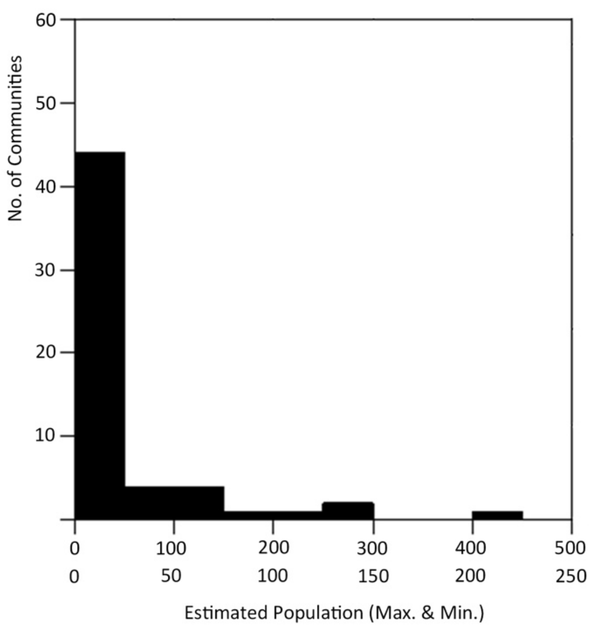

Figure 3-34 Histogram of Early Lingjiatan local communities by numbers of communities in each population range.

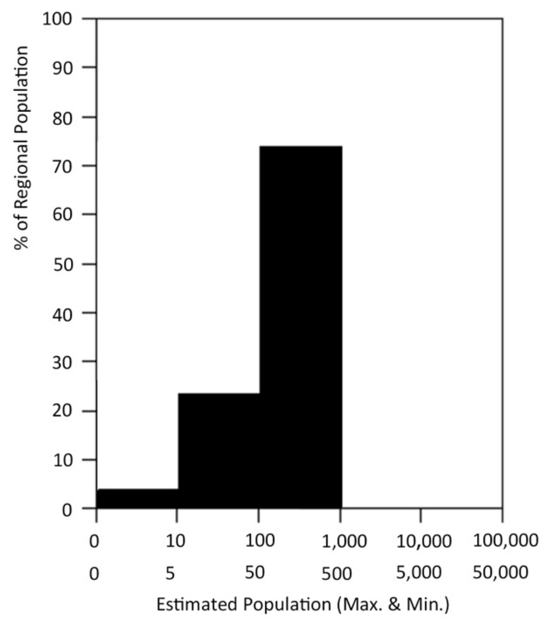

Figure 3-35 Histogram of Early Lingjiatan local communities by percent of regional population in each population range.

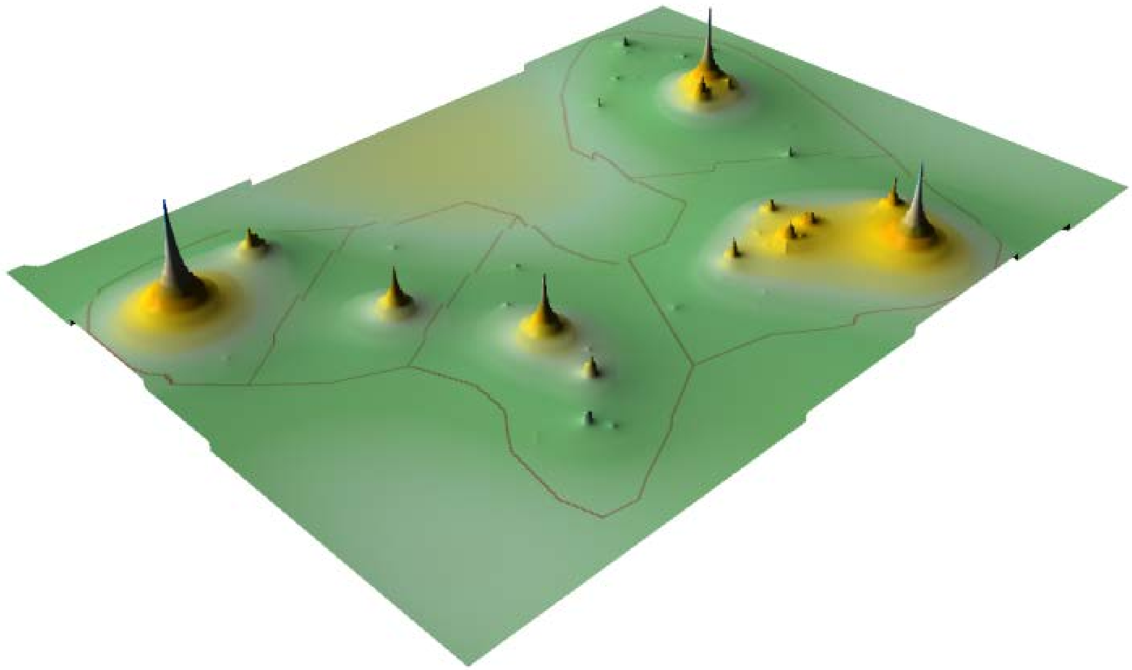

Figure 3-36 Smoothed surface representing Early Lingjiatan period occupation and supra-local communities or districts.

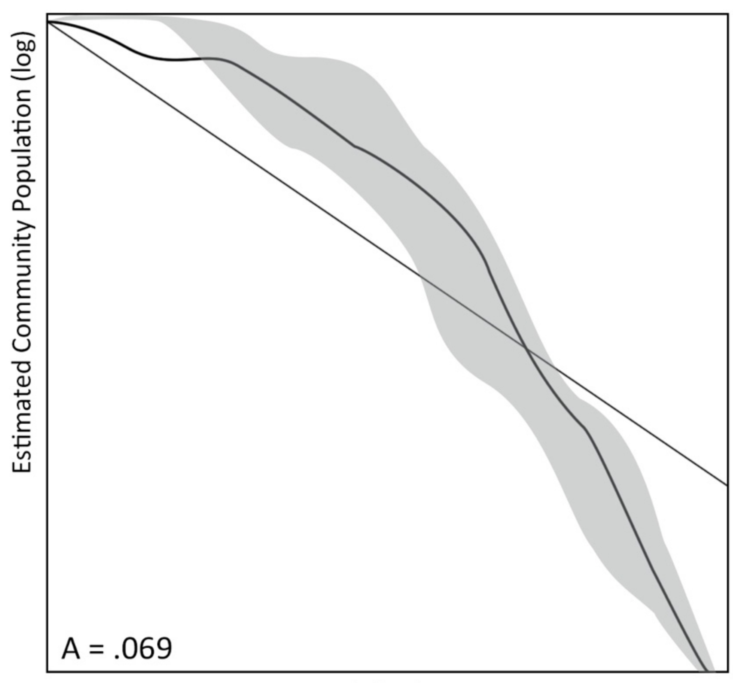

Figure 3-37 Rank-size graph of the entire Yuxi survey area in Early Lingjiatan period with error zone for 90% confidence.

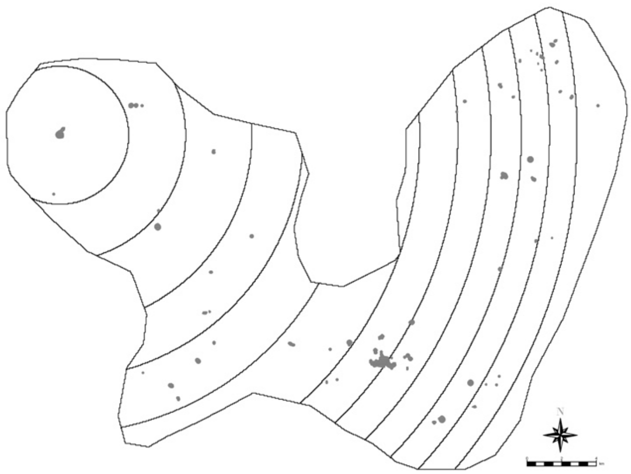

Figure 3-38 Entire Yuxi survey area in Early Lingjiatan period. Local communities are shown in gray; circles indicate 12 concentric rings for centralization analysis (Figure 3-39).

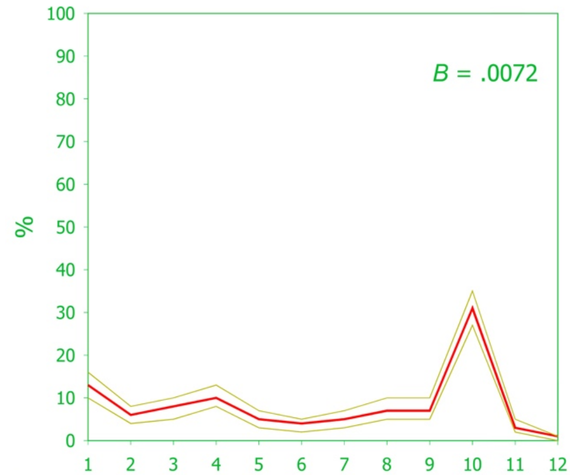

Figure 3-39 Centralization graph of the entire Yuxi survey area in Early Lingjiatan period with error range for 90% confidence.

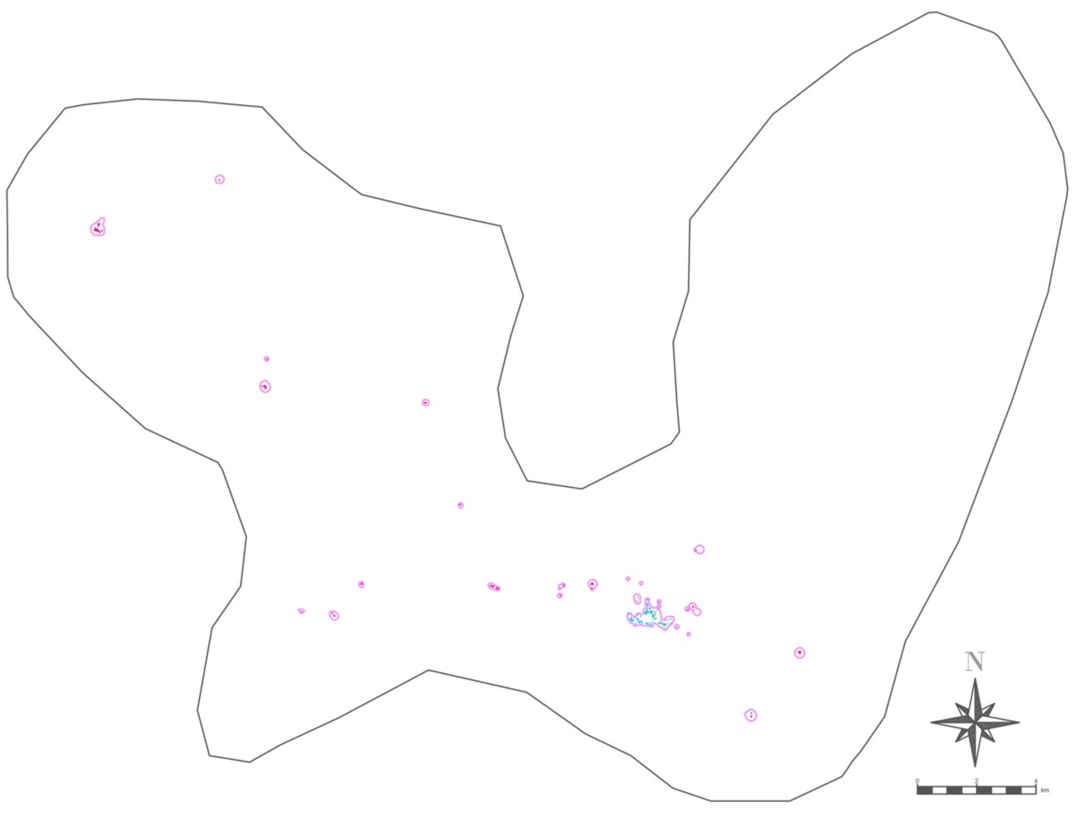

Figure 3-40 Collection units clustered into Late Lingjiatan period local community (pink polygon).

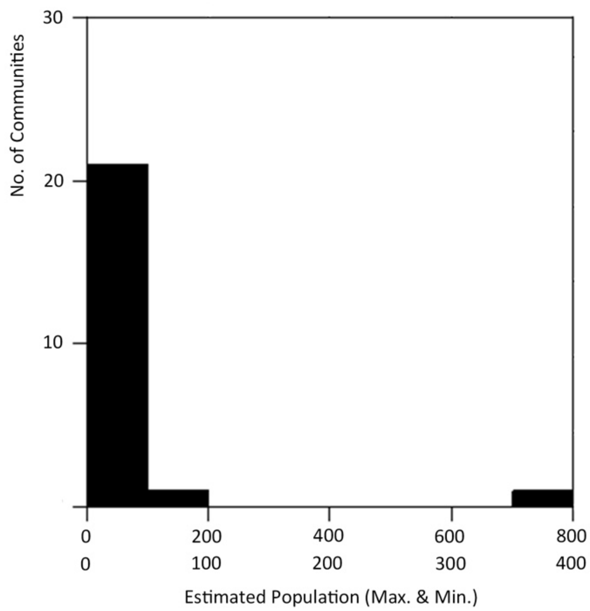

Figure 3-41 Histogram of Late Lingjiatan local communities by numbers of communities in each population range.

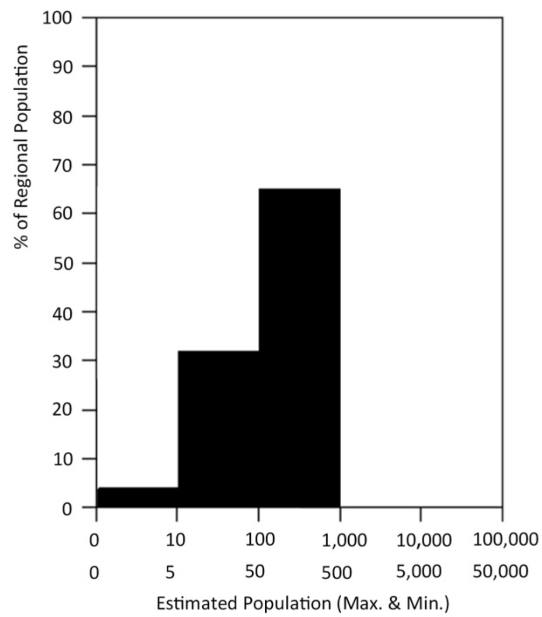

Figure 3-42 Histogram of Late Lingjiatan local communities by percent of regional population in each population range.

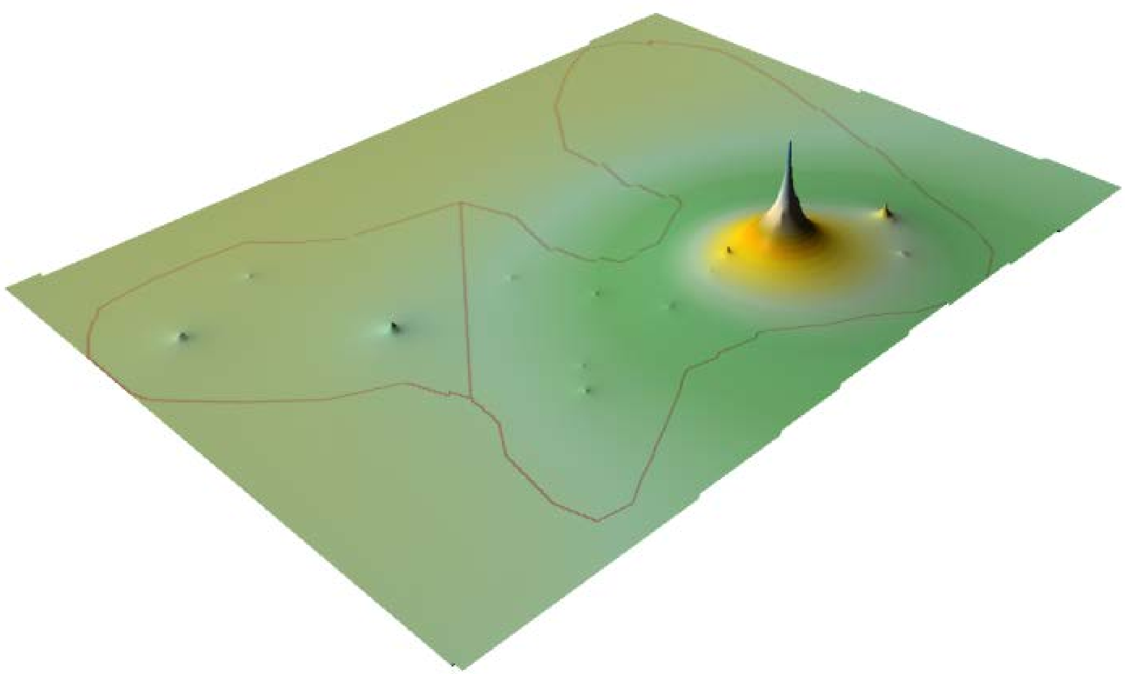

Figure 3-43 Smoothed surface representing Late Lingjiatan period occupation and supra-local communities or district.

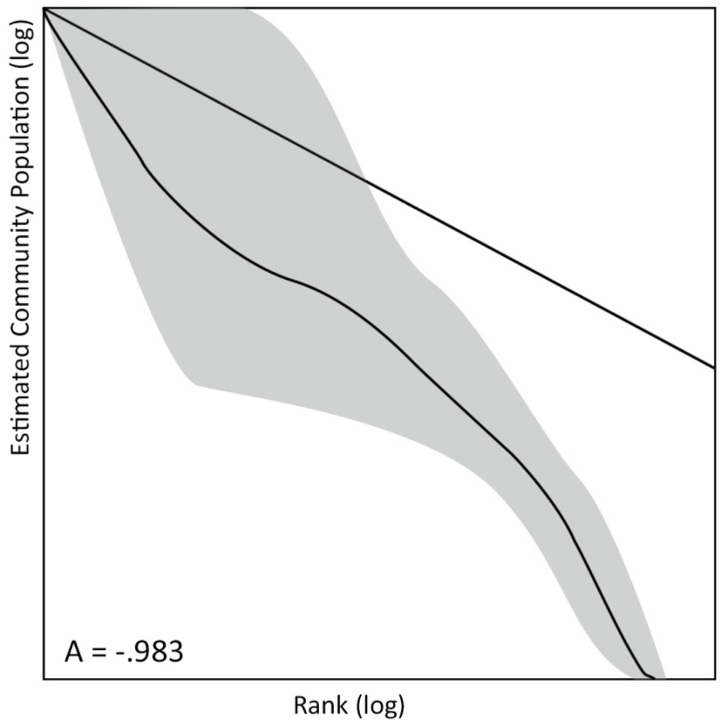

Figure 3-44 Rank-size graph of the entire Yuxi survey area in Late Lingjiatan period with error zone for 90% confidence.

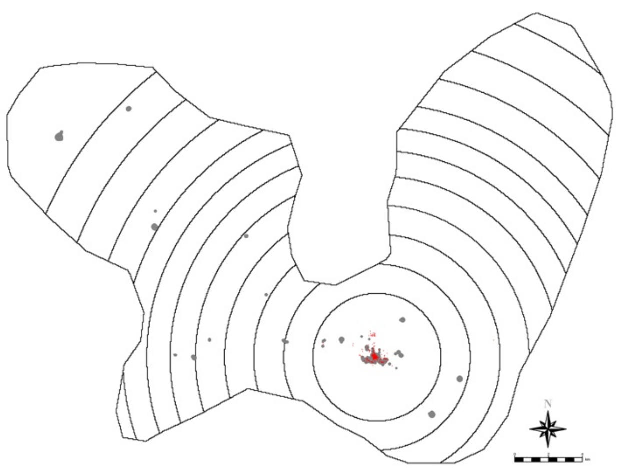

Figure 3-45 Entire Yuxi survey area in Late Lingjiatan period. Local communities are shown in gray; red triangle indicates the location of ceremonial structures; red dots are locations where ***hongshaotu*** remains were recovered; circles indicate 12 concentric rings for centralization analysis (Figure 3-46).

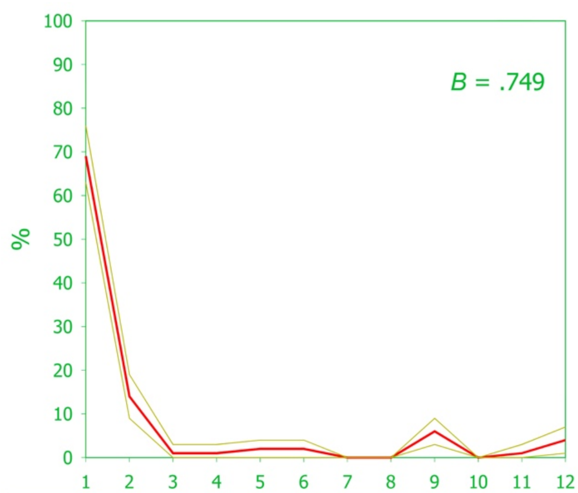

Figure 3-46 Centralization graph of the entire Yuxi survey area in Late Lingjiatan period with error range for 90% confidence.

4.0 COMPARISONS OF THE SEQUENCE OF SOCIAL CHANGE AND REGIONAL COMMUNITY ORGANIZATION IN THE YUXI REGION AND THE UPPER DALING VALLEY

The comparative analysis of social change has become increasingly important in research on social complexity in recent decades (Drennan and Peterson 2004, 2005, 2006; Earle 1997). Regional-scale settlement research has a vital role in such comparisons of prehistoric human communities and trajectories of social change. This chapter compares the trajectories of social change of the Yuxi region and the Upper Daling region, with a focus on the nature and scale of human communities.

As discussed in Chapter 1, the archaeological cultures of Lingjiatan and Hongshan are prominent examples of "the Jade Culture" in Neolithic China and have similarities as well as differences in burial goods and public structures. As an archaeological culture, Hongshan spreads, although fairly sparsely, across hundreds of thousands of square kilometers on the landscape. The anthropological results from regional settlement pattern analysis of Hongshan society have appeared in recent publications (Chifeng 2011; Drennan et al. 2017a; Drennan et al. 2017b; Peterson 2006; Peterson et al. 2014a). Full-coverage regional surveys have been conducted in the Chifeng region, the Upper Daling valley, and the Niuheliang region in past years (Chifeng 2011; Drennan et al. 2017a; Peterson et al. 2014a). It has been suggested that the Chifeng region is a Hongshan "periphery" zone, and the Upper Daling valley and the Niuheliang region are Hongshan “core” zones. Among these regions covered by the Hongshan culture, Upper Daling valley is the most comparable to the Yuxi region. As with the Yuxi regional survey, which centered around the Lingjiatan site that revealed ceremonial structures and burials with elaborate artifacts, the Upper Daling valley survey area, as a core zone of Hongshan culture, also centered around the Dongshanzui site that revealed special ceremonial architecture. The Upper Daling valley has the closest survey area (200 km^2) to that of Yuxi (400 km^2), compared to that of Chifeng (1,234 km^2) and Niuheliang (42.5 km^2). The Niuheliang site, though representing a very special religious status (like Lingjiatan) which held centripetal power and attracted people from all directions, is not the best comparison for the Yuxi region. The regional community organization indicates that the nature of Niuheliang communities is different from those in the Upper Daling valley and the Chifeng Region (Drennan et al. 2017a). Niuheling, suggested to be a place of pilgrimage, and thus has unique religious communities making the comparison with the Yuxi region difficult.

4.1 FIELD, METHODS, AND POPULATION RECONSTRUCTION

Both the Yuxi and the Upper Daling survey regions are intensively cultivated today. Irrigated and dry farming is the main type of agriculture in Upper Daling; while paddy field agriculture occupies the Yuxi region. Maize and millet are major crops in Upper Daling; rice is the key crop in the Yuxi region. Cotton, mulberry, rape, and tea are also intensively cultivated in the Yuxi region. Pigs, cattle, goats, chickens, and ducks are commonly raised in both regions. Geese, which are not very common in the Upper Daling valley are extensively raised in the Yuxi region. Surface visibility is good for both regions as long as the survey is conducted in the non-agricultural seasons. In the

Upper Daling valley, May and June are suitable months for the survey; in the Yuxi region, December and January are the best time for the survey.

Systematic complete-coverage pedestrian surveys were conducted in the Yuxi and Upper Daling regions with different methods of data collection. In the Yuxi region, the methods of data collection changed through all seasons of the survey as discussed in Chapter 2. The spatial resolution of data recording was more fine-grained. Team members walked at small intervals of approximately 10 m collecting artifacts on the surface. Surface collections were made if one or more sherds were found within one collection unit. The area of the collection unit was various from 1 m^2, 4 m^2 to 100 m^2 in different seasons of the survey. The cooordinates of collection units were recorded by GPS units at their southwest corners. In the Upper Daling survey, maximum spacing between crew members was 50 m. Surface collections were made if two or more sherds were found within one collection unit. Sherds were collected in collection units not exceeding 0.25 ha (2500 m^2). Larger occupations were divided into multiple collection units of 0.25 ha. The boundaries of collection units were drawn on printed satellite imagery during the survey.

Since differences existed in the way occupation areas were recorded and measured in the Yuxi and Upper Daling survey, some conversions were applied to the data collected from the Yuxi survey to avoid risks in the comparative analysis. It has been suggested that “the larger collection units tend to produce larger measurements of the same occupation areas than the smaller collection units because the greater precision of smaller units detects gaps in occupation that are glossed over by larger units” (Peterson et al. 2014a:29). Thus, the recorded occupation area of the Yuxi survey was converted to make the estimated population more comparable. The way of calculating the conversion factor was discussed in Chapter 2. This conversion factor makes it possible to produce an area-density index for Yuxi that is directly comparable to the one from the Upper Daling survey.

This also makes it possible to convert the Yuxi area-density index into absolute population estimates using the same conversion factor as in the Upper Daling survey.

4.2 EARLY NEOLITHIC BEGINNINGS

The trajectories of social change in Yuxi and the Upper Daling valley compared in this dissertation research stretch across 4500 years. The chronological resolution varies in each region. In the Upper Daling region, Upper Xiajiadian stretches only 600 years as the shortest period; Hongshan stretches 1500 years as the longest period. In the Yuxi region, Lingjiatan and Zhou stretch across 400 years; Post-Lingjiatan stretches 1300 years. The differences of period lengths were taken into consideration in population estimates.

Human occupation in the early Neolithic was minimal in both regions. In the Upper Daling survey, no early Neolithic remains was detected at all (Peterson et al. 2014a). Hongshan (6500-5000 BP) is the earliest period of occupation for which archaeological remains were encountered and recorded in this region. In the Yuxi region, not a single bit of evidence for settlements before Lingjiatan (5700-5300 BP) was recovered. The lack of remains in both regions does not necessarily indicate that no settlements ever occupied these regions during the early Neolithic. Early Neolithic settlements are known for the larger area of which the two survey regions are parts. For example, settlements of Xinglongwa (8000-7250 BP) and Zhaobaogou (7250-6500 BP) were widely scattered in various regions in northeastern China; remains of Majiabang (7000-6000 BP) and Early Songze (6000-5700 BP) were detected in the lower-reaches of the Yangzi river valley. It is more likely, then, that a very small population utilized the Upper Daling and Yuxi survey zones and frequently moved around during the early Neolithic.

Figure 4-1 graphs the changing population density in each region. Figure 4-2 shows the estimated population of the largest settlement or local community for each period in each region. Figure 4-3 graphs the estimated population of the largest supra-local community for each period in each region.

4.3 THE EMERGENCE OF CHIEFDOMS

The emergence of Lingjiatan period (5700-5300 BP) in Yuxi occurred during early Hongshan times. The entire Hongshan society established 800 years earlier than Lingjiatan stretches about 1500 years. Regional population densities of the Lingjiatan and Hongshan period were at similar levels, with Hongshan having a slightly higher density (Figure 4-1). None of the settlements, or local communities in the Upper Daling region approached the size of the largest settlement in the Yuxi survey area (Figure 4-2). The largest supra-local community, with a population estimated at 640-1,280 in Yuxi, also appeared to have a slightly larger population than that of the Upper Daling region (Figure 4-3). In addition, the largest supra-local community in Yuxi of the Lingjiatan period is 11-15 km across, almost twice as large in spatial scale than that in the Upper Daling of Hongshan period, which is 5-8 km across. At the same time, both regions were structured with small autonomous supra-local units, although compared to the Upper Daling region, population in Yuxi was more concentrated. Half of the entire regional population in Yuxi was concentrated into the largest supra-local community, District 2, where the Lingjiatan burial complex was located. In the Upper Daling valley, the numerous districts are more uniform and smaller spatially and demographically.

These differences imply that the population in Lingjiatan times was somewhat less dense at a regional scale but more strongly centralized than the Upper Daling population in Hongshan times. Although neither region has a supra-local unit enough larger than others to suggest a center of sociopolitical integration of multiple supra-local communities, the population of District 2 in the Yuxi region is much larger than other districts (both District 1 and 3 have populations estimated at 200-400). This contrast indicates that compared to Hongshan in the Upper Daling region, Lingjiatan society in the Yuxi region was relatively more integrated and centralized at the level above supra-local units. Excavated burials, ceremonial structures and jade artifacts in both region implied a substantial focus on ceremonial and religious activities (e.g. Anhui 2006; Guo 1995), but the degree to which the population was integrated by the ritual and religious power was different in each region. In the Upper Daling region, each district had its own ceremonial facilities, showing that centralizing forces grounded in ritual and religion were separately developed within each district. In the Yuxi region, the remains of jade artifacts and ceremonial structures were exclusively detected in District 2, indicating that these ritual functions were restricted to District 2. Such differences in the locations of ceremonial structures might help to account for the somewhat larger and more centralized District 2 in the Yuxi survey area.

4.4 THE INTERRUPTIONS IN BOTH REGIONS

Around 5300 BP settlements started to decrease in the Yuxi region, so did those in the Upper Daling region 300 years later. This interruption in the developmental trajectories of both regions lasted for more than 1000 years until their trajectories diverged around 4000 BP.

Remains of this period were much less abundant in both survey regions. The small number of sherds identifiable to the Post-Lingjiatan period in Yuxi and the Xiaoheyan period in Upper Daling produced an extremely small estimate population of 45-90 and 50-100 inhabitants, respectively. The regional population density of the Post-Lingjiatan period was barely half of that of the Xiaoheyan period (Figure 4-1). In both regions, the distribution of settlements was very broad and sparse. Most local communities had extremely low populations and were composed of one or two families except for one large local community with a single major occupation peak. This largest local community of Post-Lingjiatan had the same estimated population as Xiaoheyan had. No indication of supra-local communities was found in either region.

The decrease of the quantity and distribution of sherds might imply a dramatic population decrease from 5000 to 4000 BP and a vanishing of all traces of the supra-local organization defined in previous periods. It has been suggested that deteriorating climate during this period caused the collapse of six out of the seven well-documented Chinese Neolithic cultures, with the exception of the Longshan culture in the Henan province that eventually evolved into the more complex Erlitou culture (e.g. Li 2008; Liu and Feng 2012; Wu and Liu 2001). As discussed in Chapter 3, the climate data is too inconsistent to provide an unequivocal indication of drastic climate change. Moreover, settlement studies reveal that around 4000 BP, instead of depopulation, Lower Xiajiadian times in the Upper Daling region were characterized by substantial population growth, and political and economic development. Beyond this, the discovery of fine artifacts identifiable to this period, such as the decorated tripod feet in the Post-Lingjiatan period and the stylish pedestal vessels associated with elaborate burials in the Xiaoheyan period, is contradictory to the picture of a small remnant population under severe stress due to the deteriorating environment during this period.

It has been suggested that current information on ceramic typology is incomplete, resulting in only a small portion of sherds of the period from 5000 to 4000 BP being recognized in the Upper Daling survey. The estimated population represented by this portion of the sherds may not fully represent the Xiaoheyan population (Peterson et al. 2014a:61-66). The same scenario could be suggested in the Yuxi region. Most of the available information about Post-Lingjiatan sherds was from the excavated data of the Xuejiagang and Guangfulin sites, as discussed before. Our current knowledge of Post-Lingjiatan ceramics might be incomplete, making it hard to fully differentiate Post-Lingjiatan sherds from the Lingjiatan period. It could be a suggestion that some ceramics of 5000 BP continued to have characteristics of Lingjiatan sherds, and added some new features defined as Post-Lingjiatan "culture." It is possible that the Post-Lingjiatan period represents cultural continuity from the Lingjiatan period, which lasted longer than current ceramic knowledge suggested; while, it is also possible that a portion of Post-Lingjiatan sherds was mislabeled as Lingjiatan sherds.

Although it is tempting to suggest that two archaeological cultures far apart experienced an identical population decrease from 5000 to 4000 BP, pursuing this suggestion arising from regional settlement analysis needs a more precise chronological framework, and the ability to recognize remains dating to this period from 5000 to 4000 BP. Current knowledge confirms the presence of small, multiple, independent supra-local polities in both regions before 5000 BP; it is, though, possible that such political units of the Hongshan and Lingjiatan societies continued beyond 5000 BP.

4.5 A NEW SURGE OF DEVELOPMENT IN THE EARLY BRONZE AGE

After the interruption in the developmental trajectories of both regions, regional settlement analysis implies a clear divergence from 4000 to 3000 BP. During the Lower Xiajiadian period (4000-3200 BP) the number of settlements increased substantially from Hongshan times in the Upper Daling valley (Peterson et al. 2014a:71-75). The Lower Xiajiadian population of the survey area was estimated at 3,500-7,000, and population density reached 18 to 35 persons per square kilometer (Figure 4-1). The pattern of several supra-local communities established in Hongshan times continued into Lower Xiajiadian times, and the regional population growth was accompanied by an increase in both the size and number of supra-local communities. The largest supra-local community in the Lower Xiajiadian period has a population estimated at 1,200-2,500 (Figure 4-3).

The Yuxi region depicted an entirely different pattern for the period from 4000 to 2900 BP. No remains were detected in the entire Yuxi survey area except for a few fragmentary sherds whose characteristics could not be discerned. This pattern probably indicates that an extremely small number of people, if any, lived in this region for a very short period (Figure 4-1, Figure 4-2, and Figure 4-3). This "gap" pattern is not a rarity in the middle-and-lower reaches of the Yangzi River valley because other archaeological research has revealed very similar patterns during this period (Anhui 2004; Anhui 2006; Anhui 2015; Li 2016; Ye 2004). This "gap" does correspond to the archaeological and historical records of the emergence of the Shang state in China. The Shang state ruled in the Yellow River valley from 1600 to 1046 BC. The Early Shang centered on the south side of the Yellow River. Panlongcheng, located on the north side of the Yangzi River in Hubei, is the largest excavated Early Shang site, indicating the southernmost reach of the Early Shang culture at its peak (Xu 2003). However, to the east, this cultural influence never reached beyond the Chaohu Lake. The remains of this larger-scale, state-level polity are very scarce in the east of Chaohu (Anhui 2004; Anhui 2006; Anhui 2008; Anhui 2015). In Late Shang the capital moved to Anyang, Henan, and shifted its political and economic center to the north side of the Yellow River. Subsequently the Shang territory in the middle reaches of the Yangzi River shrank (Wang 1991). Thus, the indications from the regional settlement analysis are consistent with the historical and archaeological records of the Shang state. It is then, very likely that the Yuxi survey area was completely abandoned through the entire Shang period.

The Yuxi region witnessed a strong population growth from 2900 to 2500 BP, and the Upper Daling region experienced a population explosion during this period. The Upper Xiajiadian (3200-2600 BP) population density was nearly ten times higher than the Hongshan period and one and a half times higher than the Zhou period (2900-2500 BP) in the Yuxi region (Figure 4-1). Several separate supra-local communities were evident in the smoothed surface of the Upper Xiajiadian occupation, like those seen in other periods in the Upper Daling region. Quite distinct from the Upper Daling region, the Yuxi region during this period presented a complete reorganization of the regional system with only one supra-local community 11 kilometers across that occupied the east part of the survey area. The vast majority were small local communities of single families broadly spread in the west of the survey area. The largest district in the Zhou period has a population estimated at 7,740-15,480, more than three times larger than that in the Upper Xiajiadian times (Figure 4-3). The largest local community in the Yuxi region, however, was demographically one and a half times larger than that of the Upper Daling region (Figure 4-2). As discussed before, the reconstruction of political organization in Zhou Yuxi is consistent with the historical documents of the larger-scale state-level political integration extending far beyond the Yuxi survey area during this period. For the first time, a single social unit at a larger scale appeared in the Yuxi survey area with substantially increased population, and it became a very small part in the periphery of a huge politically integrated state known historically.

It could be a suggestion that regional settlement patterns varied in each region from 3000 to 2500 BP. Although both regions showed population growth, the surge in Yuxi was evidently tremendous (Figure 4-1, Figure 4-2 and Figure 4-3). The pattern of small autonomous polities continued in the Upper Daling region, but the degree to which the populations of these districts was concentrated into a single central settlement increased. In the southernmost district of Upper Daling survey region, the population centralization is greatest, where the governing settlement contains 95% of the whole district population (Peterson et al. 2014a:79). All the districts in the Upper Daling region were internally well integrated but independent at the larger scale across the entire survey region. However, in the Yuxi region, the degree of population nucleation in the district is not that high, with 60% of the population clustering in the central settlement in the single social unit socio-politically well integrated and centralized at the larger scale in the entire survey region. This higher degree of nucleation in supra-local communities in the Upper Daling survey region might indicate a higher level of interaction of the inhabitants living in these communities compared to that in the Yuxi region.

4.6 CONCLUDING THOUGHTS AND POSSIBLE EXPLANATION OF THE SIMILARITY AND VARIABILITY

The above comparisons between these two regions are not framed in a traditional, unilineal and typological way which is often stressed in the cultural evolutionary approach. The research is not focused on social stages, for example, simple chiefdom or complex chiefdom, that these two regions had been through. Instead, this research aims to understand their developmental trajectories, aspects of social change, and scales and natures of human communities.

The above comparison of trajectories of the Yuxi region and the Upper Daling valley shows that these two regions were roughly on the same track in terms of demographic growth and formation of supra-local communities, but the emergence of supra-local level social units was in evidence 800 years earlier in Upper Daling and lasted for a longer period. Supra-local communities grew to a slightly larger size both spatially and demographically in Lingjiatan Yuxi than in Hongshan Upper Daling (Figure 4-3). Lingjiatan emerged in a context of substantial population growth just exactly as Hongshan did. Regional population density rose to nearly the same level for these two regions during Hongshan/Lingjiatan times (Figure 4-1). Multiple independent chiefly districts characterized both regions during this period, and they were both displayed as larger communities acting as central places in integrating supra-local communities and smaller communities clustered around the larger communities. Excavation in both Lingjiatan and Hongshan regional centers indicated a solid focus on ritual and ceremonial activities (Anhui 2004; Anhui 2006; Guo 1995; Guo 1997; Guo and Zhang 1984; Guo and Zhang 2005). The similarity in the nature of centralized activities might help explain why these two regions were on the same track toward demographic growth and the formation of multiple small-scale supra-local communities. Settlement patterns analysis indicated that the ritual power probably was exclusively developed in the largest district (District 2) in the Yuxi region, but separately developed within each autonomous district in the Upper Daling region. The different degree of ritual power developed in both regions might help to account for the more stable and longer lasting polities in the Upper Daling region.

Previous chiefly polities collapsed in the second and third millennia BC in both regions. Climate change or deterioration has been suggested as a factor in the interruption of the developmental trajectories in both regions. However, pursuing this suggestion needs more evidence besides regional settlement pattern analysis. More precise and reliable chronological information, deposits from excavation, and climate data are required for accounting for the collapse of Hongshan in the Upper Daling region and Lingjiatan in the Yuxi region. This dissertation research would favor the interpretation that current knowledge of ceramic typology from 5000 to 4000 BP is incomplete in both regions.

After experiencing an interruption in the developmental trajectories, the two regions showed a sharp divergence in the later developmental trajectories. In the context of substantial population growth, the pattern of supra-local scale, spatially somewhat small political units that were established in the Hongshan period persisted in the Lower Xiajiadian period. However, settlements were entirely abandoned in the Yuxi region in this period. The two regions, with a very similar beginning, taking similar pathways to the establishment of numerous small-scale chiefly polities, finally diverged in their trajectories (Figure 4-1, Figure 4-2 and Figure 4-3). The Upper Daling region marched into a society characterized by petty states (Peterson et al. 2014a:71); whereas the Yuxi region went into a phase of abandonment until it was re-occupied 1000 years later.

This divergence in the trajectories persisted after 3000 BP but was expressed differently. Regional settlement analysis showed the continuation of small autonomous polities with substantial population growth during the Upper Xiajiadian period in the Upper Daling region, while the emergence of a single larger-scale social formation in the Yuxi region as a very small part in the periphery of a huge politically integrated Zhou state known historically. There is no sign that the ritual and religious activities that played a vital role in the emerging supra-local communities in previous times (e.g. Hongshan and Lingjiatan) continued to occupy this role after 3000 BP. It has been suggested that an increase in productive specialization and economic interdependence among population might account for the settlement patterns in Upper Xiajiadian times (Peterson et al. 2014a:75-77). But for the Yuxi region, this would not be the case. The strong integration across the entire Yuxi region was part of the sociopolitical impact of the much larger scale state centered in the Central Plain.

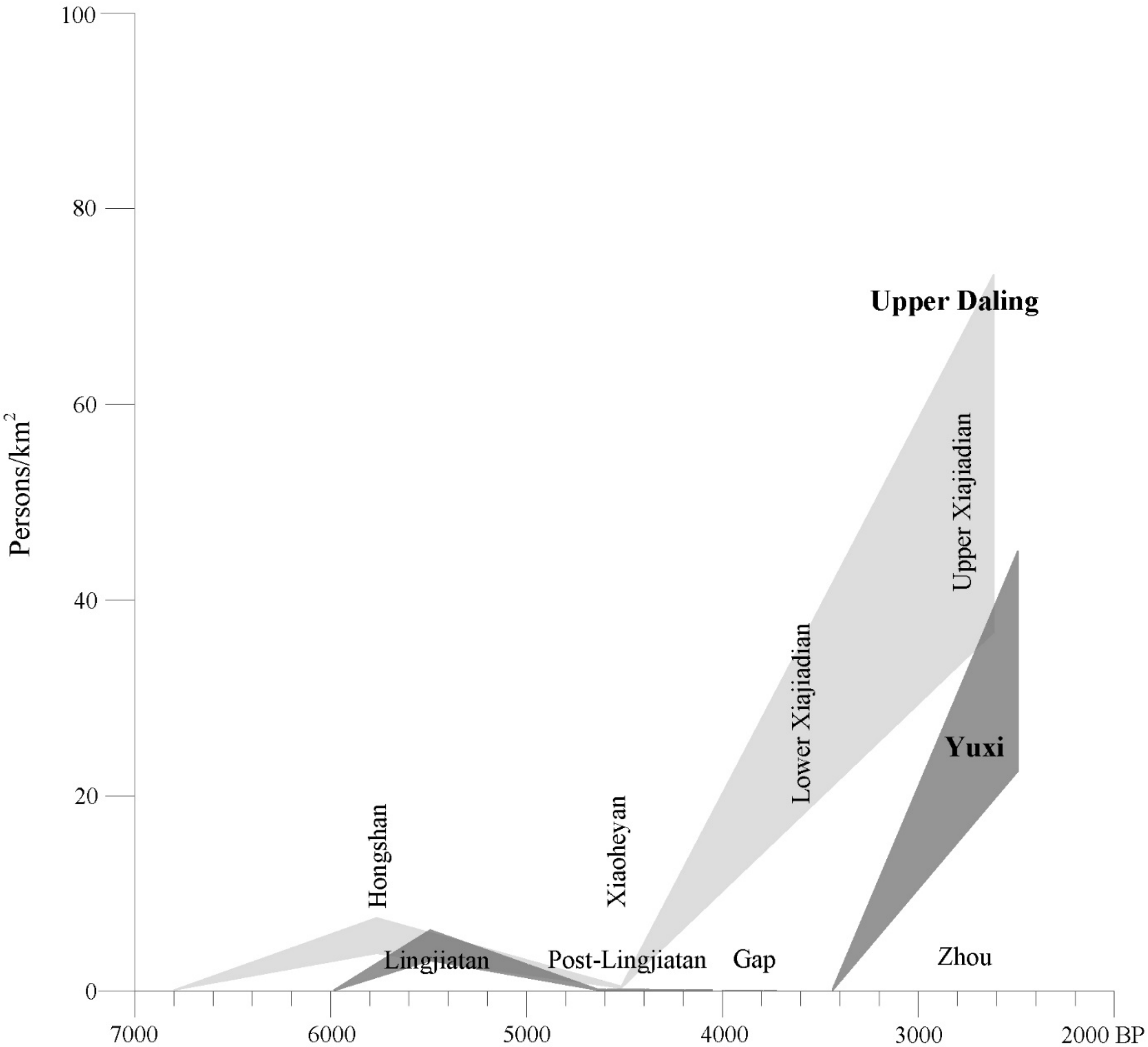

Figure 4-1 Regional population density estimates (number of inhabitants per km²) for the Upper Daling Valley and the Yuxi region. The range between minimum and maximum estimate is shown.

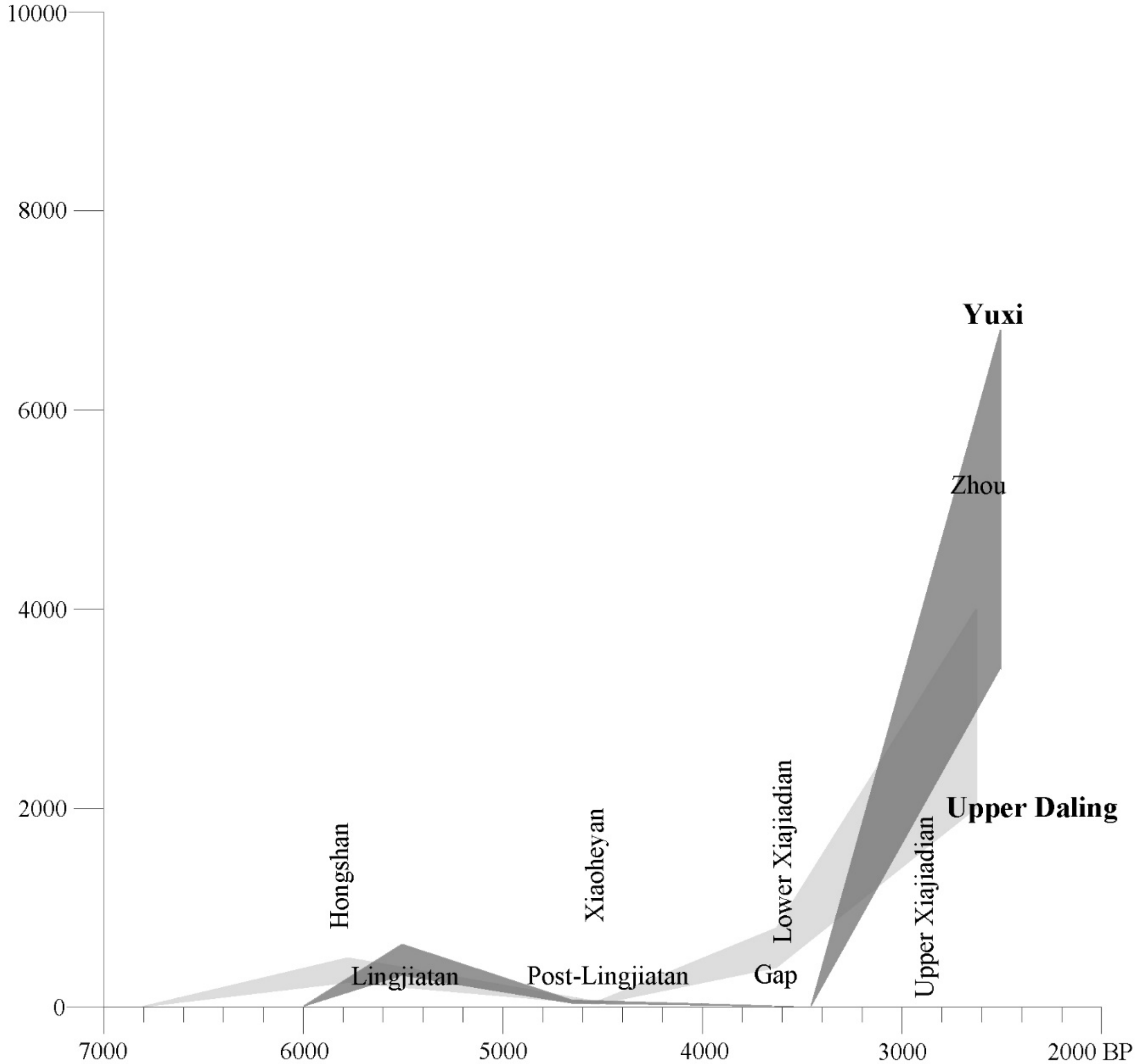

Figure 4-2 Population estimates (number of inhabitants) for the largest settlement or local community in each period in the Upper Daling Valley and the Yuxi region. The range between minimum and maximum estimates is shown.

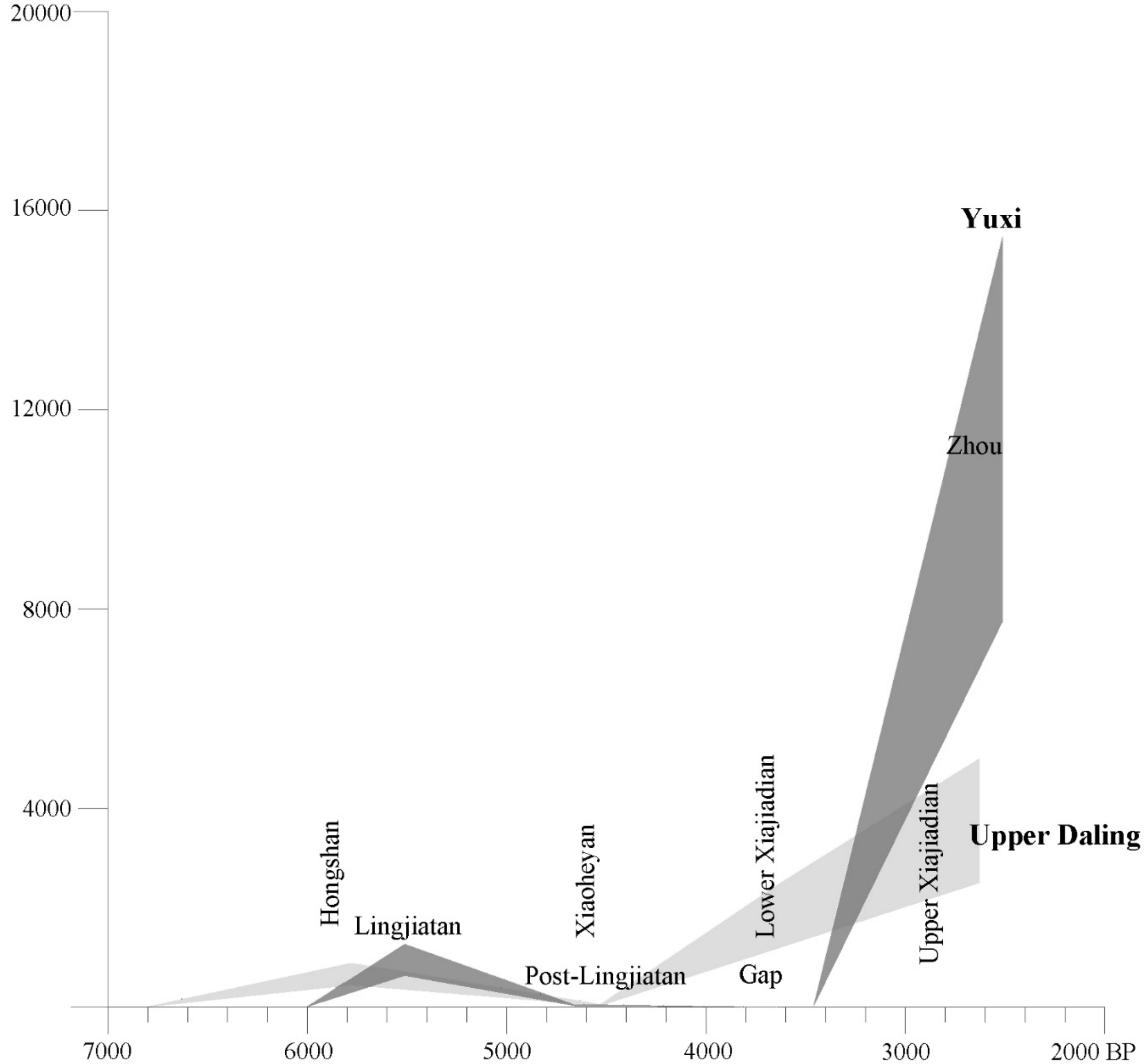

Figure 4-3 Population estimates (number of inhabitants) for the largest supra-local community in each period in the Upper Daling Valley and the Yuxi region. The range between minimum and maximum estimates is shown.

5.0 SOCIAL DIFFERENTIATION IN THE LINGJIATAN HOUSEHOLDS AND COMMUNITIES

The regional settlement analysis in this dissertation research suggested that Lingjiatan leadership probably was based on ritual and religious activities. Pursuing this suggestion arising from regional-scale analysis needs to understand the nature and organization of activities and interactions in local communities, especially in those central places. The analysis of a large sample of artifact assemblages representing households in local communities and local communities in districts dating to Lingjiatan period (5700–5300 BP) from the Yuxi survey zone can complement the regional-scale analysis and excavated information from the burial complex in the Lingjiatan site. Households are the essential units of the daily life of inhabitants in most ancient societies. The interactions between households that constitute local communities generate the forces for social change (Peterson and Drennan 2005:5). Thus, it is vital to study the patterns of interactions between households in local communities so as to understand the emergence and development of early complex societies. This chapter explores the social differentiation in the Lingjiatan local communities from four aspects, including wealth differentiation, prestige differentiation, ritual differentiation and productive differentiation (Drennan and Peterson 2012:76-78). They are hierarchical principles around which communities were organized in the early complex societies. All of them, as important archaeological evidence to understand growing social formations, could be detected in the analysis of household artifact assemblages. “Ritual differentiation” is often defined as “unequal access to the supernatural in human societies” (Drennan and Peterson 2012:77) and there is little controversy about that. However, it can be difficult to differentiate “wealth” and “prestige” in household artifact assemblages. This research would consider that, as possessions of households, more delicately crafted ceramics (including finer paste, smoothed or burnished surfaces and complicated decorations, etc.) are likely to indicate the higher status of a household as opposed to coarsely made ones because of the high labor-investment involved. Then, the practice and consumption of fine vessels is one way to express social status. If a particular kind of fine vessels with extremely high labor investment, such as the black burnished “Egg-Shell” pottery stemmed cup discovered in the Longshan society in Shandong, is present in the household artifact assemblages, it would be taken to represent “wealth” instead of “prestige.” More conclusive discussion related to this issue is presented below. In addition, this research might not be able to discuss productive differentiation effectively. Few lithic artifacts were collected during the regional survey, limiting the ability to explore productive differentiation through use of lithic tools. Thus, this research focuses on the wealth differentiation, prestige differentiation and ritual differentiation represented by ceramic artifact assemblages.

The concrete questions whose factual answers are pursued in this chapter include: What activities were populations of District 2 engaged in and how were those activities organized? How did that differ from those of District 1 and District 3? How much wealth, prestige, and ritual differentiation was present within local communities and between them? Was the differentiation between household groups within local communities in District 2 at the same level as those in District 1 and District 3?

5.1 SMOOTHED SURFACE LAYERS AS AN APPROACH TO IDENTIFY AND COMPARE ARTIFACT ASSEMBLAGE PATTERNS

Identifying the pattern of household artifact assemblages is a good way to explore interactions, activities and social standings of the vast majority of the population in local communities and supra-local communities. Traditional research at the household scale focuses on intensive excavations of household remains, which is the most direct way to discern local patterns (e.g. Duan et al. 2011; Gansu 1983; Hirth 1993; Smith 1987; Xi'an 1988; Zhongguo 1982). Intensive surface collections were introduced to understand activities at the household scale in recent research (e.g. Peterson 2006; Peterson et al. 2014a). The unambiguous connection between surface scatters of artifacts and household remains has been confirmed in recent research, and surface collecting can be an effective way to recover artifact assemblages for comparing activities at the household scale because it is much less time-consuming than extensive excavations in household studies (Drennan et al. 2017b:54). In Hongshan communities, excavations of Hongshan households provided an idea of the layout and structure of Hongshan villages (e.g. Neimenggu 1994). Based on the known area of Hongshan households, household units were delineated in the intensive surface collection, and near-surface artifacts were recovered by households (Drennan et al. 2017b). Hongshan household units were represented by artifacts consisting of sherds and lithics. For one household unit, sample size sometimes could reach thousands of sherds through the intensive surface collection, making the number of sherds statistically meaningful to be counted and proportioned into different variables which were finally analyzed and interpreted through multi-dimensional scaling.

The Lingjiatan regional survey adopted very small collection units, varying from 1 m^2, 4 m^2, to 100 m^2. It is an extremely fine-scale surface collection, though not as intensive as that of Hongshan. Compared to the intensive surface collection in Hongshan, the sherd samples are small in Lingjiatan, and the sherd densities are low regarding household scale analysis because the original Lingjiatan survey was focused on the regional scale. Even if more intensive surface collecting was conducted in Lingjiatan, it would still be difficult to collect artifacts by household units due to lack of information on Lingjiatan villages. The size and layout of Lingjiatan households are unknown so far. The lack of intensive surface collection and household information limited the ability to directly apply the methods used in studying the Hongshan community in the Upper Daling region to the Lingjiatan community in the Yuxi region to delineate household units, and to identify and compare artifact assemblage patterns among them. However, it did not limit the ability to see trends of activities varying across space within local communities and supra-local communities in Lingjiatan. With the adjusted method presented below, artifacts collected on such a small scale can still be practical to understand the Lingjiatan households and communities.

Spatial correlation analysis of different variables recorded for ceramic artifact assemblages represented by smoothed surfaces provides a good approach to explore the trend of differentiation within and between local communities in Lingjiatan. The smoothed surfaces of the population have been demonstrated in Chapter 3. It would be meaningful to explore how ceramic artifact assemblages represented by different variables were distributed among the population within each local community and supra-local community. Do the places with more concentrated population always have more high-quality vessels? Is the population factor adequate to explain the distribution of ceramic artifact assemblages represented by different variables? If so, to what extent? If not, what other factors might influence the distribution of artifact assemblages and the activities associated with them? The degree of correspondence between population distribution and artifact assemblage distribution represented by different variables can be assessed by representing both things as smoothed surfaces showing trends at different scales. These surfaces, produced in Surfer, were imported to Idrisi to carry out a regression analysis with the population surface as the independent variable and the surfaces for ceramic variables as the dependent variables. The expected distribution of different variables on the basis of the distribution of population were then predicted based on the equation generated from the regression analysis. By subtracting the predicted variable values from the observed variable values, a new *residual raster layer* was created, showing the places where certain kinds of ceramics were revealed more than or less than expected (on the basis of population there). The way artifacts represented by different variables vary across space within a local community, or a district would give a good indication of how they vary from household to household, or from local community to local community across that space.

The analysis is based on 3,939 Lingjiatan sherds collected from the Yuxi region survey. Ceramic data recorded included the counts, paste, surface finish, surface color, vessel form and decoration techniques of 3,939 sherds. Specifically, twenty-eight variables were recorded, including paste (“fine” or “coarse”), surface finish (“smoothed”, “unsmoothed”, “burnished”, “slipped”, or “painted”), surface color (“red”, “reddish-brown”, “grey”, “yellow-grey”, “black” or “other”), vessel forms (“*gang*” 缸, “*bei*” 杯, “*guan*” 罐, “*hu*” 壶, “*ding*” 鼎, “*dou*” 豆, “*bo*” 钵, or “indeterminate”), and decoration techniques (“punctate impression”, “incised impression”, “molded”, “appliqué strip”, “raised-strip”, “none”, or “other”). Surface colors of the Lingjiatan ceramic are diverse, but they are not correlated to any social differentiation. The colors are closely related to the quality of pottery paste as described in Chapter 2. Fine-paste sherds are often but not always in grey, yellow grey and black; while coarse-paste sherds are often but not always in red and reddish-brown. Lingjiatan sherds lack decorations, and the plain surface is the most distinctive characteristic in Lingjiatan times. Thus, surface color and decoration techniques were not used for producing smoothed surfaces and conducting spatial correlation analysis.

Eventually, the large numbers of variables were sieved to the four variables for the final analyses upon which interpretation relied. These consist of fine-paste sherds; smoothed, burnished, or slipped (SBS) sherds; serving-vessel (*bei*, *guan*, *hu*, *dou* and *bo*) sherds; and cooking-vessel (*gang* and *ding*) sherds.

Pottery is an important indicator of social differences in archaeological evidence. The practice of pottery in daily lives might be one of the vital ways that social differentiation was demonstrated and strengthened (Costin and Earle 1989; Drennan 1975; Welch 1991). "Fine-paste sherds" are in contrast to "coarse-paste sherds," and often, but not always, represent higher quality pottery. In most cases, people who own fine-paste pottery might be in a better position than those with coarse-paste pottery in terms of enjoying the higher quality vessels (Drennan et al. 2017b:56). Sometimes, it is much costlier to produce fine-paste pottery regarding labor investment. Thus, the unexpected high or unexpected low number of "fine-paste sherds" (on the basis of population) in space could indicate the presence of wealth differentiation or prestige differentiation across that space. Smoothing, burnishing and slipping are the most common surface treatments of Lingjiatan pottery. These three surface treatments were combined into a single variable - "SBS sherds," to indicate the presence of higher social prestige or accumulation of wealth because pottery with smoothed, burnished or slipped surfaces needs more labor investment than unsmoothed pottery. The vessel function of pottery is also closely related to social rankings. Elites are often distinguished from commoners by using serving vessels in many archaeological records (e.g. Smith 1987; Wilk and Rathje 1982). The high density of "serving-vessel sherds" indicates that the owner might have a larger number of vessels to serve and present food in sophisticated ways. Serving vessels are often related to feasts and ceremonies, which probably serve to symbolize reciprocal relationship or aggrandize power (Clark and Blake 1994; Smith 1987). In Lingjiatan times, *bei*, *guan*, *hu*, *dou* and *bo* are the most common serving vessels as discussed in Chapter 2. Different from serving vessels, which are sensitive indicators of differences in social wealth or prestige, cooking vessels might not be a good indicator of wealth or prestige, because they are often, but not always commonly owned by every household. Labor investment in cooking vessels is usually lower than that in serving vessels. In addition, archaeological and ethnographic records indicate that in some situations cooking vessels have a negative association with prestige and wealth. The ratio of serving to cooking vessels has been widely used by archaeologists as an index of the social differentiation of inhabitants who owned them (e.g. Drennan 1975; Welch 1991). Households of high prestige are more likely to have more serving vessels instead of cooking vessels, and one of the reasons could be that the low-prestige households might be responsible for cooking for the high-prestige households (Smith 1987).

It is vital to understand the nature of the above variables applied in the spatial correlation analysis. The two categories of "fine-paste sherds" and "coarse-paste sherds" are mutually exclusive in term of pottery paste in the analysis. The two categories of "SBS sherds" and "unsmoothed sherds" are also mutually exclusive regarding the surface treatment. However, vessel forms are constituted of three categories - "serving-vessel sherds," "cooking-vessel sherds," and "indeterminate sherds." Indeterminate sherds refer to those that are extremely tiny and heavily worn and lack the vital information to be identified as to vessel type. Sherds with indeterminate vessel shape account for 12% of the total sherds, which would not affect the patterns of the analysis at the supra-local community scale. However, at the local community scale analysis, the percentage of "indeterminate sherds" might increase due to the much smaller number of collection units incorporated in some local communities, which would affect the patterns of real human activities there. This factor should not be ignored in the spatial correlation analysis at the local community scale.

The density of population as the independent variable, and the density of fine-paste sherds, SBS sherds, serving-vessel sherds and cooking-vessel sherds as dependent variables, were represented by smoothed surfaces in different scales, including the supra-local community and local community scales. The reason to apply smoothed surfaces is that it would display the spatial patterning in the residuals in the districts nicely and show where in the space the high positive residuals are, and make a nice visual comparison to the smoothed population surface that illustrates the demographic pattern. At smaller scales, smoothed surfaces could directly depict the trends across the space at the local community scale. Patterns at this scale would be much easier to see as would correspondence between the population smoothed surface and the residual smoothed surface. Compared to unsmoothed surfaces, correlations would be more reliable in smoothed surfaces because random variation from one cell to the next would be averaged out and the result would be a more meaningful expression of trends across the area of the local community and between them. The residual smoothed layer would display the across trends quite nicely: yellow color represented areas with about as many sherds of any variable as expected on the basis of the population trend; dark blue and green indicated areas with fewer sherds of any variable than expected; red and purple demonstrated areas with more sherds of any variable than expected (which are considered as the “hot-spots” in the following analysis). To avoid the distraction of trends outside the survey area, the minimum value in a residual layer would be added to the residual surface itself, and then the result would be multiplied by the survey-boundary mask layer. The final result has a value of 0 for outside the survey area and would display the low and high regional trend for residuals nicely within the local communities and supra-local communities.

5.2 VARIATIONS OF ARTIFACT ASSEMBLAGE PATTERNS WITHIN SUPRA-LOCAL COMMUNITIES

The following part presents the residual smoothed surfaces of the distribution of sherds of four variables and depicts the trends of variations across the area of supra-local communities. The differentiation between local communities within supra-local communities provides a good indication of how the activities that local communities were engaged in were different in District 1, District 2 and District 3. The smoothed surface population density across the space of three supra-local communities is showed in Figure 5-1.

5.2.1 Spatial Patterns of Fine-Paste Sherds in Supra-Local Communities

A total 1,315 fine-paste ceramic sherds were recovered at Lingjiatan, accounting for 33.3% of the total Lingjiatan ceramic sherds. Regression analysis between the smoothed surfaces of the Lingjiatan population and fine-paste ceramic sherds shows that 92.78% of the distribution of fine-paste sherds could be explained by the population factor (Figure 5-2). The distribution of population and fine-paste sherds across the area of supra-local communities were strongly correlated. However, more than 7% of the distribution cannot be explained by the population factor. The smoothed residual surface of fine-paste sherds (Figure 5-3), in contrast to the smoothed population surface (Figure 5-1), reveals that the densities of fine-paste sherds are either higher or lower than expected particularly in the demographic center in each supra-local community. The density of fine-paste sherds, in dark blue and green colors, is clearly lower than expected in the center of the supra-local community in the northeast corner (District 3); and it is about as many as expected in the center of the northwestern supra-local community (District 1), which are filled in yellow. However, the center of District 2 (the supra-local community in the center toward the southeast corner) is filled with red and purple pixels, indicating that the density of fine-paste sherds is higher than expected. Although not so pronounced, it still could be felt that the fine-paste sherds tend to cluster in the center of the largest supra-local community (District 2). The centers of District 1 and District 3 also have a high population density, but they do not have the higher-than-expected density of fine-paste sherds as observed in District 2. It is possible that other factors besides population pushed the fine-paste pottery toward the center of District 2. Pottery with fine-paste is considered costlier to produce than those with coarse-paste regarding labor investment, and it has often been related to prestige differentiation or wealth differentiation. However, in Lingjiatan society, the concentration of fine-paste pottery is more likely to show higher prestige for the following reasons. First, fine-paste pottery in Lingjiatan times is not much more expensive to produce due to their plain surface. Second, the differentiation suggested by the fine-paste sherds between the central communities in each district is very slight. The places that have more fine-paste pottery than expected actually do not have a lot more of it. Third, the demographic center of District 2, which has been suggested with higher-than-expected fine-paste sherds, is extremely close to the location of the public structures and burials associated with elaborate jade artifacts. It is suggested that the group of elites buried with elaborate jade artifacts in the Lingjiatan ceremonial structures, probably held ceremonial feasts with the fine-paste pottery to express their social refinement during their life time. Such activities that populations of District 2 were engaged in were organized through prestige and promoted the growth of supra-local formation of District 2.

5.2.2 Spatial Patterns of Smoothed, Burnished or Slipped (SBS) Sherds in Supra-Local Communities

A total of 2,205 smoothed, burnished or slipped (SBS) sherds were recovered for the Lingjiatan period, accounting for 55.9% of the total Lingjiatan ceramic sherds. Among these 2,205 sherds, 1,410 are smoothed, 788 are slipped and only seven are burnished. Burnishing is an uncommon surface finish technique in Lingjiatan times. Regression analysis between the smoothed surfaces of the Lingjiatan population and SBS ceramic sherds shows that 95.05% of the distribution of the SBS ceramic sherds can be explained by the population factor (Figure 5-4). The pattern displayed by the smoothed residual layer of SBS sherds is similar to what has been revealed by the fine-paste sherds, but in a more noticeable way (Figure 5-5). The center of the northeastern supra-local community (District 3) is still in dark green and blue clearly indicating that SBS sherds densities are lower than expected (on the basis of population there). The center of the northwestern supra-local community (District 1) is unambiguously in yellow indicating that it has as many SBS sherds as expected. The center of District 2 is in red and purple and stronger compared to Figure 5-3, showing that the SBS sherds densities are much higher than expected (on the basis of population there). The similar distribution pattern of fine-paste and SBS sherds suggests that there is little distinction between the use of fine-paste pottery and the use of smoothed, slipped, or burnished pottery in all three supra-local communities in the Lingjiatan period. As with fine-paste pottery, the use of smoothed, burnished or slipped pottery is also one of the ways in which wealth or prestige was displayed. The increase in the labor cost of producing the smoothed, burnished or slipped surface of pottery could be a sign of wealth accumulation, but in the case of Lingjiatan, this cost is so minimal that could be neglected. The use of pottery with smoothed, burnished or slipped surfaces is more likely to be a way to show that the owners were in a better position than others to enjoy those nicer vessels. Above this, in District 2, the hot-spots where SBS sherds density was substantially more concentrated than population was, parallels the distribution of ritual objects (elaborate jade artifacts), burial complex and public architecture, as well as the hot-spots of fine-paste sherds, which again, confirms that the activities in District 2 were organized around social prestige rather than wealth.

5.2.3 Spatial Patterns of Serving-Vessel Sherds in Supra-Local Communities

Altogether 1,402 serving-vessel sherds were recorded for the Lingjiatan period, accounting for 35.5% of the total Lingjiatan ceramic sherds. These serving vessels are composed of five types – *bei* (杯), *guan* (罐), *hu* (壶), *dou* (豆), *and bo* (钵). Among these 1,402 sherds, 35 are *bei*, 784 are *guan*, 83 are *hu*, 430 are *dou*, and 70 are *bo*. Regression analysis between the smoothed surfaces of the Lingjiatan population and serving-vessel sherds shows that 95.51% of the distribution of the serving-vessel sherds could be explained by the population factor (Figure 5-6). Only less than 5% of the distribution cannot be explained by the population factor. The smoothed residual layer of serving-vessel sherds reveals an identical trend as SBS sherds did but in a more pronounced way (Figure 5-7). On the residual layer of serving-vessel sherds, not only the center of the northeastern supra-local community (District 3) is in dark green and blue, the center of the northwestern supra-local community (District 1) is also unambiguously in green color, clearly indicating that the density of serving-vessel sherds is lower than expected (on the basis of population there). The center of District 2 is still in solid red and purple, showing that serving-vessel sherds were considerably more concentrated than population was. In the comparison to the concentration of fine-paste and SBS sherds, the concentration of serving-vessel sherds is stronger in the center of District 2. It could be suggested that inhabitants in District 1 and District 3 did not have the same level of access to the practice of serving vessels as inhabitants in District 2 did. The number and quality of serving vessels is a good indicator of household wealth and prestige in many archaeological records (Costin and Earle 1989; Mills 1999; Smith 1987). Serving vessels at Lingjiatan, however, are not extremely elaborate and precious objects with high labor and skills investment, such as the painted pottery in Majiayao culture in Gansu (Shi 1962), or the burnished black "Egg-Shell" pottery stemmed cups in Longshan culture in Shandong (Du 1982; Yan 1981). Instead, they are just finer and thinner vessels in contrast to cooking vessels and were used for food consumption and presentation. Serving vessels are frequently related to consumption patterns in the archaeological contexts. The use of serving vessels is an important marker of social gathering that includes consumption of food and drinks, which conveys the information of the social or economic status of the host (Welch and Scarry 1995). Thus, the pattern revealed from Figure 5-7 demonstrates that the center of the largest supra-local community in Lingjiatan (District 2) probably had more activities of social gathering and food consumption than that of the other two supra-local communities had, and used them as an approach to convey elegance and enhance social prestige. It could be a suggestion that the food consumption and feasting occurring in the center of District 2 were associated with ritual and ceremonial activates. If the Lingjiatan site was a ritual and ceremonial place in the Yuxi region as suggested (e.g. Anhui 2006), then, the social gathering represented by these serving vessels could be a vital part of ritual activities performed at this place.

5.2.4 Spatial Patterns of Cooking-Vessel Sherds in Supra-Local Communities

Altogether 2,026 cooking vessel sherds were recorded for the Lingjiatan period, accounting for 52% of the total Lingjiatan ceramic sherds. *Ding* (鼎) and *Gang* (缸) constituted the main types of cooking vessel. There are 785 sherds identifiable to *Ding* and 1,241 sherds distinguishable to *Gang*.

These cooking vessels were often made in coarse paste mixed with the temper of sand, clamshell and plants, and commonly with the heavy and thick wall. Regression analysis between the smoothed surfaces of the Lingjiatan population and cooking-vessel sherds suggests that 91.20% of the distribution of the cooking-vessel sherds in three supra-local communities was explained by the population factor (Figure 5-8). The trend revealed by the residual layer of cooking-vessel sherds displays a picture different from the other three variables (Figure 5-9). The center of the supra-local community in the northeast (District 3) is still in dark blue and green, indicating that the density of cooking-vessel sherds is lower than expected (on the basis of population there) (Figure 5-9). The center of the supra-local community in the northwest (District 1) is filled with purple and red, suggesting that the number of cooking-vessel sherds is much higher than expected. The center of District 2 is somewhat in between yellow and orange, indicating that the number of cooking-vessel sherds there was slightly more concentrated than population was. In contrast to serving vessels, cooking vessels are less labor-invested and less likely to be a positive indicator of wealth or prestige. They are commonly associated with every household. In addition, archaeological and ethnographical records indicate that in many situations cooking vessels have a negative association with wealth and prestige. Households of elites and commoners could be differentiated by the ratio of cooking vessels to serving vessels they had (e.g. Drennan 1975; Welch 1991). The picture that households of higher prestige might have more serving vessels rather than cooking vessels, and households with more cooking vessels might have lower prestige in a society could summarize the patterns revealed in the three districts in the Lingjiatan period. The hot-spots on the residual layers show that the densities of fine-paste sherds, smoothed-burnished-slipped sherds, and serving-vessels sherds were all more concentrated in the center of the largest supra-local community (District 2) than population was. However, the density of cooking-vessel sherds was unquestionably less concentrated in the center of District 2 than population was (Figure 5-9). The pattern is just the opposite in the center of District 1, which has a lower-than-expected number of SBS sherds, much lower-than-expected number of serving-vessel sherds, not higher-than-expected number of fine-paste sherds and much higher-than-expected cooking vessel sherds. It could be a suggestion that the center of District 2 was occupied by a group of elites with higher social prestige owning relatively large numbers of high-quality vessels for social gatherings, feasting or ritual activities. While the center of District 1 probably was occupied by more common people owning fairly large numbers of cooking vessels.

5.2.5 Summary

The above analysis considered the number of fine-paste sherds, smoothed, burnished or slipped sherds, and serving-vessel sherds, as an index of the quantity of finer, more elegant and more labor-intensive vessels. The spatial correlation analysis and the residual layers indicated that some local communities, for example those in the center in District 2, had more such high-quality vessels than others in the Yuxi survey area. The concentration of such vessels demonstrates that inhabitants in the center of District 2 had better access than others to such finer and more elegant vessels for food serving and presentation. Moreover, this kind of concentration is in a progressive trend, expressed as serving vessels more exclusive to those inhabitants, and smoothed, burnished or slipped vessels less exclusive, and fine-paste vessels the least exclusive. In District 2, the increase of high-quality pottery was consistent with the concentration of ceremonial architecture and elaborate jade artifacts associated with burials, suggesting that the use of the high-quality pottery was more likely a way to display social elegance at social gatherings, probably often associated with ritual activities.

The lower-than-expected amount of high-quality pottery, accompanied with the greater aggregation of cooking vessels characterizes the center of District 1. The center of District 3 located in the northeast is always filled with green and dark blue indicating that the ceramic sherd densities represented by these four variables are all lower than expected (on the basis of population there). Such patterns suggest that ritual and prestige differentiation are much weaker in District 1 and 3 than is indicated in District 2. Presumably there was some sort of centripetal forces drawing people toward the center of District 1 and 3, and it may have been the same kind of thing that drew people toward the center of District 2. But the force (ritual and prestige differentiation) was strongest in District 2 and made it the district that stood out for larger population, for heavy concentration of population in its center, and for more pottery indicating prestige than expected, even on the basis of its very large population.

5.3 VARIATIONS OF ARTIFACT ASSEMBLAGE PATTERNS WITHIN LOCAL COMMUNITIES

The spatial correlation analysis at the supra-local community scale suggested that District 2 had more strongly developed prestige and ritual differentiation than District 1 or 3 did. This part of the analysis attempts to explore how artifact assemblages represented by different variables vary from household to household across space through observing the way they vary across space within local communities. This research considers that trends across space within local communities could represent the trend from household to household, and attempts to answer these questions: Were households within local communities engaged in different activities? Is the degree of differentiation between households within the local communities in District 2 different from that in District 1 or 3?

As Figure 5-10 demonstrates, sixty-four local communities were delineated for the Lingjiatan period based on the remains of artifacts collected from the Yuxi regional survey. Among them, seven local communities (showed as pink polygons) were chosen for analysis of the trend of variations within local communities across the Yuxi survey area. These seven local communities fulfilled the following criteria. First, the seven local communities have to come from different supra-local communities to make sure they spread out adequately to represent the variations of artifact assemblage patterns within all local communities in the Yuxi survey zone. Second, the largest one or two local communities from each district were included in the analysis. Third, only local communities containing no less than five collection units with non-zero data of different variables were counted in the analysis, because not all local communities have sufficient data to produce smoothed surfaces of the four variables. For example, one local community contained 13 collection units, but the number of collection units with non-zero data for fine-paste sherds is only 3, too low to produce statistically meaningful smoothed surfaces. In this case, this local community was excluded from the spatial correlation analysis. Five smoothed surfaces were produced for each local community: one smoothed surface of the population distribution, and four residual smoothed layers of the distribution of fine-paste, smoothed-burnished-slipped (SBS), serving-vessel, and cooking-vessel sherds. As discussed before, the sherds of "indeterminate vessel type" were removed from the dataset, to avoid just showing the patterns of how badly broken up sherds are distributed in local communities rather than reconstructing the real human activities there. The spatial patterns of four variables within each of the seven local communities are identified, interpreted and compared as follows.

5.3.1 Spatial Patterns of Four Variables within Local Community 1

Local community 1 as the largest local community, is located right in the center of District 2 (Figure 5-10). The Lingjiatan burial complex and public structures marked by the red square in Figure 5-11, were discovered in the north of local community 1. The distribution of the remains of these ceremonial structures stayed away from the hot-spots on the smoothed surface of the population distribution in local community 1 (Figure 5-11). The remains of *hongshaotu* (红烧土) were spread out in local community 1. Regression analysis shows that the distributions of four variables are strongly correlated to the population (with r^2=97.33%, r^2=99.02%, r^2=99.76%, and r^2=99.65% respectively, Figure 5-12, Figure 5-13, Figure 5-14 and Figure 5-15). The distribution of 3% fine-paste sherds cannot be explained by the population factor, and less than 1% SBS sherds, serving-vessel sherds and cooking-vessel sherds cannot be explained by the population factor. In local community 1, there appears to be a sharp discrepancy between the use of cooking vessels and the use of fine-paste, serving and SBS vessels. There appeared three hot-spots (in red and purple) of fine-paste sherds with highest densities (Figure 5-16), almost identical with the hot-spots of SBS sherds and serving-vessel sherds, despite that the southwest corner of the residual layer of the serving-vessel sherds is not "red" enough to form in a clear hot-spot (Figure 5-17 and Figure 5-18). The hot-spots of cooking-vessel sherds were entirely distributed in the area covered by much fewer fine-paste, SBS, and serving-vessel sherds, forming a complementary pattern with the distribution of the high-quality pottery (Figure 5-19). The location of the hot-spot of the high-quality pottery in the north is extremely close to that of the elaborate burials and public structures marked by the red square, which is approximately 50 m to the west of the hot-spot in Figure 5-16. Thus, the pattern of the ceramic artifact assemblages varying across the area of local community

1 reveals that some household groups represented by the three hot-spots stand out with more high-quality pottery (fine-paste, SBS, and serving-vessel pottery) than others. Especially the household group in the north, located about 50 m to the east of the burial complex, might have higher social prestige than others in local community 1 through accessing finer vessels in social gatherings of ritual activities. As discussed before, the labor cost of the decoration of the Lingjiatan pottery is near zero because most Lingjiatan pottery is with the plain surface. The increase in labor cost that goes with those serving vessels is also insignificant. Above that, the Lingjiatan burials, the location of which is extremely close to the household group with more high-quality pottery in the north, have symbolic and ostentatious things like jade objects rather than numerous high-quality utilitarian things like pottery and tools, suggesting that the wealth accumulation might not be emphasized in their society. Thus, the use of high-quality pottery for some household groups in local community 1 is more likely to be a way to display elegance and enhance social prestige.

5.3.2 Spatial Patterns of Four Variables within Local Community 2

Located in the center of District 1, local community 2 is the largest settlement in this district (Figure 5-10). The population was more concentrated in the center of local community 2, represented by the red and purple pixels in Figure 5-20. Regression analysis reveals that the distribution of ceramic artifacts represented by the four variables is strongly correlated to the distribution of the population in local community 2 (with r^2=97.28% for fine-paste sherds, r^2=96.26% for SBS sherds, r^2=99.31% for serving-vessel sherds, and r^2=99.82% for cooking-vessel sherds in Figure 5-21, Figure 5-22, Figure 5-23, and Figure 5-24). This indicates that 96% or more of the distribution of the variables can be explained by the population factor. The residual layer of local community 2 demonstrates a pattern similar to those in local community 1, but somewhat more ambiguous. There appears to be a division of two groups of activities, with one represented by cooking-vessel sherds in the center, and the other represented by serving-vessel, fine-paste and SBS sherds in the north and west (Figure 5-25. Figure 5-26, Figure 5-27 and Figure 5-28). Distinct from local community 1, the hot-spots of fine-paste, SBS and serving-vessel sherds in local community 2 were combined in different ways, rather than completely identical to each other and complementary to the hot-spots of cooking-vessel sherds. There appears to be a distinction between the use of fine-paste serving vessels in food presentation (in red spots towards the north) and the use of pottery with smoothed, burnished and slipped surfaces (in red spots towards the west) in local community 2 (Figure 5-25, Figure 5-26, and Figure 5-27). Thus, the prestige differentiation indicated by various activities between household groups within local community 2 is somewhat weaker than those seen in local community 1.

5.3.3 Spatial Patterns of Four Variables within Local Community 3

Located in-between District 1 and District 2 (Figure 5-10), local community 3 has its population more concentrated in the center of the smoothed surface (Figure 5-29). Similar to local community 2, regression analysis reveals that the distribution of ceramic artifacts represented by the variables is also strongly correlated to the distribution of the population within local community 3 (with r^2=98.85% for fine-paste sherds, r^2=94.97% for SBS sherds, r^2=99.70% for serving-vessel sherds, and r^2=99.50% for cooking-vessel sherds in Figure 5-30, Figure 5-31, Figure 5-32, and Figure 5-33). The residual layers of local community 3 also demonstrate a discrepancy between the use of fine-paste, SBS and serving vessels in the center against the use of cooking vessels in the north and south (Figure 5-34, Figure 5-35, Figure 5-36, and Figure 5-37). There appeared to be three household groups delineated within local community 3. The one in the center was in better position than others to enjoy finer vessels, the one in the northwest was with lower social prestige, and the one in the south was in a somewhat vague position compared to the other two. Thus, it could be a suggestion that local community 3 was also identified with prestige differentiation, which is less pronounced than that in local community 1.

5.3.4 Spatial Patterns of Four Variables within Local Community 4

Local community 4 is located in the southeast of District 2 (Figure 5-10), with its population concentrated in the east on the smoothed surface (Figure 5-38). Regression analysis reveals that the distribution of ceramic artifacts represented by the variables is also strongly correlated to the distribution of the population within local community 4 (with r^2=96.64% for fine-paste sherds, r^2=97.66% for SBS sherds, r^2=99.74% for serving-vessel sherds, and r^2=99.76% for cooking-vessel sherds in Figure 5-39, Figure 5-40, Figure 5-41, and Figure 5-42). The hot-spots of the distribution of fine-paste, SBS, and serving-vessel sherds are unequivocally parallel with each other and combined indicating a set of behaviors associated with social prestige (Figure 5-43, Figure 5-44, Figure 5-45). These hot-spots are, in addition, clearly separated from those of cooking-vessel sherds, which represent a group of households in possession of fewer high-quality pottery (Figure 5-46). The sharp distinction of activities associated with these two groups of households unambiguously implies the presence of prestige differentiation in local community 4.

5.3.5 Spatial Patterns of Four Variables within Local Community 5

Local community 5 is in the west of District 2 (Figure 5-10), with its population concentrated in the center on the smoothed surface (Figure 5-47). Regression analysis reveals that the distribution of fine-paste sherds and cooking-vessel sherds are strongly correlated with the distribution of the population (with r^2=96.27% for fine-paste sherds and r^2=97.85% for cooking-vessel sherds; Figure 5-48 and Figure 5-51). However, regression analysis also reveals that the SBS sherds and serving-vessel sherds are modestly correlated to the population factor (with r^2=82.07% for SBS sherds, Figure 5-49), especially for serving-vessel sherds (with r^2=57.34% for serving vessel sherds, Figure 5-50), suggesting that around 18% of the distribution of SBS sherds and 43% serving-vessel sherds cannot be explained by the population factor. A sharp distinction between the use of cooking vessel against the use of fine-paste, SBS and serving vessels characterized the pattern of household activities in local community 5. The number of fine-paste, SBS, and serving-vessel sherds are obviously more concentrated in the southeast while less concentrated in the northwest, and the number of cooking-vessel sherds has the exactly opposite trend (Figure 5-52, Figure 5-53, Figure 5-54 and Figure 5-55). This observation possibly suggests that two distinct activities organized by prestige differentiation were associated with the households in local community 5, with one group in the southeast probably as the higher-ranking households and the other group in the northwest as the lower-ranking households.

5.3.6 Spatial Patterns of Four Variables within Local Community 6

Local community 6 is in the center of District 3 (Figure 5-10), with its population more concentrated in the center of the smoothed surface (Figure 5-56). Regression analysis shows that the distribution of 86.62% fine-paste sherds, 86.53% SBS sherds, 85.73% serving-vessel sherds, and 96.36% cooking-vessel sherds are explained by the population factor (Figure 5-57, Figure 5-58, Figure 5-59, and Figure 5-60). The hot-spots of these four variables are somewhat clustered into two sets of behaviors, with SBS sherds and serving-vessel sherds identical in the west, while cooking-vessel sherds alone in the north and east (Figure 5-62, Figure 5-63, and Figure 5-64). The hot-spots of fine-paste pottery are not identical with any of the above; they join both behaviors from the west and the east, respectively (Figure 5-61). Such a pattern might imply the presence of prestige differentiation in local community 6, but unequivocally minimal.

5.3.7 Spatial Patterns of Four Variables within Local Community 7

Local community 7 is located in the east of District 1, about 3 km away from local community 2 (Figure 5-10), with its population more concentrated in the west of the smoothed surface (Figure 5-65). Regression analysis reveals that the distribution of ceramic artifacts represented by the variables are strongly correlated to the distribution of the population in local community 7 (with r^2=93.75% for fine-paste sherds, r^2=98.83% for SBS sherds, r^2=97.58% for serving-vessel sherds, and r^2=99.70% for cooking-vessel sherds in Figure 5-66, Figure 5-67, Figure 5-68, and Figure 5-69). The residual layers of local community 7 reveal a similar pattern to that seen in local community 6. The hot-spots of SBS sherds and serving-vessel sherds are identical (Figure 5-71 and Figure 5-72), which are also in an opposite trend to those of cooking-vessel sherds (Figure 5-73). There appeared to be a discrepancy between the cooking activity and the serving activity, both of which are involved with fine-paste pottery (Figure 5-70). As with local community 6, such a pattern seems to suggest the presence of very minimal prestige differentiation in local community 7.

5.3.8 Summary

It could be suggested that the prestige differentiation was identified not only between local communities within districts, but also between household groups within local communities. The spatial correlation analysis and the residual layers produced for seven local communities reveal that the use of high-quality pottery might have been among the ways in which social refinement was demonstrated in Lingjiatan society. A clear indication of prestige differentiation was present within local communities, despite the fact that the differentiation suggested by the four variables never created a strong division among household groups. It created, however, a slighter variation because the large portion of the distribution of the four ceramic variables was explained by the population factor in each local community.

5.4 CONCLUDING THOUGHTS

As discussed before, something was different with District 2. The regional settlement study showed that District 2 has the largest estimated population in the Yuxi survey region and is internally well integrated and strongly centralized. Distinct from Districts 1 and 3, it had the unique ceremonial structures and elaborate jades associated with burials, suggesting that the ritual power was exclusively developed, or at least strongly developed and in more archaeologically visible ways within District 2. The residual layers at the supra-local community scale, moreover, demonstrate that District 2 had more strongly developed prestige and ritual differentiation than District 1 or 3 did. The residual layers at the local community scale, again, showed that the differentiation between households within local communities in District 2, is even stronger and clearer than that of District 1 and District 3. Local community 1, 4, and 5 located in District 2 had more pronounced prestige differentiation than local communities 2, 3, 6, and 7 located in District 1 and District 3 had as residual layers indicated. The households in local communities 1, 4, and 5 clearly formed into two groups, with one standing out with more concentrated fine-paste, SBS and serving-vessel pottery, and the other with noticeable cooking-vessel pottery. The distinction between activities represented by fine-paste, SBS and serving-vessel pottery against cooking-vessel pottery was sharp in local communities 1, 4, and 5 in District 2. However, the use of high-quality pottery (fine-paste, SBS, and serving) against cooking-vessel pottery was not entirely separated in local communities 2, 3, 6, and 7: some households might have had more concentrated cooking vessels rather than serving vessels, but they also had access to a fair amount of fine-paste pottery, or even pottery with smoothed, burnished or slipped surfaces. It could be concluded that, compared to District 1 and District 3, District 2 is more “advanced” in terms of chiefdom development.

This research does not suggest the presence of wealth differentiation at either the local community level or the supra-local community level in Lingjiatan for several reasons. First, nothing in the ceramic assemblages can present luxury goods or living for the prestigious household groups and local communities in Lingjiatan. As discussed, most Lingjiatan pottery has plain surfaces, so the labor cost of pottery decoration is near zero. The serving vessels are not much more labor-intensive in contrast to cooking vessels. Thus, the high-quality pottery that shows higher prestige is not much more expensive to produce. Second, the differentiation suggested by the four variables among household groups (or local communities) is modest. The places that have more high-quality pottery than expected (on the basis of population there), actually do not have a lot more of it. Third, the location of the remains of the ceremonial structures and burials with elaborate jade is extremely close to that of the household group with more high-quality pottery in the north of local community 1 in District 2. This propinquity somewhat confirmed that the differentiation was associated with prestige generated by the ritual and religious activities, rather than wealth accumulation. In the end, the burial goods at Lingjiatan were associated with more symbolic objects such as jade, rather than high-quality utilitarian things such as pottery and tools, suggesting that the wealth accumulation might not be stressed in Lingjiatan society.

The prestige differentiation exposed from four ceramic variables between District 2 and District 1 and 3, however, is not as strong as the ritual differentiation between them, which is expressed as the exclusive access to ceremonial structure and burial complex with elaborate jade artifacts in the center of District 2. Beyond that, ritual differentiation and prestige differentiation are intertwined. Ceramic artifacts representing prestige differentiation also reflected the importance of ritual activities. High-prestige communities are closer to the ceremonial structures, and the increase in the amount of high-quality pottery is consistent with the concentration of ceremonial architecture, burial complex and elaborate jade artifacts, suggesting that the use of high-quality pottery on occasions such as social gatherings, could be associated with ritual activities. The food consumption activities, through which the social prestige of the host was enhanced, were a vital part of the ritual and ceremonial activities organized in Lingjiatan. Thus, it could be concluded that the strong ritual differentiation, which produced the modest prestige differentiation, constructed the uneven relationships between Lingjiatan communities and drove the growth of District 2.

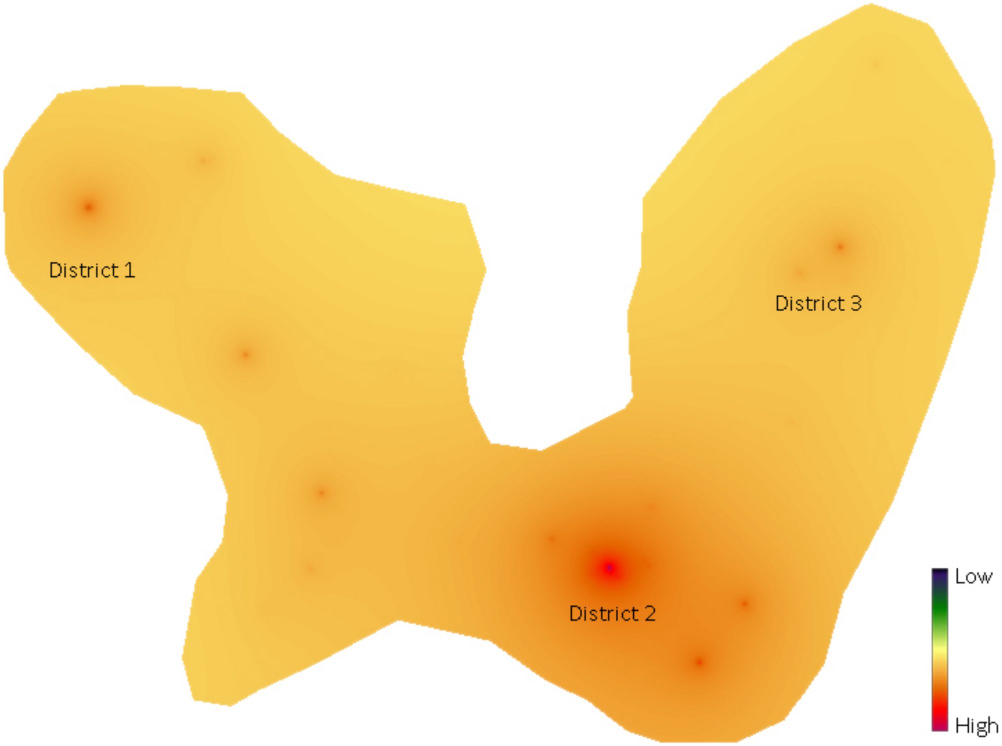

Figure 5-1 Smoothed surface population density across the area of three supra-local communities.

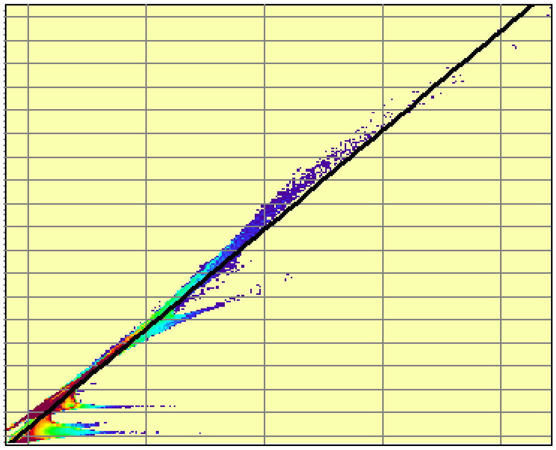

Figure 5-2 Regression analysis between population density (X-axis) and fine-paste sherds density (Y-axis) across the area of three supra-local communities (r^2=92.78%).

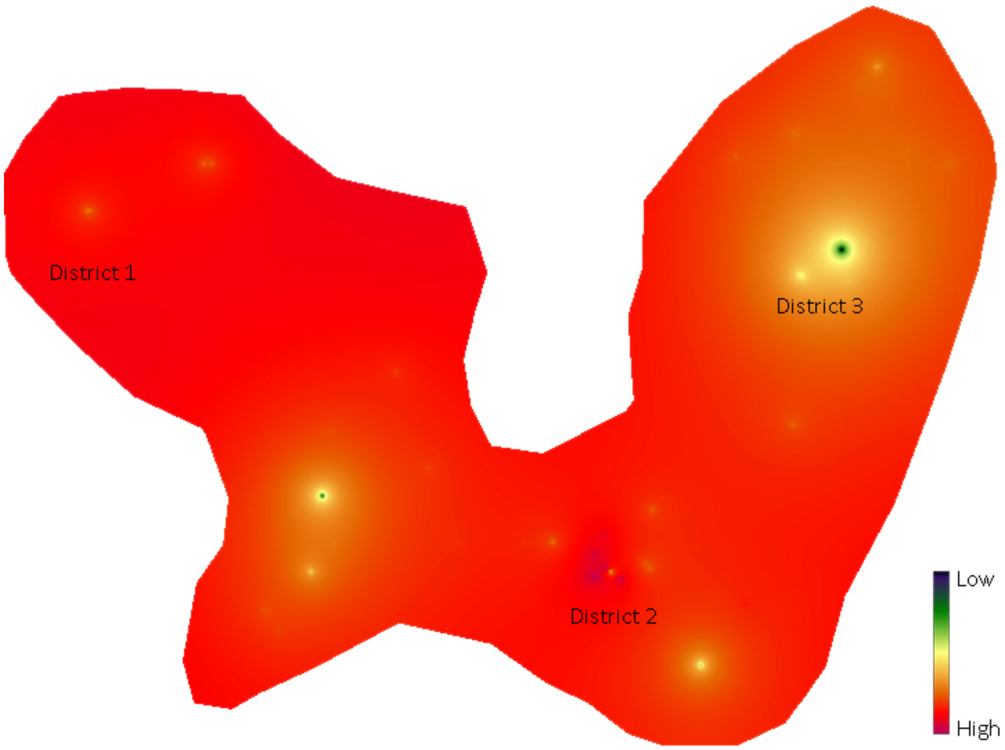

Figure 5-3 Residual smoothed surface of fine-paste sherds density across the area of three supra-local communities.

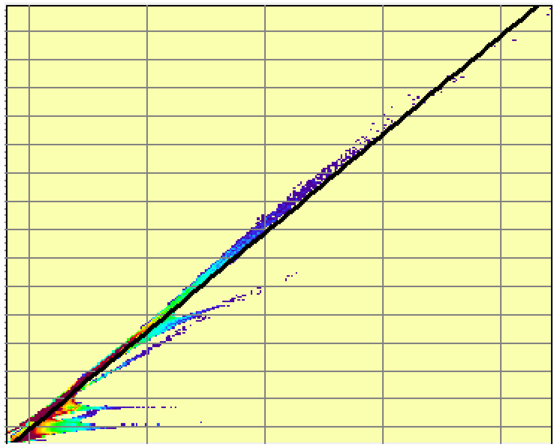

Figure 5-4 Regression analysis between population density (X-axis) and SBS sherds density (Y-axis) across the area of three supra-local communities (r^2=95.05%).

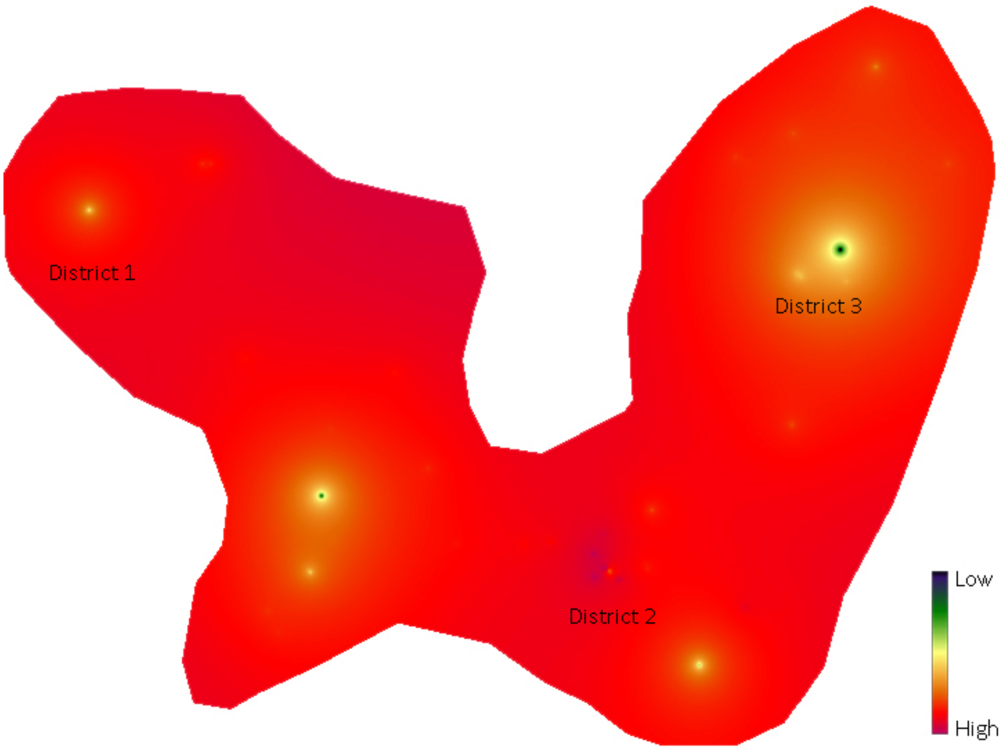

Figure 5-5 Residual smoothed surface of SBS sherds density across the area of three supra-local communities.

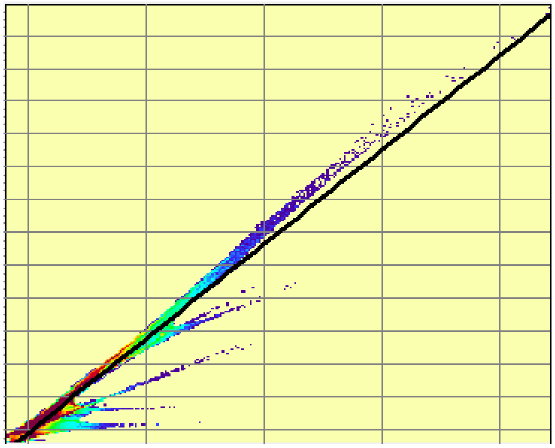

Figure 5-6 Regression analysis between population density (X-axis) and serving vessel sherds density (Y-axis) across the area of three supra-local communities (r^2=95.51%).

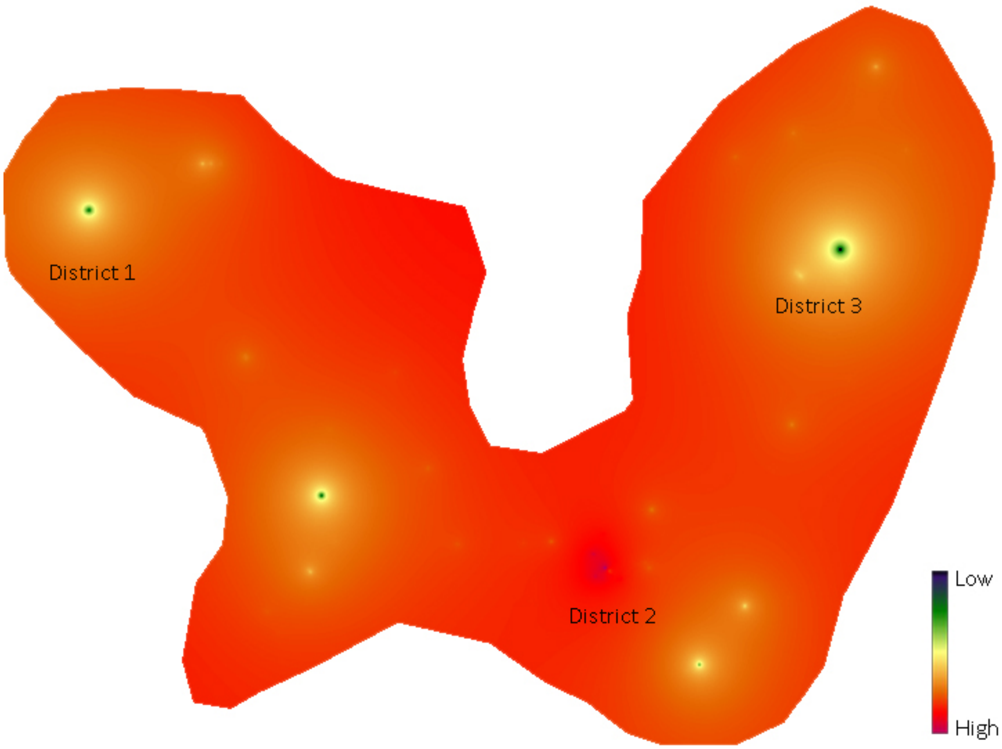

Figure 5-7 Residual smoothed surface of serving vessel sherds density across the area of three supra-local communities.

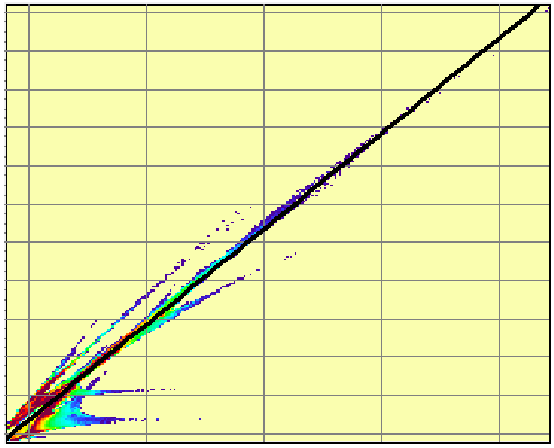

Figure 5-8 Regression analysis between population density (X-axis) and cooking vessel sherds density (Y-axis) across the area of three supra-local communities (r^2=91.20%).

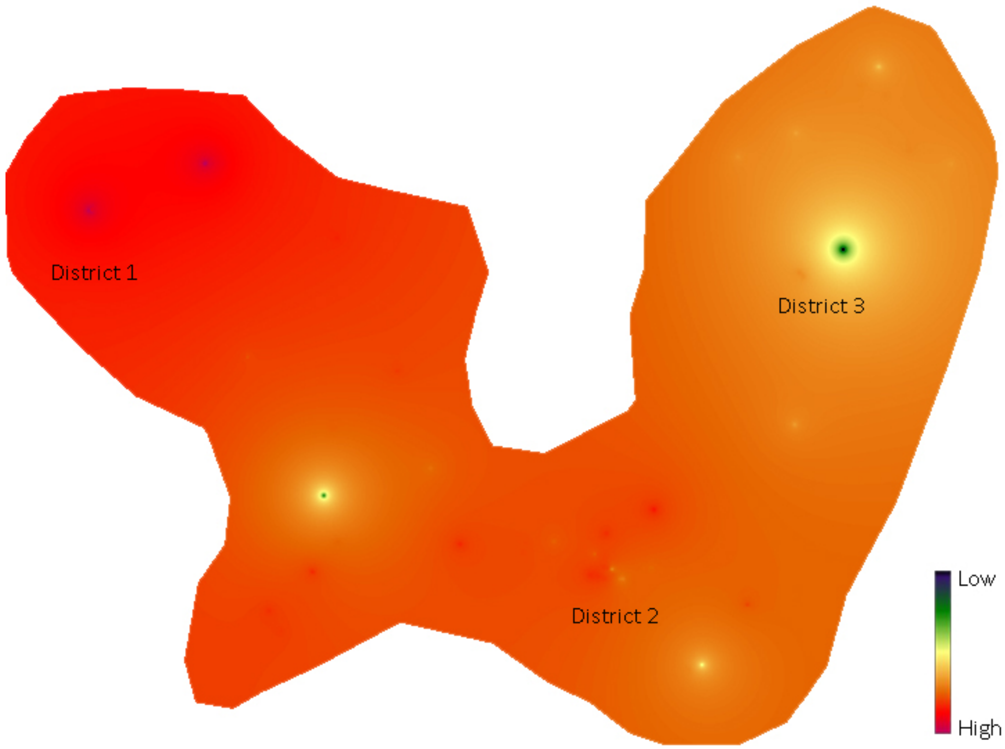

Figure 5-9 Residual smoothed surface of cooking vessel sherds density across the area of three supra-local communities.

Figure 5-10 The location of seven local communities in the Yuxi survey area.

Figure 5-11 Smoothed surface population density in local community 1.

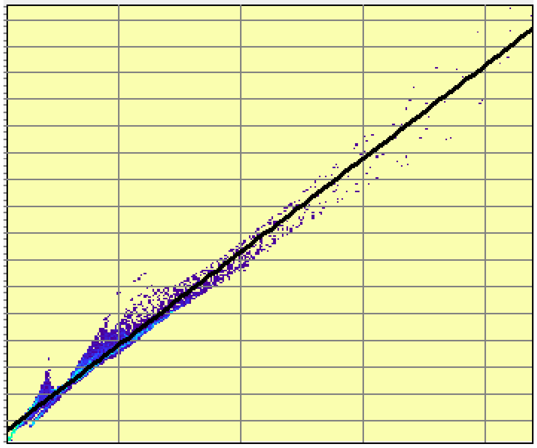

Figure 5-12 Regression analysis between population density (X-axis) and fine-paste sherds density (Y-axis) in local community 1 (r^2=97.33%).

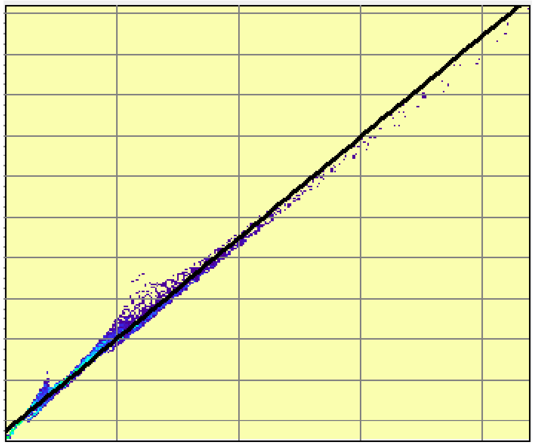

Figure 5-13 Regression analysis between population density (X-axis) and SBS sherd s density (Y-axis) in local community 1 (r^2=99.02%).

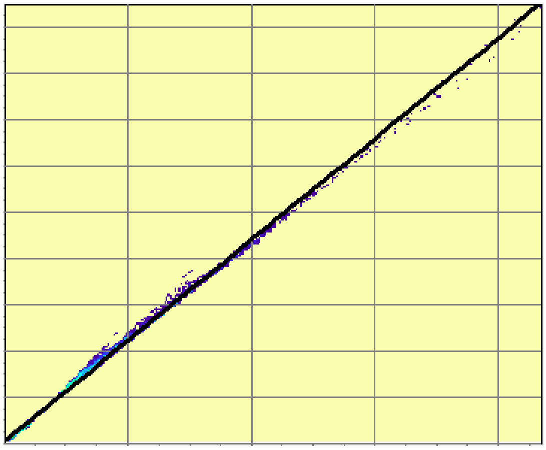

Figure 5-14 Regression analysis between population density (X-axis) and serving vessel sherds density (Y-axis) in local community 1 (r^2=99.76%).

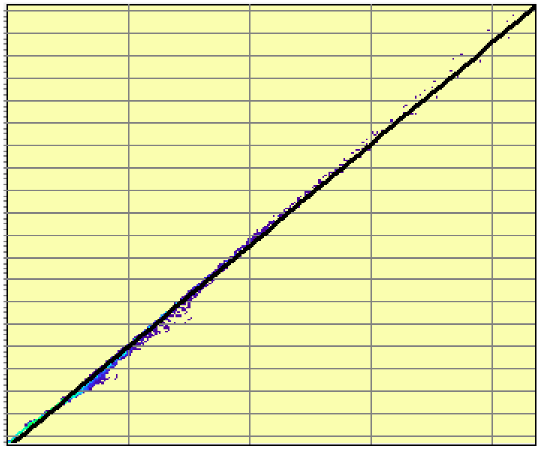

Figure 5-15 Regression analysis between population density (X-axis) and cooking vessel sherds density (Y-axis) in local community 1 (r^2=99.65%).

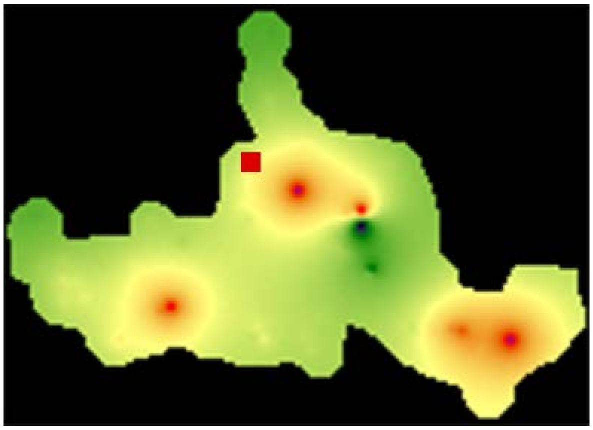

Figure 5-16 Residual smoothed surface of fine-paste sherds density in local community 1.

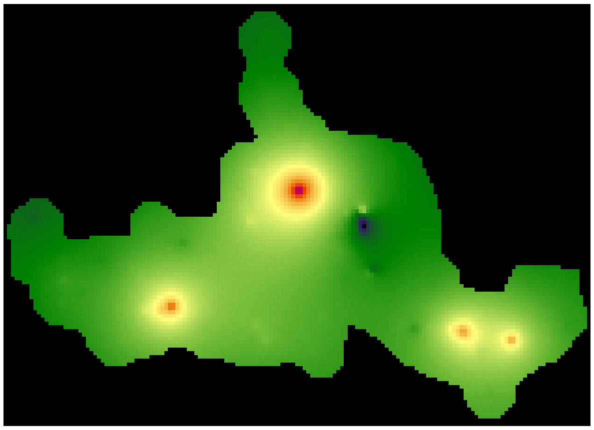

Figure 5-17 Residual smoothed surface of SBS sherds density in local community 1.

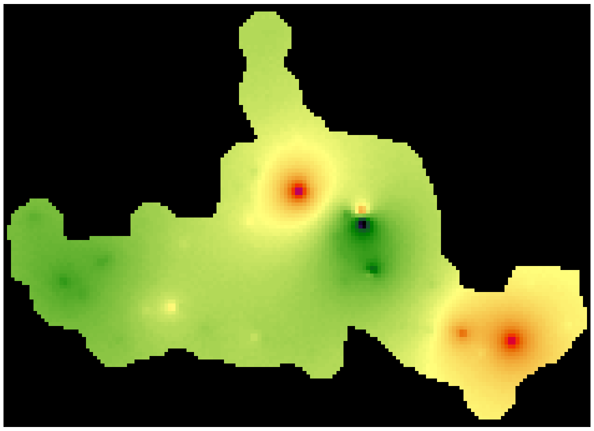

Figure 5-18 Residual smoothed surface of serving vessel sherds density in local community 1.

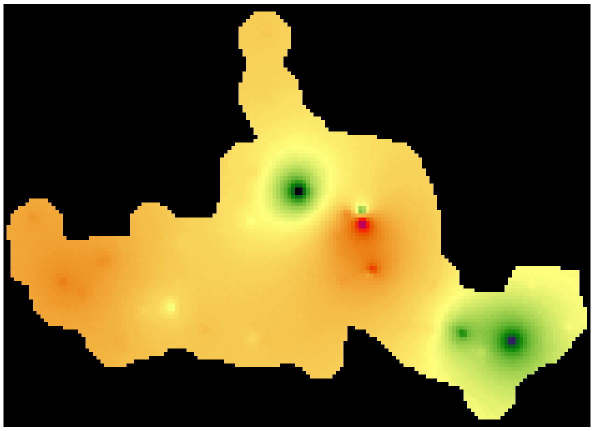

Figure 5-19 Residual smoothed surface of cooking vessel sherds density in local community 1.

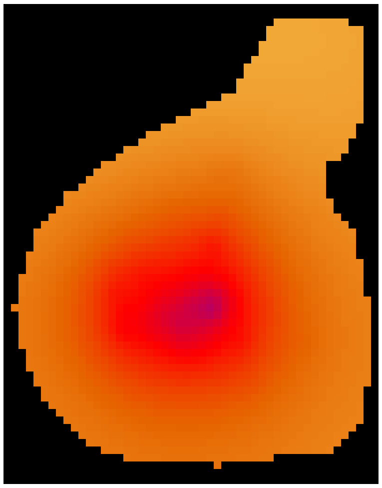

Figure 5-20 Smoothed surface population density in local community 2.

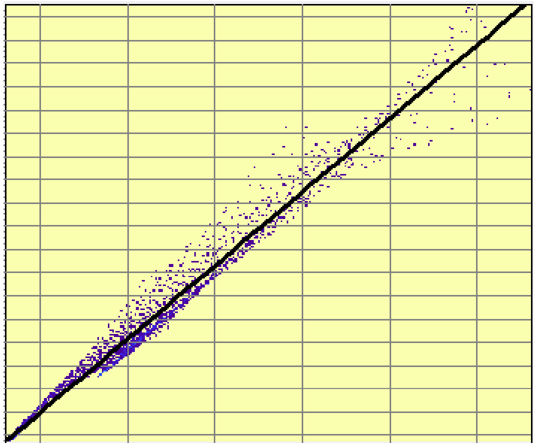

Figure 5-21 Regression analysis between population density (X-axis) and fine-paste sherds density (Y-axis) in local community 2 (r^2=97.28%).

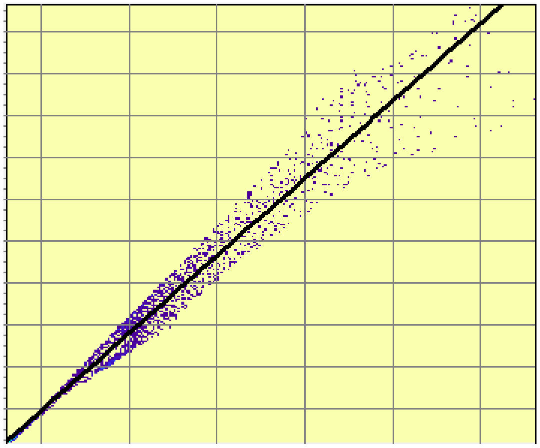

Figure 5-22 Regression analysis between population density (X-axis) and SBS sherds density (Y-axis) in local community 2 (r^2=96.26%).

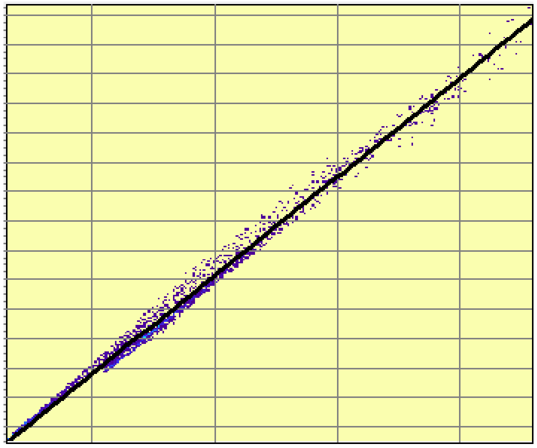

Figure 5-23 Regression analysis between population density (X-axis) and serving vessel sherds density (Y-axis) in local community 2 (r^2=99.31%).

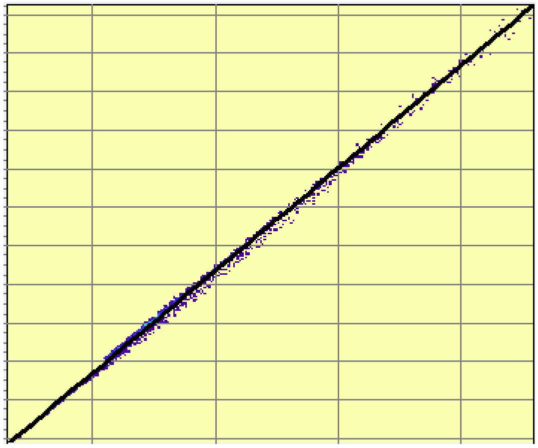

Figure 5-24 Regression analysis between population density (X-axis) and cooking vessel sherds density (Y-axis) in local community 2 (r^2=99.82%).

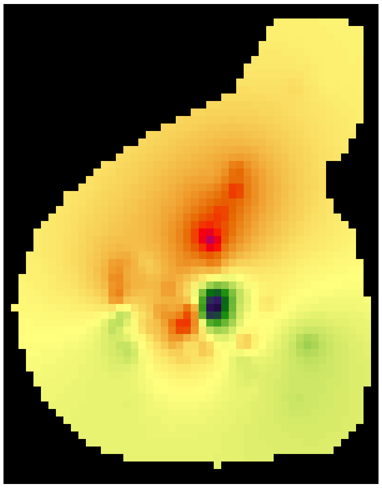

Figure 5-25 Residual smoothed surface of fine-paste sherds density in local community 2.

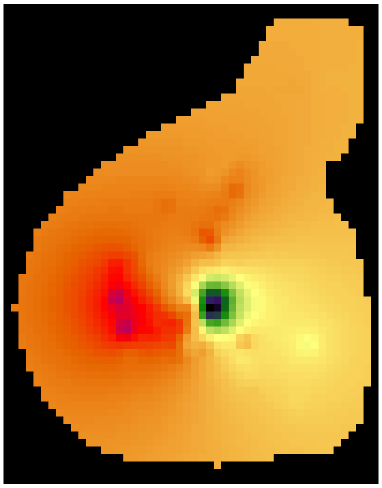

Figure 5-26 Residual smoothed surface of SBS sherds density in local community 2.

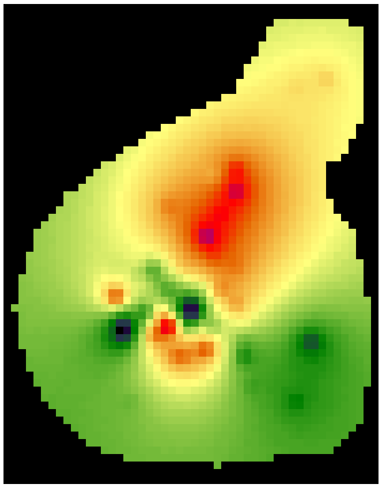

Figure 5-27 Residual smoothed surface serving vessel sherds density in local community 2.

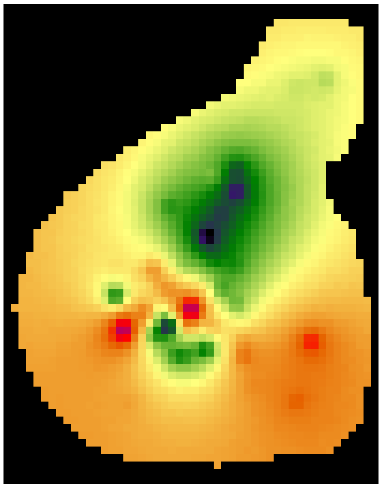

Figure 5-28 Residual smoothed surface of cooking vessel sherds density in local community 2.

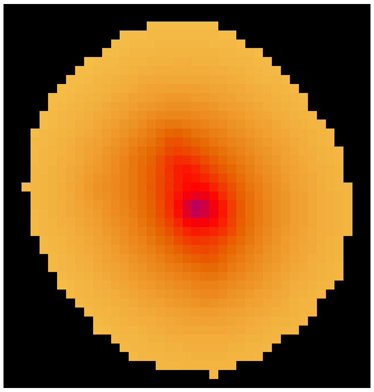

Figure 5-29 Smoothed surface population density in local community 3.

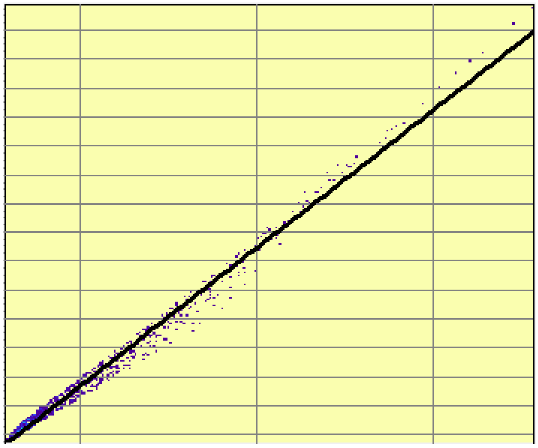

Figure 5-30 Regression analysis between population density (X-axis) and fine-paste sherds density (Y-axis) in local community 3 (r^2=98.85%).

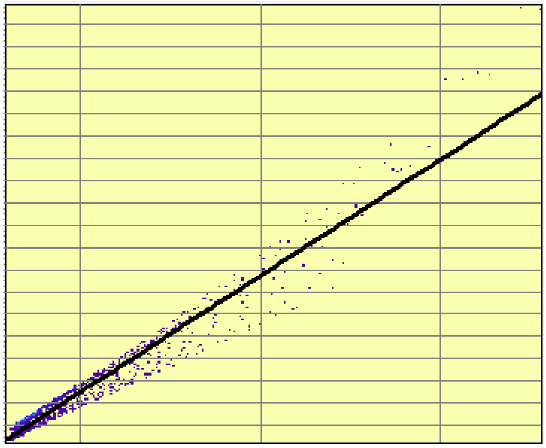

Figure 5-31 Regression analysis between population density (X-axis) and SBS sherds density (Y-axis) in local community 3 (r^2=94.97%).

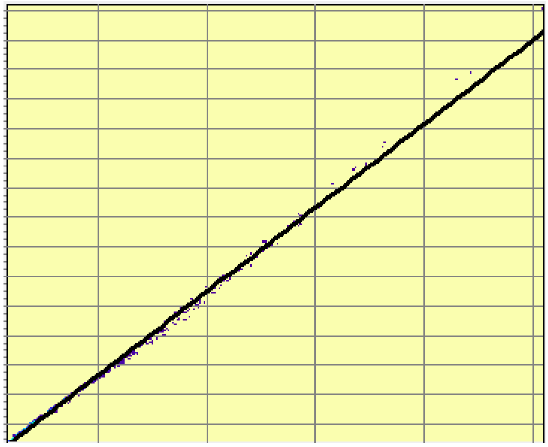

Figure 5-32 Regression analysis between population density (X-axis) and serving vessel sherds density (Y-axis) in local community 3 (r^2=99.70%).

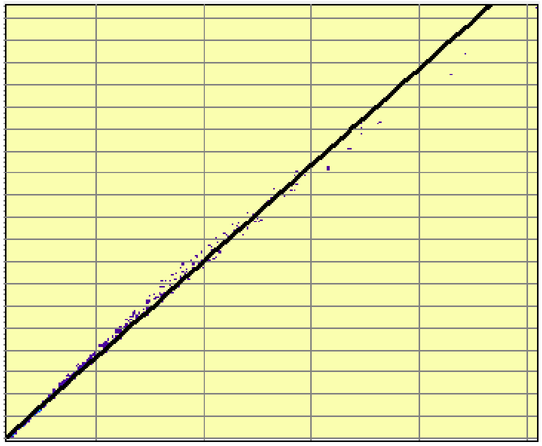

Figure 5-33 Regression analysis between population density (X-axis) and cooking vessel sherds density (Y-axis) in local community 3 (r^2=99.50%).

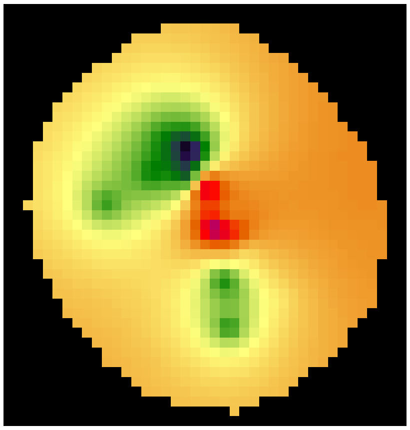

Figure 5-34 Residual smoothed surface of fine-paste sherds density in local community 3.

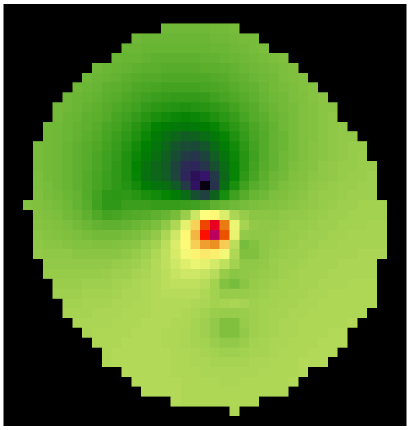

Figure 5-35 Residual smoothed surface of SBS sherds density in local community 3.

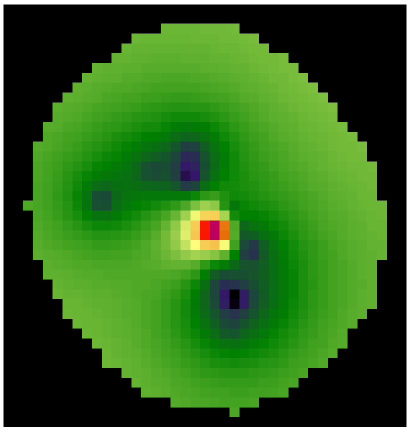

Figure 5-36 Residual smoothed surface of serving vessel sherds density in local community 3.

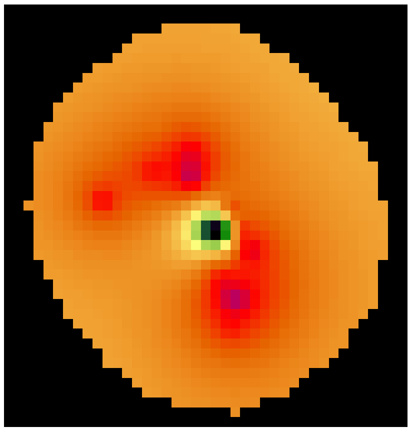

Figure 5-37 Residual smoothed surface of cooking vessel sherds density in local community 3.

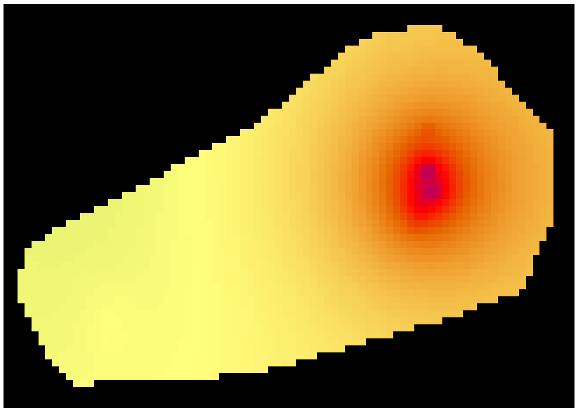

Figure 5-38 Smoothed surface population density in local community 4.

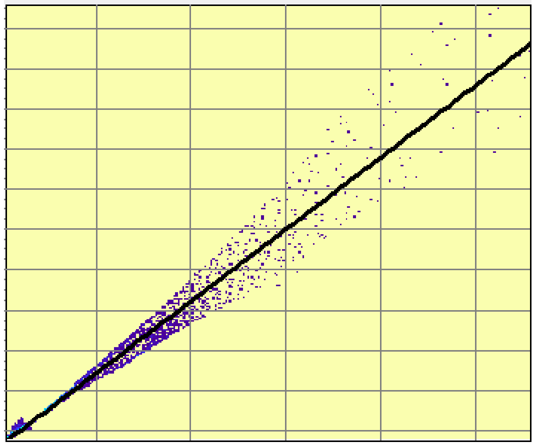

Figure 5-39 Regression analysis between population density (X-axis) and fine-paste sherds density (Y-axis) in local community 4 (r^2=96.64%).

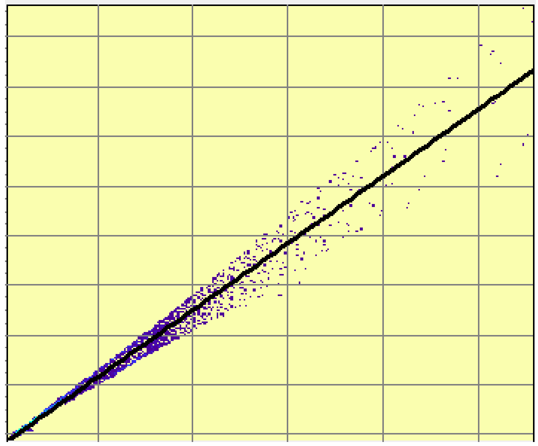

Figure 5-40 Regression analysis between population density (X-axis) and SBS sherds density (Y-axis) in local community 4 (r^2=97.66%).

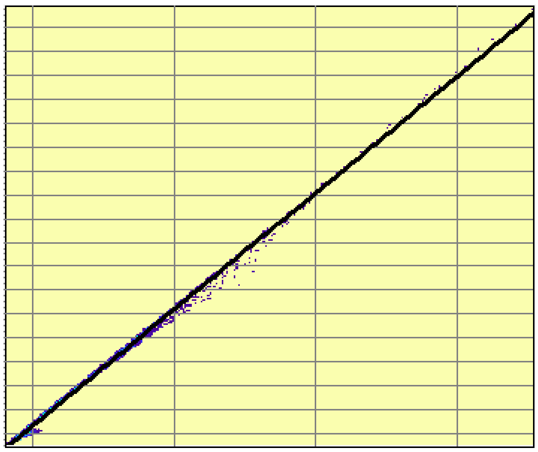

Figure 5-41 Regression analysis between population density (X-axis) and serving vessel sherds density (Y-axis) in local community 4 (r^2=99.74%).

Figure 5-42 Regression analysis between population density (X-axis) and cooking vessel sherds density (Y-axis) in local community 4 (r^2=99.76%).

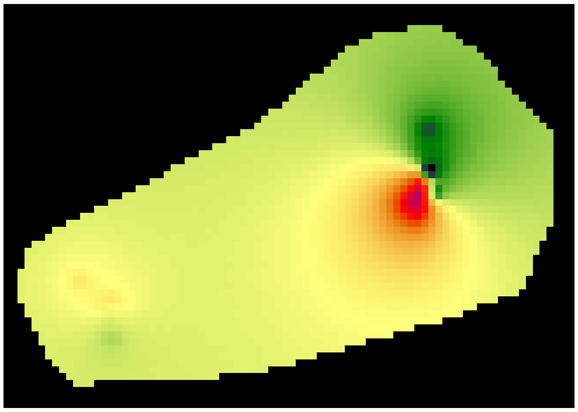

Figure 5-43 Residual smoothed surface of fine-paste sherds density in local community 4.

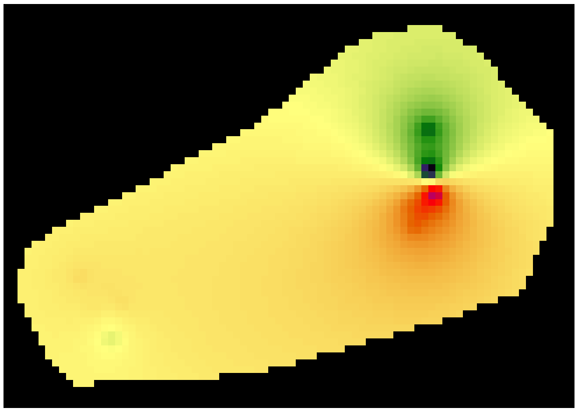

Figure 5-44 Residual smoothed surface of SBS sherds density in local community 4.

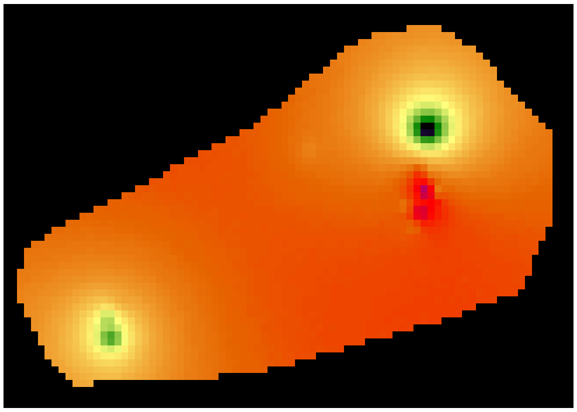

Figure 5-45 Residual smoothed surface of serving vessel sherds density in local community 4.

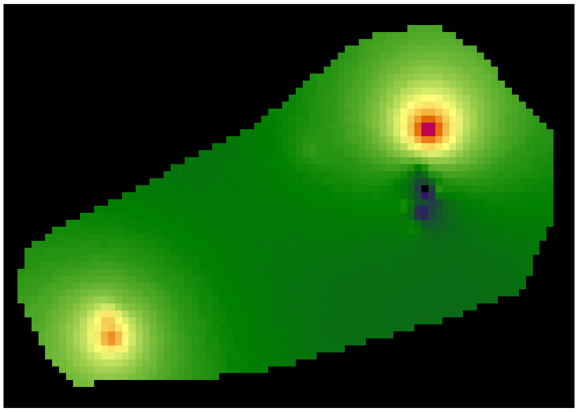

Figure 5-46 Residual smoothed surface of cooking vessel sherds density in local community 4.

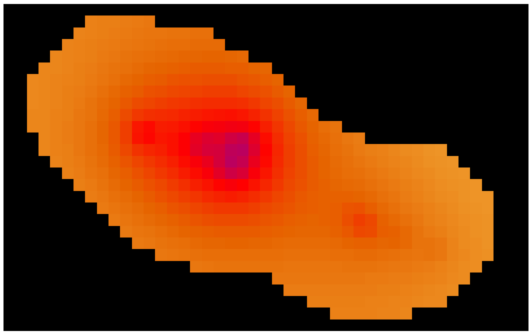

Figure 5-47 Smoothed surface population density in local community 5.

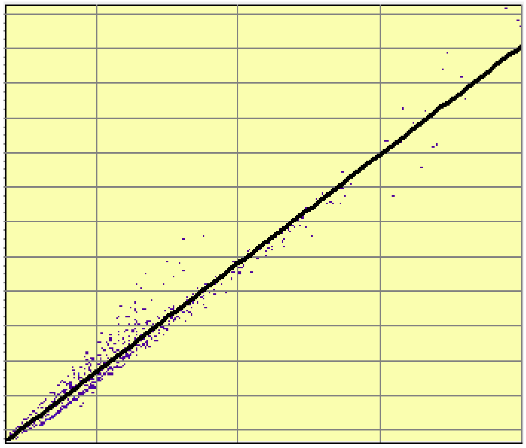

Figure 5-48 Regression analysis between population density (X-axis) and fine-paste sherds density (Y-axis) in local community 5 (r^2=96.27%).

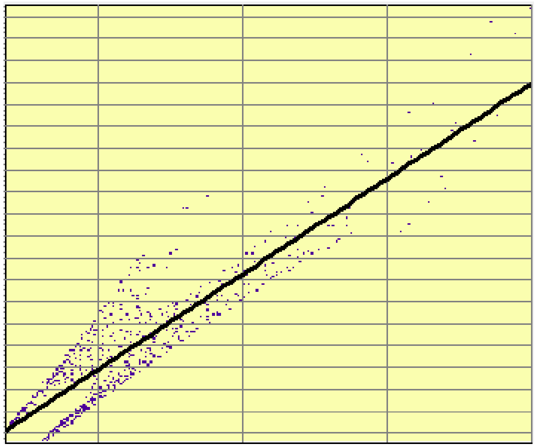

Figure 5-49 Regression analysis between population density (X-axis) and SBS sherds density (Y-axis) in local community 5 (r^2=82.07%).

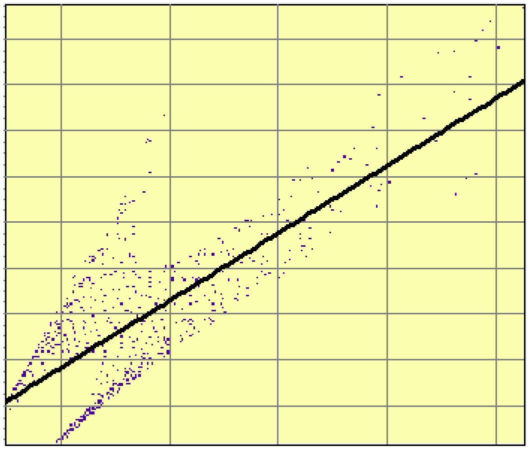

Figure 5-50 Regression analysis between population density (X-axis) and serving vessel sherds density (Y-axis) in local community 5 (r^2=57.34%).

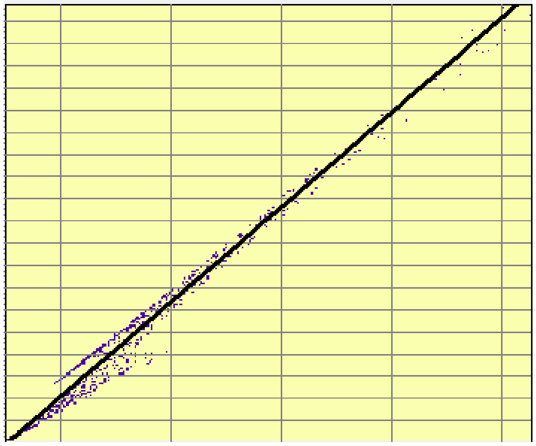

Figure 5-51 Regression analysis between population density (X-axis) and cooking vessel sherds density (Y-axis) in local community 5 (r^2=97.85%).

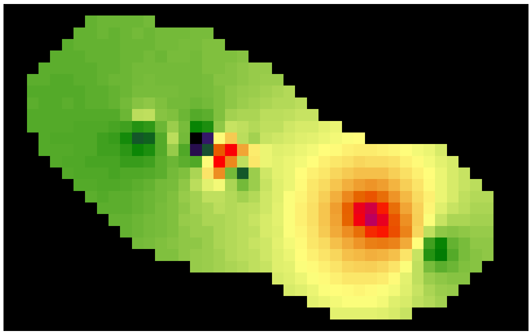

Figure 5-52 Residual smoothed surface of fine-paste sherds density in local community 5.

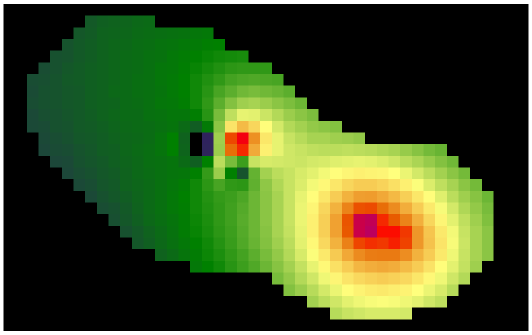

Figure 5-53 Residual smoothed surface of SBS sherds density in local community 5.

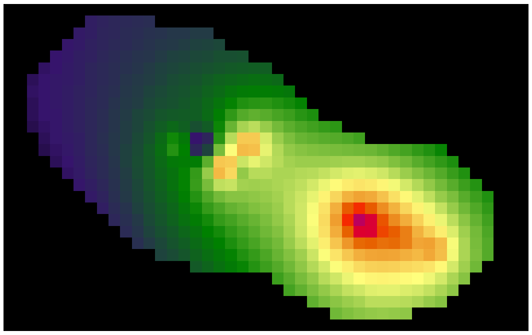

Figure 5-54 Residual smoothed surface of serving vessel sherds density in local community 5.

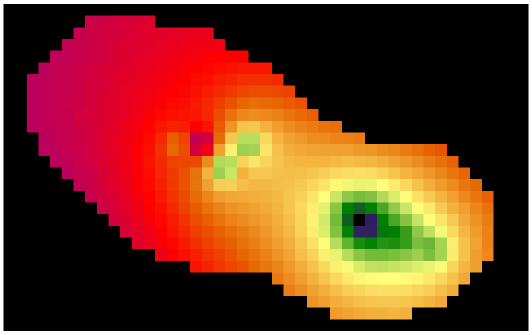

Figure 5-55 Residual smoothed surface of cooking vessel sherds density in local community 5.

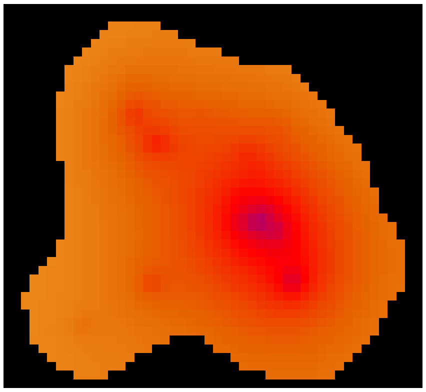

Figure 5-56 Smoothed surface population density in local community 6.

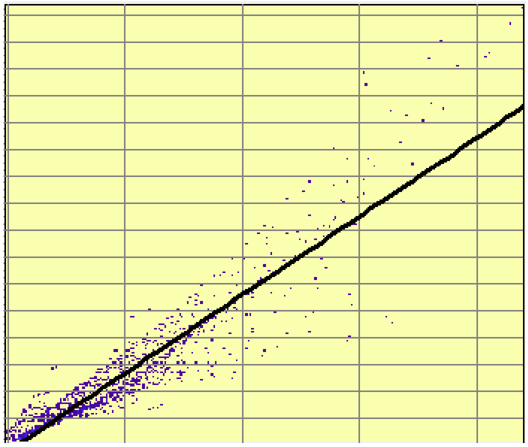

Figure 5-57 Regression analysis between population density (X-axis) and fine-paste sherds density (Y-axis) in local community 6 (r^2=86.62%).

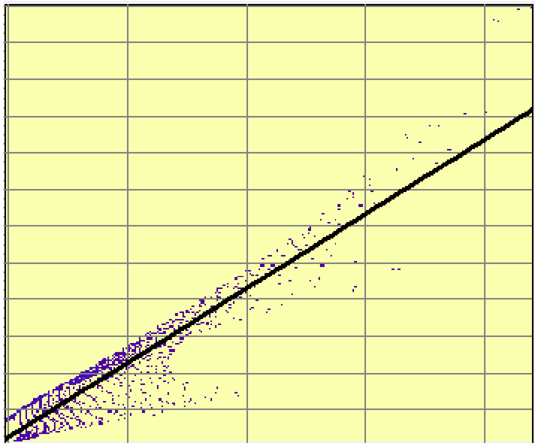

Figure 5-58 Regression analysis between population density (X-axis) and SBS sherds density (Y-axis) in local community 6 (r^2=86.53%).

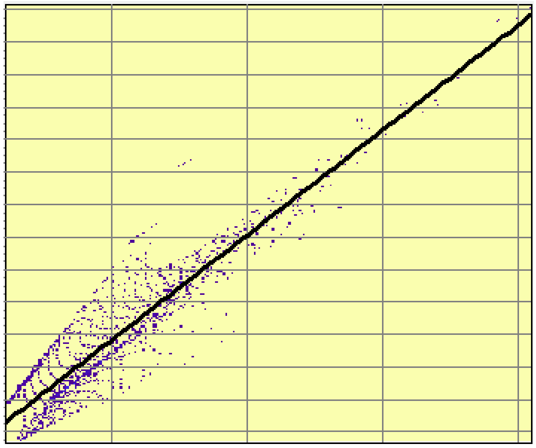

Figure 5-59 Regression analysis between population density (X-axis) and serving vessel sherds density (Y-axis) in local community 6 (r^2=85.73%).

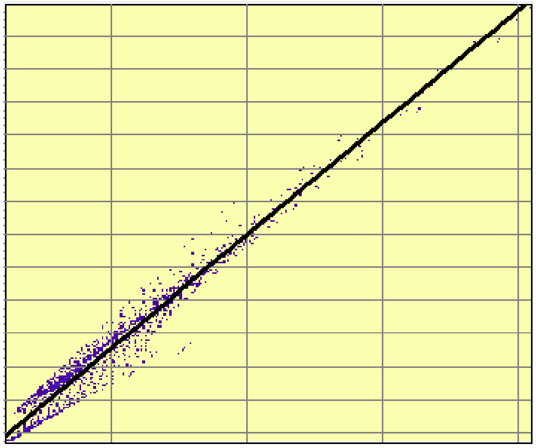

Figure 5-60 Regression analysis between population density (X-axis) and cooking vessel sherds density (Y-axis) in local community 6 (r^2=96.36%).

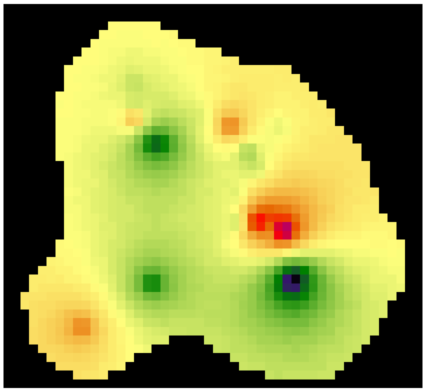

Figure 5-61 Residual smoothed surface of fine-paste sherds density in local community 6.

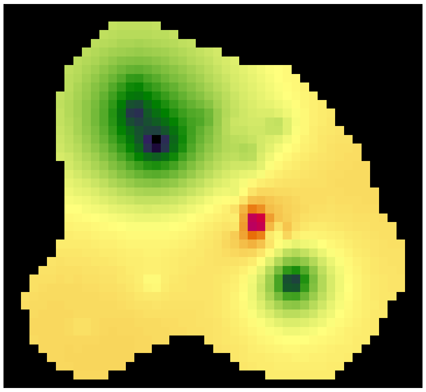

Figure 5-62 Residual smoothed surface of SBS sherds density in local community 6.

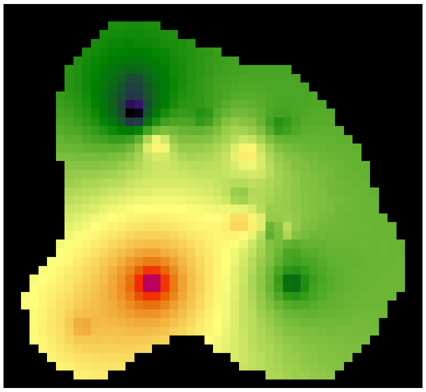

Figure 5-63 Residual smoothed surface of serving vessel sherds density in local community 6.

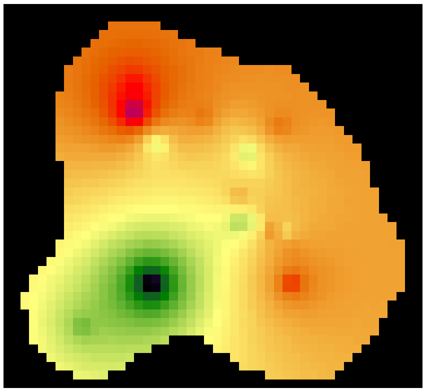

Figure 5-64 Residual smoothed surface of cooking vessel sherds density in local community 6.

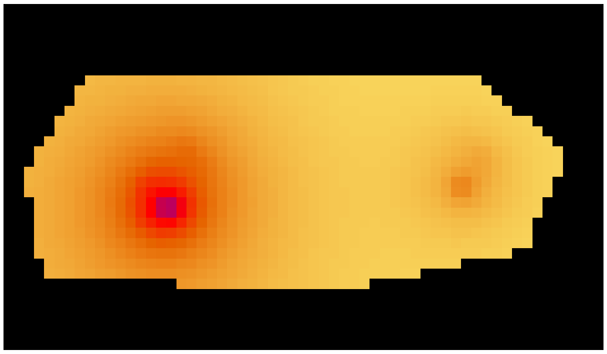

Figure 5-65 Smoothed surface population density in local community 7.

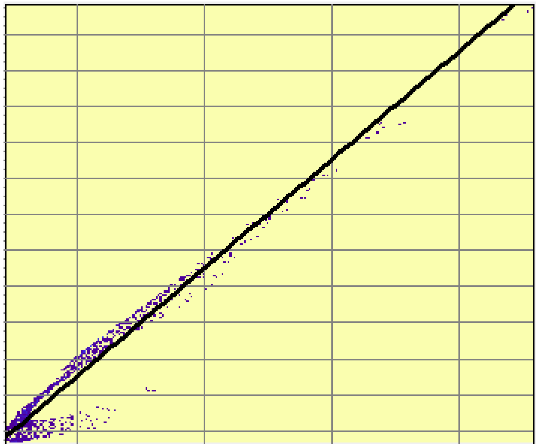

Figure 5-66 Regression analysis between population density (X-axis) and fine-paste sherds density (Y-axis) in local community 7 (r^2=93.75%).

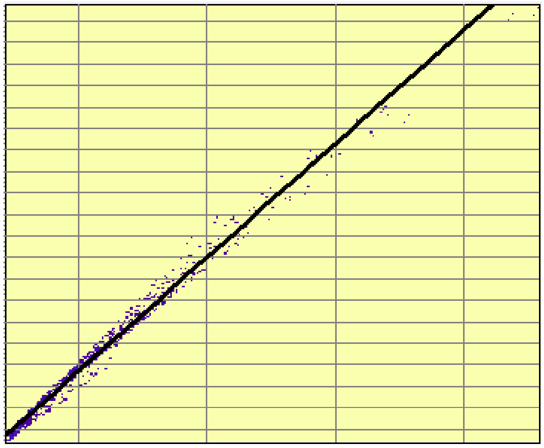

Figure 5-67 Regression analysis between population density (X-axis) and SBS sherds density (Y-axis) in local community 7 (r^2=98.83%).

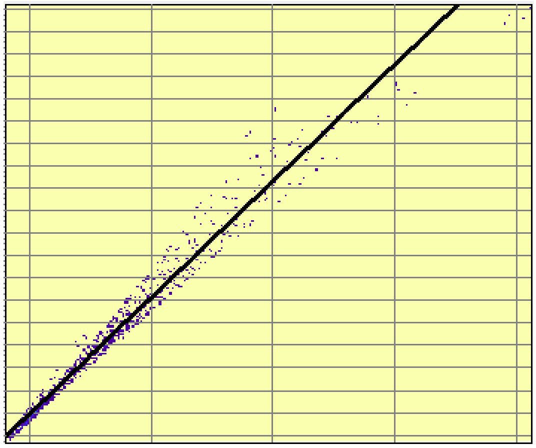

Figure 5-68 Regression analysis between population density (X-axis) and serving vessel sherds density (Y-axis) in local community 7 (r^2=97.58%).

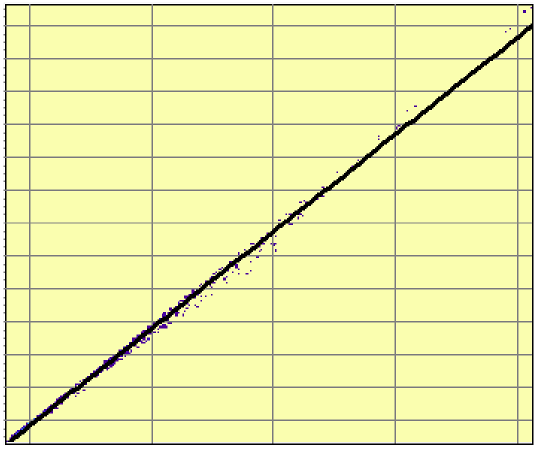

Figure 5-69 Regression analysis between population density (X-axis) and cooking vessel sherds density (Y-axis) in local community 7 (r^2=99.70%).

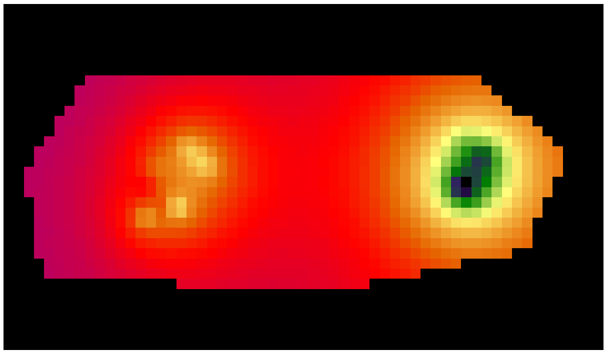

Figure 5-70 Residual smoothed surface of fine-paste sherds density in local community 7.

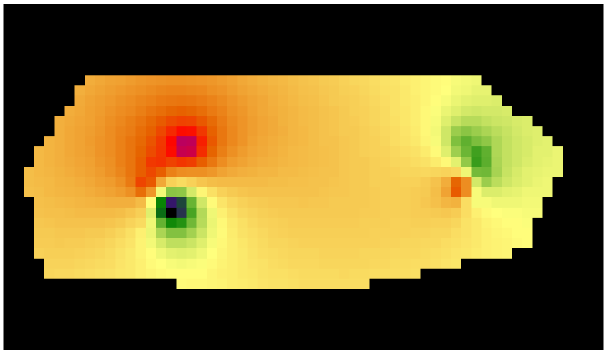

Figure 5-71 Residual smoothed surface of SBS sherds density in local community 7.

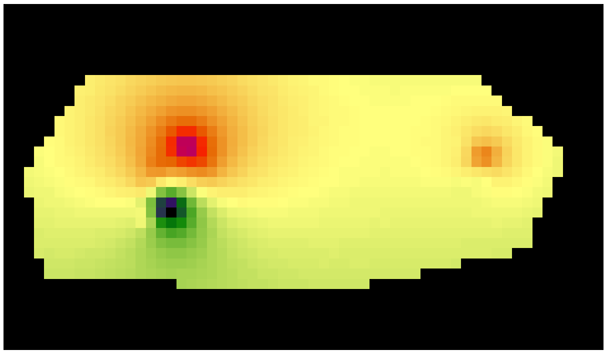

Figure 5-72 Residual smoothed surface of serving vessel sherds density in local community 7.

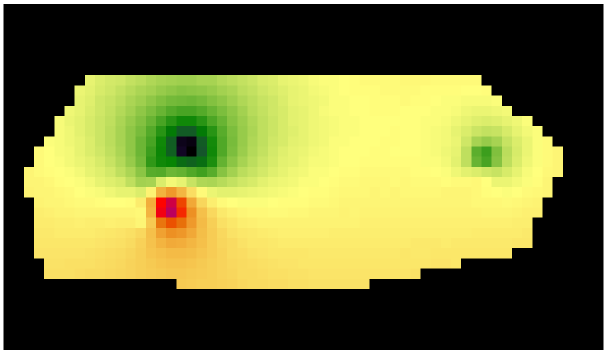

Figure 5-73 Residual smoothed surface of cooking vessel sherds density in local community 7.

6.0 COMPARISONS OF SOCIAL DIFFERENTIATION BETWEEN LINGJIATAN AND HONGSHAN

Organizational differences and similarities between Lingjiatan and Hongshan societies result not only from variabilities and similarities in their developmental trajectories and nature of communities, but also from the way interactions between households in local communities change as the development of supra-local formations. This chapter discusses the observed variability and similarities of social differentiation between Lingjiatan in the Yuxi region and Hongshan in the Upper Daling region through comparisons of activities that inhabitants were engaged in at the community level, and of the role of ritual authority in integrating the supra-local formations in each region.

The activities that Lingjiatan and Hongshan inhabitants were engaged in at the local community level were examined through multivariate analysis - identifying and comparing artifact assemblage patterns from surface collections. In the Upper Daling region, the interpretation was based on a nonmetric multi-dimensional scaling analysis to explain the complicated relationships between household units in local communities (Drennan et al. 2017b). In the Yuxi region, spatial correlation analysis of characteristics of artifact assemblages represented by residual smoothed surfaces was used to explore the trend of variations within local communities. The Upper Daling research considered each household unit as a case to graph the varied relationship between households in local communities. The Yuxi research was built on smoothed surfaces constituted in collection units, which depict the way characteristics of artifact assemblages vary across space within local communities thus reflecting variation between households in local communities. By different routes, both analyses toward answers to the same question: what sorts of differentiation were community activities organized around?

Prestige differentiation is unmistakable in the ceramic assemblages in households and communities at Lingjiatan and Hongshan. Both multivariate analyses reveal that a few household units (at Hongshan), or household groups (at Lingjiatan) have higher quality pottery assemblages, including fine-paste, smoothed, slipped, and burnished surfaces, decorations and larger numbers of serving vessels, than the others do. These households possibly were in better positions than others to enjoy the finer and more elegant vessels through which their social refinement was enhanced (Drennan et al. 2017b:58). Meanwhile, higher proportions (densities) of the variables representing higher quality pottery are combined in various ways to assemble households together, suggesting that social prestige was displayed in slightly different behaviors from household group to household group. For example, in Upper Daling, high proportions of fine-paste ceramics, sometimes combined with high proportions of slipped surfaces, sometimes with decoration or serving vessels in the multi-dimensional scaling, separate households of higher prestige from the majority. In the Yuxi region, household groups of higher prestige were distinguished by the hot-spots on the smoothed surfaces of variables representing higher quality pottery. The hot-spots of SBS sherds are often identical with those of serving-vessel sherds, but not with fine-paste sherds in some local communities.

The degree of prestige differentiation slightly varied from community to community for both Hongshan and Lingjiatan. The multi-dimensional scaling analysis suggested that very slightly greater prestige differentiation as indicated by ceramic variables was present between households in the Hongshan core zone communities (Drennan et al. 2017b:66). The residual smoothed surfaces showed that the differentiation between households within local communities in District 2, is stronger and clearer than that of District 1 and District 3 at Lingjiatan. Local communities 1, 4 and 5 located in District 2 had more pronounced prestige differentiation than local communities 2, 3, 6 and 7 located in District 1 and District 3. In addition, compared to those in the center of Districts 1 and 3, local communities in the center of District 2 were suggested to be more prestigious due to the higher density of high-quality pottery there.

Wealth differentiation was not detected in either region, which is consistent with other archaeological information known so far. First, the Lingjiatan burials, like those at Niuheliang of Hongshan society, have elaborate symbolic objects, such as jade artifacts rather than high-quality utilitarian things like pottery and tools. The ideological and symbolic objects involved in burials indicate that elites were treated well at death probably because of their social prestige rather than a remarkably higher standard of living (Drennan et al. 2017b:68). Large amounts of symbolic objects and few ceramic vessels (with low labor investment) are associated with burials, thus suggesting that wealth accumulation might not be emphasized in either society.

Second, the characteristics of ceramic assemblages in both regions are least likely to be related to wealth differentiation. No such valuable possessions were included in the ceramic assemblages that can suggest a significantly higher standard of living. The growth in labor cost in higher quality pottery is minimal in both societies, and the differentiation indicated by higher proportions (densities) of high-quality pottery between households and communities is modest, suggesting that the use of higher quality pottery for household groups is more likely a way to display elegance or sophistication on special occasions, such as social gatherings.

Finally, in both societies, high-prestige communities or households are closer to burial complexes associated with jade artifacts. The increase of higher quality pottery is consistent with the concentration of ceremonial architecture, burial complex and elaborate jade artifacts, suggesting possibly that the use of this high-quality pottery is more like displaying social elegance associated with ritual and ceremonial activities.

The multi-dimensional scaling analysis of lithic assemblages and geochemical analysis of pottery indicates that very modest productive differentiation was detectable in Hongshan patterns, and these production activities somewhat related to social prestige (Drennan et al. 2017b:63-66). Production activities are unclear so far at Lingjiatan because few lithic artifacts were collected from the Yuxi regional survey, limiting the ability to explore production differentiation through lithic assemblages. The geochemical analysis of Lingjiatan pottery by X-ray fluorescence (XRF) and X-ray diffraction (XRD) can also be conducted to explore productive differentiation through pottery production and distribution in the future research. Based on observation so far, the quality of Lingjiatan pottery, in general, is very low. The characteristics of elaborate painted surfaces and decoration which might need special skills are absent among Lingjiatan pottery. It is very likely that pottery production at Lingjiatan does not require a high level of specialization. Economic interdependence is possibly minimal or even absent between households at Lingjiatan.

Ritual differentiation has been suggested as the strongest factor in organizing community activities and constructing asymmetrical relationships in Hongshan society (Drennan et al. 2017b:68), and the same can be said for Lingjiatan society. Ritual authority was connected to prestige differentiation in both societies. Elites of both Hongshan and Lingjiatan society were buried with elaborate jade artifacts (as ritual objects) in ceremonial structures. This group of elites who were treated differently from the majority after death might have a larger number of higher-quality vessels to serve and present food in sophisticated ways on special occasions, such as feasts associated with ceremonial activities during their lifetime. The degree of prestige differentiation suggested by ceramic artifact assemblages in local communities between District 2 and District 1 and 3 (at Lingjiatan), or between core zone communities and peripheral communities (at Hongshan), is subtle compared to the ritual differentiation between them, which is expressed as the exclusive access to ceremonial facilities and burials with elaborate jade artifacts in the center of District 2 (at Lingjiatan), or the core zone communities (of Hongshan).

The elites with ritual authority in both societies, might have lived in more elegant ways but were not much wealthier than others, and had little real political power. The scale of political integration and the number of controllable labors were taken to be important indicators of political power (e.g. Drennan and Peterson 2005; Drennan et al. 2010; Drennan et al. 2017b). Regarding the scale of political integration, the elites of Lingjiatan might hold slightly greater political power than those of Hongshan due to the spatially and demographically larger District 2 in the Yuxi region. But, both regions are characterized by numerous, independent chiefly polities of relatively small scale, suggesting that political integration is weak at the larger scale above supra-local communities. The labor investment in constructing public architecture in the center of District 2 in the Yuxi region was estimated at 11,000 person-days based on classic ethnoarchaeological research (Abrams 1994; Erasmus 1965; Lekson et al. 1984). District 2 had an estimated population of 640-1280 during Lingjiatan times. If Lingjiatan elites mobilized the same proportion (one-third) of the population as that assumed at Dongshanzui as laborers, they would need 25-51 days for constructing the public architecture. Considering that the district of Dongshanzui might need 21–42 days for constructing ceremonial architecture (Drennan et al. 2017b:69), neither of the Hongshan or Lingjiatan districts needed a large number of workers for the construction. Political power, thus, could be considered subtle in both societies.

It could be concluded that, as with Hongshan societies, the social organization and community activities at Lingjiatan also strongly centered on ritual authority, which produced some modest prestige differentiation.

7.0 LINGJIATAN/HONGSHAN PATTERNS IN COMPARATIVE PERSPECTIVE

Comparative study of complex societies all around the world reveals various ways in which larger-scale and more complex societies were structured and developed (e.g. Berrey 2015; Drennan and Dai 2010; Drennan and Peterson 2004, 2005, 2006, 2008, 2012; Drennan et al. 2010; Earle and Smith 2012; Feinman 2011; Peterson and Drennan 2005; Smith and Peregrine 2012). This dissertation research compared Lingjiatan and Hongshan societies in several aspects including ceremonial architecture complexes, developmental trajectories, and nature and organization of different kinds of activities in local and supra-local communities. Rather than focusing on the larger-scale political integration, economic power and wealth differentiation, elites of both societies accomplished their domination through ritual authority. The Lingjiatan society in the Yuxi region and Hongshan society in the Upper Daling region indicated a very similar pathway to develop larger-scale and more complex societies. Both regions were characterized by ceremonial structures and numbers of burials that contained special people (elites) with symbolic jade artifacts, although Lingjiatan featured social inequality expressed through burial offerings, while Hongshan was characterized by relatively higher labor investment in monumental public works rather than burial offerings. Both regions emerged in a context of substantial population growth and were on the same track toward demographic growth and formation of supra-local communities. Both regions were characterized by numerous, relatively autonomous supra-local communities and lacked political integration on a larger regional scale. Both regions organized their community activities around strong ritual differentiation and modest prestige differentiation. Such studies have provided significant indications of the factors that might trigger the emergence and development of large-scale hierarchical social formations in much broader comparative perspectives.

It has been suggested that the dimensions of the "packages" of social complexity, including political integration, economic control, organization of labor, higher standard of living, elaborate burial customs and other features, are not always present altogether to characterize a social organization (Drennan et al. 2010). This has been confirmed by the comparative study of Hongshan and Lingjiatan societies. It is vital to explore the correlations of these dimensions, because "if high values on some dimensions correspond to consistently high (or low) values on others, these dimensions form 'packages' and knowing that such packages exist gives us patterns to try to make sense of by building theoretical constructs to account for them" (Drennan et al. 2010:72). Hongshan and Lingjiatan societies share "high values" on the dimension of "ritual and religious authority," and meanwhile they share "low values" on other dimensions, such as political integration, accumulation of wealth, organization of labor and specialized production. Such similar social profiles probably make these two societies characterized as the same "type" of society with "socially cohesive, centrally focused, supra-local, territorial groupings of people whose interaction and integration revolved around ceremony, ritual, and belief more than centralized political power" (Drennan et al. 2017b:69).

During the fourth and third millennia BC, settlements increased in numbers, and early complex societies grew not only in these two regions, but also flourished in most of China. For example, Yangshao societies developed in the Central Plain; Dawenkou settlements expanded in the lower-reaches of Yellow River valley. The social transformation was intense and universal in various parts of China and with different emphasis and pathways, which brings up the question:

how the Lingjiatan/Hongshan "type" of society appears to resemble or differ from other Neolithic complex societies in China.

Yangshao societies (7000-5000 BP) extensively grew in the Yellow River valley in China, and mainly thrived in the Central Plain, including Henan, Shaanxi and Shanxi provinces. Current research divides Yangshao into Early (7000-6000 BP), Middle (6000-5500 BP) and Late (5500-5000 BP) periods. The mortuary patterns revealed no pronounced social, ritual and economic differences in the treatment of the dead, although moderate differentiation in burial practices were observed (Li 2009; Liu 2004; Liu and Chen 2012; Liu et al. 2004). Large platforms and elaborate jade objects such as those found in Hongshan and Lingjiatan were absent from Yangshao. Excavations from multiple Yangshao burials and settlements suggest that elites emphasized ritual and ceremonial activities less (Liu and Chen 2012).

Regional settlement research has played a key role in understanding the social trajectory and nature of communities in Yangshao society (Dai 2006; Drennan and Dai 2010; Liu et al. 2004). Compared to the Lingjiatan/Hongshan patterns, the systematic complete-coverage surveys in the Yuncheng Basin (Figure 7-1) revealed a different developmental trajectory of Yangshao society. The demographic growth and development of large local communities were on a fast track in the Yuncheng Basin (Drennan and Dai 2010:467). Compared to Lingjiatan/Hongshan societies, the population in the Early Yangshao period was more concentrated into larger local communities, and the social interaction within each local community was stronger (Drennan and Dai 2010:464). In Middle Yangshao, the population substantially increased and further concentrated into more clearly delineated large-scale communities. The nature of these strongly integrated and nucleated settlements indicated strong interaction within communities and political and economic control (Drennan and Dai 2010; Liu 2004). Both local communities and supra-local communities in

Lingjiatan/Hongshan were much smaller and more numerous than those in Early and Middle Yangshao. The Zhoujiazhuang community in the Longshan period (4400-3900 BP) in the Yuncheng Basin increased substantially and grew into a principal polity which dominated its surrounding communities and "reflects a larger spatial and demographic scale of political integration than ever" (Drennan and Dai 2010:467). However, social organizations of Lingjiatan/Hongshan during this period were still characterized by multiple small-scale supra-local communities. Eventually the Yangshao chiefly polity successfully expanded and developed into the Early Shang state, while the political integration of Lingjiatan/Hongshan societies came apart.

Excavated burials and settlements suggest that the Yangshao elites emphasized politics and economic activities more while Lingjiatan/Hongshan societies revolved strongly around ritual, belief, and ceremony. Regional settlement research reveals that not only the developmental trajectory toward large-scale social formations was faster in the Yuncheng Basin but also the Yangshao chiefly polities were significantly larger spatially and demographically than those of Hongshan/Lingjiatan. Strong political power, accompanied by economic power played an important role in integrating Yangshao society; while ceremonial activities led the formation of supra-local communities in the Lingjiatan/Hongshan societies. Some scholars have argued that in the different pathways to social complexity, powers grounded in the politics and economy are more stable and easily extended; while powers grounded in the ideology are more unstable and short-lasting (Earle 1997). Other scholars have suggested that the dominant role of ritual and religious power in the societies is not only unstable but also may become an obstacle in their development to more complex societies, such as states (Drennan et al. 2017b; Li 2009). These theoretical constructs probably help to explain the emergence of the demographically and spatially larger-scale and highly integrated Yangshao supra-local formations in the Yuncheng Basin. The exclusive role of religious and ritual power in Hongshan/Lingjiatan societies may have become barriers that prevented these early complex societies from developing into larger scale and more complex forms. The unstable ritual power not rooted in political or economic control resulted in the Lingjiatan/Hongshan societies losing the base for sustainable development (Li 2009).

Dawenkou (6300-4600 BP) society expanded in the lower reaches of Yellow River valley, primarily in Shandong province. Most excavations in Dawenkou sites were burials, and these burials were grouped into clusters by kin groups (Liu and Chen 2012; Underhill et al. 2002). Social inequality was expressed in the Late Dawenkou period (5000-4600 BP) through burial practice. A group of large burials with hundreds of elaborate goods (including turtle shell, jade, and black pottery stemmed cups, etc.) stood out, suggesting that the buried person probably had a higher social or economic status. Burial patterns demonstrated that burial and ritual ceremonies particularly focused on individual male ancestors (Underhill 2002). Compared to Yangshao society, the nature of the Dawenkou burials is more like what was revealed in the Lingjiatan/Hongshan societies, where burials have developed more pronounced differentiation through which ritual authority was highlighted.

Regional settlement research conducted in the Rizhao area (Figure 7-1), southeastern Shandong province revealed the developmental trajectory of Dawenkou society (Underhill et al. 1998; Underhill et al. 2008). Population increased substantially in the Late Dawenkou period. Settlement clusters (similar to the "local communities" in the Lingjiatan/Hongshan societies) were found in the southeast, but no evidence suggested that "there was more than a modest settlement hierarchy in the Rizhao area during the Late Dawenkou" (Underhill et al. 2008:6). Three-tiered settlement structure (similar to the "supra-local communities" in the Lingjiatan/Hongshan societies) were delineated in western Shandong. In the Longshan period (4600-3900 BP), two larger-scale social formations, Liangchengzhen and Yaowangcheng, emerged in the Late Dawenkou and Early Longshan period (Underhill et al. 2008). Liangchengzhen and Yaowangcheng, as two sociopolitically independent chiefly polities, or petty states, were internally nucleated and dominated their neighbors. In the Middle Longshan period, Liangchengzhen continued to grow, but Yaowangcheng somewhat lost its control over its neighbors and started to decrease. Eventually, both of them decreased, and the Rizhao area was far beyond the control of Shang state that mainly developed in the Central Plain (Underhill et al. 2008).

Some scholars have argued that these larger-scale centers in the Dawenkou-Longshan societies were organized by strong productive differentiation and social competition (Underhill 2002; Underhill et al. 2008). It was suggested that a few households had exclusive access to control labor and craft specialists to produce prestige goods (a large number of labor-intense pottery vessels found in a few large burials) and host feasts during funerals, so as to accomplish competition and achieve power. The Dawenkou society is most likely to be one of those small-scale societies defined by Spielmann (2002) that using ritualized feasting to define the rules for production, distribution, and consumption in the societies. However, this kind of feasting as a particular form of ritual activities is still grounded in religious and ritual power. The strategy of competitive feasting used by individuals to pursue “personal aggrandizement” (Clark and Blake 1994) probably would not be as strong as political and economic power in organizing larger-scale and more complex societies.

It is interesting to note that, in the trajectories of social change described here, neither of them is entirely identical to each other. But, the way in which Dawenkou societies grew is like Lingjiatan/Hongshan societies much more than Yangshao societies, where belief, ritual, and ceremony were very underdeveloped. Hongshan, Lingjiatan and Dawenkou societies, all grounded in ritual activities, were unable to achieve real political power and to grow into more complex social organizations, such as states. Yangshao societies rooted in true politics and economic activities, as well as in strong socio-political integration, eventually developed into the Early Shang state. It is vital to know these correspondences between the "high values" on some dimensions of social complexity and the "low values" on others in these trajectories in comparative context, to understand better the forces that produced them.

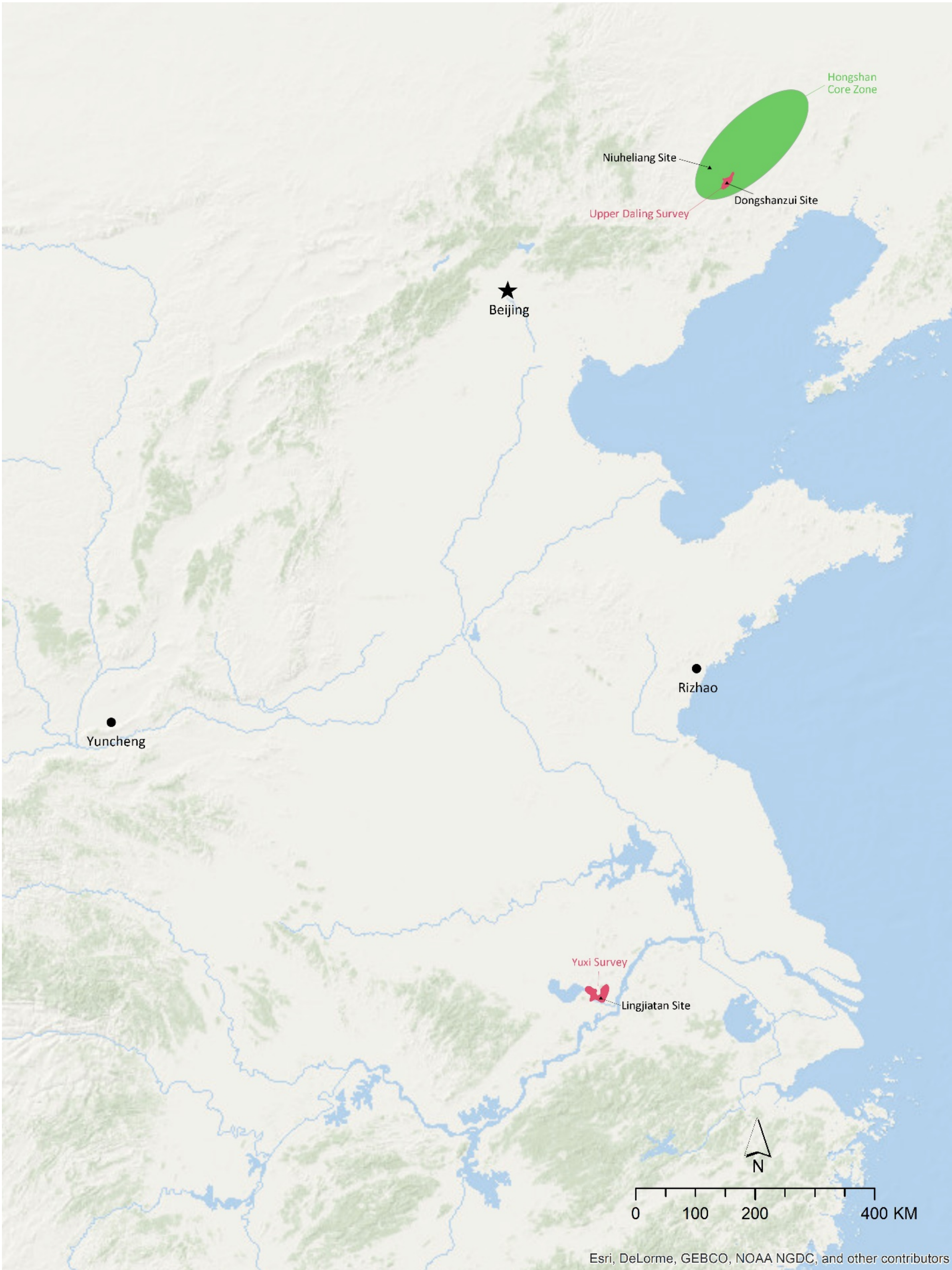

Figure 7-1 The location of Yuncheng and Rizhao in China.

APPENDIX

Electronic Access to Dataset

Detailed data upon which this research is based are available online in the University of Pittsburgh Comparative Archaeology Database at www.cadb.pitt.edu. The data provide relative locations of individual collection units within the Yuxi survey area in map and tabular form, along with classification and counts of ceramics recovered from each collection unit. The purpose of this dataset is to facilitate comparative analysis firmly grounded in archaeological data. General questions regarding the database and its contents should be sent to *cadb@pitt.edu*.

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