TRANSITION FROM FORAGING TO FARMING IN NORTHEAST CHINA

VOLUME ONE

(TEXT)

A THESIS SUBMITTED IN FULFILMENT OF THE REQUIREMENTS FOR ADMISSION TO THE DEGREE OF DOCTOR OF PHILOSOPHY

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PREFACE

This study was carried out in Department of Archaeology, the School of Philosophical and Historical Inquiry, the University of Sydney from March 2000 to August 2004.

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(ii) Jia, Weiming, 2003. The problem of the term "Neolithic" in the archaeology of northeast China. Conference. In: Institute of Russian Far East eds. Proceeding of "Century to Century" Conference of Archaeology in East Pacific, 2003. Vladivostok, Russia: Institute of Russian Far East, 252-254.

(iii) Jia, Weiming, 2002. The method of settlement pattern research. Wenwu, 8.

(iv) Jia, Weiming, 2001. The origin of agriculture and the Neolithic periods in northeast China. Beifangwenwu, 3.

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DECLARATION

I declare that all work in this thesis is the result of my own research and all references to the work of other researchers have been acknowledged. This thesis has not been submitted in whole or in part for any other degree.

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ABSTRACT

The main aim of this thesis is to demonstrate a new research method, using a framework of tool complexes analysis to trace back prehistoric economy. Using this framework the model of transition from foraging to farming such as "the availability model" proposed by Zvelebil and Rowley-Conwy (1984) can be tested with common archaeological data. Through case studies in northeast China, this thesis has made a contribution to this aim and has provided a useful method to study prehistoric economies relying on archaeological discoveries. The methodological approach in this thesis has suggested that the economies chosen by prehistoric societies are retrievable from the archaeological record without direct reference of faunal and floral data. This makes this method particularly useful for regions and periods where no faunal and floral information available. This method for retrieving economic information is also without direct reference to ethnographic analogy. This study has shown the potential significance of the use of common archaeological data without directly using highly technological equipment and a large amount of scientific analysis. This makes this method particularly valuable for the research in most archaeological records in China and elsewhere when there are few modern technologies, methodologies and research conditions available.

The theoretical approach in this thesis has implicated that the transition to agricultural economy is the result of the interaction between human societies and environment and many factors are involved in this interaction. The motivation may have to be the major factor leading to the transition to farming. This transition to agriculture would have to be the choice of society in the certain level of social complexity. Otherwise plant cultivation would not become a social economic behaviour and would have to become individual interest and remain in a very small amount.

Chapter 1 outlines the major purpose of this thesis and background of current archaeological studies in northeast China in relation to transition from foraging to farming. I have made some justifications for the "availability model" suggested by Zvelebil and Rowley-Conwy (1984) in this Chapter.

Chapter 2 reviews the studies in transition to farming worldwide, including transition research in the west, China and northeast China. A summery of Chinese archaeology in its method and theory is also included.

Chapter 3 establishes my methodological framework in studies of transition to farming in northeast China, including the explanation of tool complex analysis, interpretation of the results of this analysis and establishing a baseline based on studies in the transition to farming in central China.

Chapter 4 reconstructs Palaeo-environment in northeast China, involving sea level, temperature and precipitation, and vegetation changes during the Holocene in northeast China. Mainly based on pollen data, including present pollen reference, studies of the summer monsoon, this reconstruction provides an outline of environmental changes in northeast China.

Chapter 5 to 8 are case studies. Based on the archaeological records in the four regions: the Liao River region, Liaodong peninsula, Song-Nen plain and Changbaishan mountains in northeast China, they use my methodological framework to analyse the process of transition to farming in each region, to establish the patterns of transition in northeast China.

Chapter 9 synthetically analyses the process and model of the transition to farming in northeast China, including the analysis of transition patterns, the relationship between environmental changes, technological level and agricultural transition in northeast China. Some tentative explanations of the causes of the transition to farming are also included.

Chapter 10 extends some theoretical discussions, including discussion of the relationship between environment and economies in different transition models. The potential usage of tool complex analysis in other regions is discussed in this Chapter and followed by some suggestions in the future studies, such as transition to animal farming, transition within one archaeological culture and studies on individual species of plants and animals. The suggestion of studies using the same method of tool complex analysis in present ethnic groups to compare to its economies is also included in this Chapter.

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TABLE OF CONTENTS

VOLUME TWO: Figures, Tables, Bibliography and Appendixes

VOLUME ONE (TEXT)

CHAPTER 1. INTRODUCTION

1.1 INTRODUCTION

Studies on the transition to farming have been one of the major projects in archaeological research worldwide. Such studies have been extensively in areas such as the Near East, Europe and, north and Central America. However, northeast China is less developed in many subjects in relation to the study on the transition to farming. In northeast China, earliest human occupation can be traced back to 400,000 years ago found in the Jinniushan site (Jinniushan Team 1976, 1978 and Zhang, Shenshui 1985) and human activities continued to be discovered throughout the Holocene, but the study around the subject of prehistoric economy, including transition from foraging to farming is less developed. Therefore, it is necessary to summarise the studies of transition to farming in northeast China. In considering the lack of faunal and floral data in current archaeology in this region, this thesis aims to demonstrate that based on a practicable method tool complex analysis and using a framework, prehistoric economies can be studied and the theory of transition from foraging to farming such as "the availability model" proposed by Zvelebil and Rowley-Conwy (1986, 1984) can be tested with common archaeological data. Through this framework the model of transition to farming in northeast China will be generated from case studies in each region. In relation to the research subject of transition from foraging to farming, this thesis will mainly involve the period from the termination of Pleistocene around 13000BP to about 2000BP.

In this first Chapter, I will discuss research background about the current situation of archaeology in northeast China and geographical areas included in this thesis in section 2. As an initial part of archaeological study in relation to the transition to farming in northeast China, in section 3, I will summarise the current studies in human settlement during the Upper Pleistocene. Some discussions about stone tool technology from the Upper Pleistocene will be in section 4. In section 5, some questions in relation to the archaeology during the early Holocene will be reviewed. Some comparisons of environmental conditions between northeast China and Baltic area in northern Europe will be in section 6. In section 7, I will analyse the model proposed by Zvelebil and Rowley-Conwy (1986, 1984) and this model will be applied to the transition study in northeast China in this thesis. Section 8 is about the construction of this thesis and followed by a short summary in section 9.

1.2 BACKGROUND

In this section I discuss the current situation of archaeological studies in northeast China and the research areas included in this thesis.

1.2.1 Current situation of Archaeology in northeast China

There has been little analytical study of the transition to farming in northeast China before the late 1990s. Like western archaeology fifty years ago, before the late 1990s, the major interest of archaeologists in northeast China is to find new cultural complexes, to analyse the chronology and establish the context of archaeological sequences. With little interest in the study in environmental and prehistoric economy, such archaeological materials as the faunal and floral remains have mostly been neglected during fieldwork. Referring to the theory of study, one strong influence was from the classical Marxist social evolutionism. Another influence from the initial purpose of archaeology in China was particularly for reconstruction of national history. Under these influences, archaeologists in northeast China are more interested in simplistic sociological study rather than anthropological research based on scientific analysis. In addition, this simplistic sociological study usually was to select evidence in order to fit the old theory rather than to develop a new hypothesis through scientific analysis. This was the traditional Chinese archaeology. However, this situation has been changed along with many international collaborative projects inside China, although the influence of traditional Chinese archaeology still exits.

In the western world, “Archaeologists were enjoined to go beyond the mere connecting of pottery types in time and space, and consider the *anthropology* of the past” (Nelson 1995:5). From the “theoretical and methodological” standpoints before the late 1990s, in northeast China, “systematic archaeological surveys are rarely conducted”(Shelach 1999:50). Archaeology in northeast China was focused on “identifying cultures and defining their geographical extent”(Shelach 1999:50).

Certainly, analysing the relationship between the material complexes in time and space is significant, especially in establishing a reliable chronology and sequence of archaeological assemblages. Also this analysis usually is the basis of further study particularly in some regions "where chronologies and site relationships are also still under development"(Nelson 1995:5). Archaeologists in northeast China seem totally immersed in this analysis and hesitate to step up reaching the international standpoint. This is the current situation of archaeology in northeast China.

Even if this situation has significantly improved in last decade, the research carried out by some local Chinese archaeologists may still under the influence of traditional Chinese archaeological theory and method. The documents used in this thesis involve a large number of publications before the late 1990s. Most excavations quoted in this thesis were conducted even earlier although the date of publication is recent year. Therefore, it is necessary to assess and summarise Chinese archaeology (in Chapter 2) in order to correctly using these materials.

As a part of Chinese archaeology, however, the study in northeast China reveals some improvements along with the debate between the "New" and "Old" school of Chinese archaeology since 1980s (Chang 1995:132). The "New" means the "New Archaeology" directly derived from the West. The "Old" indicates the Chinese traditional archaeology such as over emphasizing the significance of stratigraphy and typology in archaeological research. No matter the contents of the debate itself, only the circumstances of academic debate in China is a delightful sign. This sign indicates the old Chinese way of archaeological research has been changed. This debate seems not finalized until the late 1990s.

During the late 1990s some multidisciplinary research projects carried out by Archaeological Institute of Chinese Academy of social Science, including the excavation and research in the Zhaobaogou site (Liu G.X. et al. 2004), and microwear analysis (Wang, X.Q. 2002 and 2004). Some collaborative international research projects have been carried out in northeast China, such as "Chifeng Project" (Chifeng Collaborative Archaeological Survey Team 2003). Although these projects may be a small proportion in archaeological practice in northeast China compared to a large number of excavations carried out every year by local Chinese archaeologists alone these projects represent the current level of developed Chinese archaeology, which have significant impact on Chinese traditional archaeological practice. Also, Chinese archaeologists have learnt the new methods, techniques, such as GIS intensive survey and settlement pattern research, floatation recovery technique and microwear analysis by participating these projects. This circumstance will push Chinese archaeology in northeast China finally catching up with the rest of world and the research on transition to farming in northeast China will be well developed.

This thesis is the first systematic analysis particularly on the transition to farming in this region, and is mainly based on written documents related to the faunal and floral remains collected in previous fieldwork. This thesis aims to test and modify the proposed model through the data analysis. The data collected for this thesis is derived from 647 sites all over northeast China, as well as 124 sites in neighbouring areas, including more than 19,410 artefacts in the archaeological record. Through the analysis and model testing, I attempt to draw an outline of the transition in northeast China. Also, by comparing the contexts of these data in a Geographic Information System (GIS) and using the Mapinfo software, this study will directly generate a geographical view of the relationships between the sites and assemblages. This study will establish a tentative model of the transition process in northeast China as well.

1.2.2 Research Region

The research region is called northeast China and this region that is familiar in English as “Manchuria”. After World War II, the name “Manchuria” was abandoned by Mainland China, instead using “northeast China”. In Chinese this area is called *Dongbei* and “Dongbei” already appears in English literature (Nelson 1995). Manchuria, as a historic name was used in English for a long time and is still employed sometimes. But most people use northeast China or Dongbei now in their papers, and in this thesis I use northeast China.

Northeast China is not a natural geographic region, but was formed after several inventions of Russian Empire during the late of nineteenth century. My research area is inside the political area of northeast China, and involves four administrative areas:

Heilongjiang, Jilin and Liaoning provinces, and the southeast part of Inner Mongolia. This region is a quite large area with 1.32 million square kilometres approximately. Its geographical location is about from 114°49'E to 134°46'E in longitude and 38°43'N to 53°33'N in latitude (Table 1-1).

Northeast China is located in the middle of northeast Asia and is characterised by various natural resources distributed in diverse landscapes. The Steppe covers the Mongolian Plateau, swamps, grasslands and deserts are found along the Song-Liao and Sanjiang Plains, and temperate forests cover the Daxinganling, Xiaoxinganling and Changbaishan Ranges. The varied natural resources in this region provide the necessary environmental conditions to satisfy different economic needs, such as hunting, fishing, gathering, herding and farming. Agriculture, except the area covered by the steppe, desert and swamp, has been broadly adopted in most regions in northeast China today. The natural resources for a farming economy were also present in their current form since the early Holocene and formed a basic framework within which many prehistoric societies changed their economies from foraging to farming.

1.2.3 Human settlement around 12000BP in northeast China

Human occupation in northeast Asia had increased during the Upper Pleistocene according to the number of the sites discovered (Figure 1-1, 1-2). In northeast China the Upper Palaeolithic discoveries are relatively less than Korea and Japan. One of the reasons for that would have to be the lack of attention in the area of Palaeolithic archaeology in China. The archaeological practice in northeast China, in particular, is divided into several professional groups, which refer to the chronology of archaeological periods. For example, an institutional organization of archaeology in China usually comprises sub-divisions, such as the Palaeolithic, Neolithic division, and after Neolithic, the divisions will refer to the Chinese dynasties.

Archaeologists in a same division share the common research interests and the Palaeolithic division is always short of employees because of less interest by archaeological students in universities, which is the result of the particular education system. Archaeological students are only with the social science knowledge and interest. Palaeolithic archaeology has naturally involved more interdisciplinary study in natural science than any other division in Chinese archaeology. In the provincial institute of archaeology in northeast China, there are only one or two persons involved in the study of Palaeolithic archaeology. A similar situation also can be found in universities.

If considering that the reason of fewer discoveries is caused by neglect in archaeological research in northeast China, human occupation in northeast China during the Upper Pleistocene should not be less than the neighbouring areas such as Korea (Figure 1-1). According to the geographical advantage of northeast China directly connecting to Mainland China and the large number of sites discovered dating to the Upper Pleistocene in central China, a similar density of human settlement is very likely to be discovered in future fieldwork.

Another possible reason of less discovery of Palaeolithic site in northeast China is the high latitude in northeast China provided a cold climate during the late Pleistocene. This cold climate together with the wide distribution of desert or semidesert during the Last Glacial Maximum (LGM) would have to make human habitation more difficult than warm area down the south such as central China and Korea. There are more sites discovered in Korea than northeast China. Besides the warm climate, the Korean peninsula was directly connecting to Mainland China via the Bohai and Huanghai plains during the LGM. Bohai and Huanghai was a flood plain with grassland and swamp due to the drop of sea surface about 140m during the LGM. Human habitation should also be distributed in this plain during this period and this human group once was the significant intercultural exchanger through the flood plain, connecting to the both sides of the plains, Mainland China at the west and the Korea at the east. There are no human remains that have been discovered in the seabed of Bohai and Huanghai since the archaeological research is not able to extend into this area yet. However, several discoveries of the LGM fossils in the seabed deposit around this area, such as mammoth, indicate the high possibility of human habitation in this area.

1.2.4 Stone Tool Technology

Overall stone tool technology in northeast China shows no substantial change until the early Holocene. Referring to the size of stone tools, there are two traditions of techniques, the small and large stone tools. These two traditions of stone tool techniques are assumed to connect to the same traditions in north China. But the techniques for making tools have no much changed through time in each tradition. The major technique of stone reduction is flaking and stone tools are mainly made of flakes not cores. The tool complexes based on categories of possible functions basically have not changed from 400000 to 10000 BP. This may imply that economy or the way of food procurement, hunting and gathering has not been changed.

1.2.4.1 The complexes of stone tools from 400000 to 10000 BP

Stone tools in the Upper Palaeolithic in northeast China are less sophisticated compared to the stone artefacts discovered at the early period such as the Jinniushan and Miaohoushan caves (Xin Z. and Gu Y.1996). The stone artefacts found in the Miaohoushan site from the early deposit about 400ka BP to the very late horizons around 20000BP show no much improvement in terms of tool making technology. During the Upper Palaeolithic stone tools, in almost all the sites in northeast China are dominated by flake stone tool called either “Small stone tool tradition”, or “Simple core and flake tool” (Figure 1-3). For example, 66 stone artefacts were discovered at the Daxingtun site during the first excavation and 39 of them were flakes (Huang et al. 1984), and 44 flakes out of the total 60 stone artefacts were found during the second excavation (Gao 1988). Stone tools discovered from the Upper Palaeolithic sites in northeast China revealed a similar complex, such as predominant with flakes and scrapers and lack of hand-axes or Levallois techniques (Figure 1-4). This may indicate that northeast China had closer relationship with north China rather than Siberia during the Upper Pleistocene.

1.2.4.2 Two stone tool traditions

Among the flake stone tool industries, however, there are some differences between the stone tool categories in different sites. For example, the Miaohoushan site contains some large stone tools like chopping tools but these are rare elsewhere. The size of the stone tool is usually larger than six centimetres. The stone tools found at the Xinxiang

Zhuanchang and Xianrenqiaodong sites reveal a similar component (Chen, Quanjia et al. 1996). Apart from the large stone complex, the small stone tool tradition seems dominant in most sites in northeast China. This difference normally leads to the connection with the Palaeolithic discoveries in north China where stone tools have been classified into two different traditions, the large (Kehe/Dingcun) and small (Zhoukoudian) stone tool (Jia, Lanpo et al. 1986).

Chen has speculated that the different stone tool traditions might imply humans adapting to different environments, such as the large stone tool complex seems only located along the eastern mountain regions, the small stone tool tradition only discovered around the central plains, while the microblade tradition is mainly distributed in the western grassland of northeast China (Chen,Quanjia et al. 1996:255). Although, only three sites, Miaohoushan (both the Lower and Upper horizon), Xinxiang Zhuanchang and Xianrenqiaodong have been classified as containing the large stone tool complex, this complex might imply that the human adaptation in this period diverged to the different environment such as mountains. There is no Palaeolithic discovery yet in the northern of the east mountainous regions, particularly in the Mudanjiang River area. Whether the Palaeolithic tradition in this region would be similar to the large stone tool depends on future discoveries. The sites that have been ascribed to the small stone tool tradition were indeed found in the central plains of northeast China. The microlithic tradition, even if sites containing the microlithic stone artefacts were found in the western grassland, however, is premature to be considered as the remains of the Upper Pleistocene of Palaeolithic period in northeast China, because there only a few sites contain a very small amount of microlithic artefacts dated around 10000BP, and they are very likely to be considered as Holocene in date (Table 1-2).

Nelson (1993:42) has described the debate between Binford and Watanabe when she analysed the stone tools found in the Korea peninsular. Binford has proposed that hand axes had little or nothing to do with the fauna and were unlikely to be used for meat processing. On the contrary, Watanabe has ascribed the large chopping tools to the rainforest and the exploitation of smaller fauna. As the final solution Nelson has pointed out that use-wear analysis such as microscopic and organic analysis of the residue left on stone tools has to be the crucial method. Northeast China is dealing with the similar problem with Korea, in that both need improvements in research methodology.

Compared to the LGM environment (Figure 1-2) human settlement is very likely to be dispersed in the landscape covered by mid-latitude grassland and scarce woodland around desert or semidesert in northeast China. The sites are also likely to be located at the transition area between semidesert and steppe or woodland. It is likely that the particular stone tool tradition related to the specific fauna in northeast China. However, in the current stage, how the prehistoric human societies adapted to the Upper Pleistocene environment and what the function of stone tool tradition that related to the specific environment in northeast China are questions in the current archaeological research. The solution would have to be the method that Nelson has pointed out, that of residue analysis and animal bone examination in order to scientifically work out the function of the stone tools. The application of these methods will answer the question of the stone tool function as well as the possible subsistence supporting the prehistoric societies acquired by either hunting or gathering activities.

Apart from the large and small tool traditions, the microlithic technique, as previously discussed, seems to occur in a particular area and is dispersed in the western or northwest and eastern grasslands. This tradition was very likely adopted by human settlers in northeast China during the beginning of the Holocene. After the beginning of the Holocene, along with the increase of the density of human settlement (Figure 1-5) this microblade technology quickly merged into the tool complexes of either the large or small tool traditions.

1.2.5 Early Holocene adaptation

There are not many discoveries of human activities in the early Holocene between 10000 to 8000BP, which may be caused by insufficient fieldwork. After 8000BP, many sites are found throughout northeast China.

1.2.5.1 Deficient fieldwork in the period of the early Holocene (10000-8000BP)

There is little discovery in the period between10000 – 8000 BP during the early Holocene in relation to the human habitation in northeast China (Figure 1-5, 1-6) (Table 1-3). One site Qingshantou belongs to this period but with only a single human burial and six stone artefacts, including one burin, one scraper and four flakes (You et al. 1984:73, Li, Xikun et al. 1984:11). As previously discussed the inadequate availability of data for this period is very likely caused by deficient fieldwork. The single site Qingshantou cannot represent the actual situation in the early Holocene because the environment in the area without human inhabitation is similar to the area with human settlers (Figure 1-7). For instance, during the early Holocene northeast China was widely covered by temperate forest or mixed needle and broadleaved forest along the mountainous areas. Grassland is only found at the central northeast China, where the flood plains were developed. The human settlement sites have been found in both the mountainous forests and the grassland plains. For this reason human habitation should widely distributed in northeast China between 10000 to 8000BP during the early Holocene.

The archaeological study in the neighbouring regions also supports this assumption. For example, in northern China, there are some sites distributed at the boundaries between forest and woodland, or between forest and grassland. The artefacts found in these sites revealed a variety of economic activities related to hunting/gathering and possible plant seed collecting and grinding, e.g. the Nanzhuangtou site (Jin et al. 1992). Japan has a well-established database of human habitation indicated by the early ceramic discoveries in the very beginning of the early Holocene. In Japanese terminology these periods are called the Incipient and Initial Jomon (Imamura 1996:50). These early Jomon societies lived in a temperate forest, and relied mostly on hunting and gathering economy, since the large number of stone tools discovered in these Jomon sites and these stone tools have been assigned to the hunting activities (Imamura 1996: 88).

Along the Amur River and Primorye region in Russian Far East, many sites have been excavated such as Ushki (Chard 1974:37-39), Uskinovka (Kononenko 2001) and Gasya (Derevianko et al. 1996a). These sites are located either in the banks of the rivers or the coastal area which were covered by the forest. Early ceramics were also found in these sites associated with hunting, fishing and gathering tools. Hence, the small number of archaeological discovery in northeast China during the early Holocene has to be ascribed to the limited amount of archaeological fieldwork and should be filled by the future discoveries (Figure 1-6).

1.2.5.2 Microblade Stone tool technology

Along with the termination of the Pleistocene, human adaptation indicated by artefacts in this transitional period appeared some changes. For example, one of the significant changes was the stone tool technology. As discussed previously, Pleistocene stone technology was basically flake tools which can be divided into small and large flake stone tool traditions. During the terminal Pleistocene, this tradition was added to by some new techniques such as the bifacial flaking skills and pressure flaking skills (Zhang, Zhenzhong 1981:188, 1985:76, Figure 1-4). These circumstances seem to have occurred earlier in the neighbouring areas like Korea, Japan and Russian Far East than in northeast China. For instance, some new aspects such as “well-defined core-blades industry” (Aikens et al. 1996) appeared in the stone tool complex between 15000-18000 BP and the microlithic technique, the specific wedged core preparation to produce the microblade quickly appeared almost everywhere in the regions around Japan Sea during the terminal Pleistocene (Aikens et al. 1996). The old tool tradition was not replaced by these new techniques. On the contrary, the integration of all stone tool traditions, including the large, small, bifacial, long-blade and microblade occurred around 13000BP (Aikens et al. 1996:218).

Some Chinese archaeologists have claimed that the northern China, Yellow River region is the place of microlithic origin. The Xiachuan site dated at more than 20000BP has been assigned as evidence of the beginning of microlithic industry in Chinese archaeology (Lu, L 1998, Yu,Zhiyong 1995, An, Zhimin 1978). On the other hand, Russian archaeologists consider that the microlithic technique was initiated around Siberian steppe and might developed from the local Levallois tradition (Larichev et al. 1990). So the origin of microlithic techniques in northeast asia is not clear, need further investigation.

Unlike the neighbouring regions, northeast China tends to be later in the microlithic appearance even though it geographically connects to the microlithic initiating regions either northern China or Siberia. For instance, the earliest date of microlithic artefacts in northeast China is discovered at the Daxingtun site dated at c.13000BP (after calibration). Most stone artefacts discovered in this site were not formed by microlithic technique (Huang 1984). Only one core called "microlithic core" in the report was found in this site which seems less typical features of microlithic technique, such as the wedged and conical shape cores associated with the microblades processed from them. Another example the Qingshantou site, the microlithic artefacts found in this site were only surface collection. The stone artefacts derived from the excavation in this site dated about 13000-8000BP were unlikely to be considered as microlithic (Li, Xikun et al. 1984). As well, the Dakanzi site, even if the typical microlithic artefacts and the fossils of the LGM fauna were discovered in this site (Chen, Quanjia 2001), the surface collection of these artefacts and the fossils might not originate in the same horizon. The further proper excavation is required for this site in order to assure the correct date of the microlithic artefacts.

Around 8000 BP, in northeast China the microlithic technique seemed suddenly to emerge in almost all the regions, including the west grasslands and the central plains, as well as the eastern Sanjiang Plain. Only the eastern mountainous regions where was favoured in large stone tool tradition in previous period, were still deficient in typical microlithic artefacts. The period between 13000 to 8000BP that was discussed previously was the time when microlithic adaptation occurred in northeast China. This transition period is unclear if relying on current available data in northeast China. However, at least the date of the transition period is clear which is around 10000 to 8000 BP because of microlithic discoveries in surrounding areas.

1.3 THE THORETICAL MODEL

In this section, I am going to discuss about the theoretical model used in this thesis and why we need a model in the study of northeast China.

1.3.1 Why we need a model

There are many theoretical models and hypotheses have been addressed in relation to the study of transition from foraging to farming. Lu, T.L. (1999) has summarised these various hypotheses into three main groups: alteration of ecology, pressure of population, and evolution with natural selection. Lu, T.L. (1999:2) has also noted that a single explanation seems to be oversimplified when attempting to address such a worldwide issue. These three groups are to attempt to explain the reason why transition from foraging to farming happened. This question cannot be answered prior to the studies on the process of transition itself. My study in this thesis is to analyse the process of transition to farming by a model-testing method in the region of northeast China. Thus I need a previous theoretical model selected from these existing hypotheses of transition to farming to put in my testing process.

There are two subjects are involved in my study, the first, agricultural expansion from primary area, central China to a possible secondary area, northeast China and the second, the process of transition from foraging to farming within each region in northeast China. Before the actual analysis in my research I just assume that northeast China is a secondary agricultural area since the dominant theory of agricultural expansion from central to northeast China is widely accepted by Chinese and Japanese archaeologists (Yan 2000a; Yoshinory 2000) although there is also another opinion arguing that northeast China may become another region of agricultural origin out of central China (Shelach 2000). However, whether northeast China is a secondary agriculture area as whole or some regions may develop local agriculture independently to be seen as a primary agricultural area, depends on the details of the process in transition to agriculture in each region. Therefore, the chosen model should be related to these two subjects regardless primary or secondary agricultural area. Applying the model in a new area, northeast China and trying to see whether transition to agriculture has features in common with elsewhere of the world is the major purpose of this thesis. In this part of my thesis I will analyse these hypotheses and select a model from these existing hypotheses for further test.

In relation to the process of agriculture transition and expansion archaeologists have proposed several models. I am going to list several proposals to explain what I need for this thesis. These models include “the wave of advance model” (Ammerman et al. 1973:347) and its further development of “the staged population interaction wave of advance model (SPIWA)” (Renfrew 2002), and “migration model”, which ascribed farming transition is the result of actual farmer migration to the new area (Bellwood 2002). These three models describe the processes of agricultural expansion from the centre of agricultural origin to the peripheral area. Also the “availability model” (Zvelebil & Rowley-Conwy 1984), the theory of “four stages” in transition to farming proposed by Price et al. (1992) are to illustrate the process of agricultural transition.

Some opinions are also considered because they are based on the studies of Chinese archaeology. Such as Nelson (1990) and Shelach (2000) suggested that “northeast China is a new area of agricultural origin”; Yan, Wenming (2000a) and Yoshinory (2000) discussed two rice agricultural origin and its expansion to northeast China, Korea and Japan; based on study of agricultural origin in China Lu (1999) proposed that agricultural origins in the world were connected to the worldwide Holocene environmental change; Chen (1989) has proposed three stages of transition to agriculture in Chinese prehistory. All these opinions are considered but not selected for testing in this thesis and will be discussed further in Chapter 2.

In relation to agricultural expansion, both Ammerman et al. (1973:347) and Renrfrew (2004) suggested that the process of expansion is similar to the chain reaction and not necessarily involving population movement based on west Asia agricultural expansion to Europe. Ammerman’s theory is based on the archaeological data only but Renfrew’s hypothesis considers both archaeological data and DNA analysis. Based on the studies in Austronesian archaeology Bellwood (2004) has suggested that farming expansion would have to involve farmer migration to the new area regardless the number of population involved in the migration. However, without ancient human DAN analysis, which is not available in northeast China, this theory is difficult to be established or tested.

In relation to the process of agricultural transition, Price et al. (1992) have also disserted that the transition process from hunter-gatherers to farmers has four stages when he studied the Baltic area:

1). Upper Palaeolithic (or Mesolithic),
2). Last hunters,
3). First Farmers,
4). Neolithic
(Price et al. 1992:104-105).

Price is using the traditional concept to explain that from foraging lifestyle during the Upper Palaeolithic transform towards to farming and enter the Neolithic. It seems precisely appropriate with the conventional terminology in archaeological period, such as Upper Palaeolithic, Mesolithic and Neolithic reflecting the lifestyles of hunting and gathering, transition period and farming respectively. However, this reflecting could not be established in some particular areas. Sometime in the particular ethnic groups persist their hunting gathering and reject agriculture for a quite long period. As mentioned earlier, Japanese prehistory has no traditional Neolithic, farming adoption was happened during Bronze or Iron Age (Imamura 1996). The similar circumstances are reported in northern northeast China and Russian Far East. Therefore, it is better to create a transition model based on the great number of regional research.

Price et al. (1995) have pointed out that this transition process is a "global phenomenon requires a general explanation" and the explanation should be "plausible, simple, causal, verifiable and global". The attempt to search for a universal "model" or a general explanation of this transition also requires regional research based on archaeological data. In this thesis I select the "availability model" proposed by Zvelebil and Rowley-Conwy (1984). This model is derived from the study on the transition to agriculture in Baltic area of northern Europe. About the details of this model will be discussed in the next part of this section.

The "availability model" proposed by Zvelebil and Rowley-Conwy (I called it ZRC model, Z: Zvelebil, RC: Rowley-Conwy) model is more appropriate than others for research on the transition to farming in northeast China. The ZRC model illustrates a transition process in a secondary area, which is similar to northeast China as discussed in Chapter 2. Secondly, the ZRC model focuses on the economic details of the transition process and emphasises the social context between foragers and farmers.

Thirdly, as the background to the ZRC model, the result of environmental reconstruction is the significant reference, because neither farming nor foraging would survive without the necessary resources provided by the environment. No matter which type of economy that humans chose, farming or foraging, sufficient natural resources are necessary for both types economy (Zvelebil 1998:11).

1.3.2 The ZRC model

The ZRC model was first proposed in 1984 by Zvelebil and Rowley-Conwy. The model illustrates the “three-phase” process of transition to farming. These three phases represent three progressive stages of the transition to farming called **availability, substitution and consolidation** phases. In the ZRC model proposed in 1984 described mainly three phases based on domestic animals. The ZRC model also considered archaeological data in relation to the movement between agricultural and hunting/gathering societies. In the further discussions, Zvelebil (1986, 1998) has applied percentage of domesticates in the total economy and presented a diagram showing the ZRC model (Figure 1-8).

In these further discussions, the first stage, availability, mainly means that the contact between forager and farmer has been established, and through this contact the exchange of materials and information amongst foragers and farmers has occurred. During this contact, the foragers still dominantly rely on foraging economy. The second, substitution phase, is the period of when farmers move into the territory of foragers - farmer migration (Bellwood 2002), or when the foragers adopt farming without giving up foraging – mixed economy. Apparently, competition between farmers and foragers has occurred. Also, the increasing farming economy inside the forager society competes with traditional foraging. The third, consolidation phase, is the final stage of the transition when farming replaces foraging and becomes predominant in the economy (Figure1-8) (Zvelebil and Rowley-Conwy 1984:105-106).

1.3.3 Analysing the ZRC model

To apply the ZRC model to northeast China, however, some aspects, such as the definition of “phase”, content in each phase, differences between the model and actual data need to be analysed.

1.3.3.1 The meaning of “phase”

The concept of “phase” used in the ZRC model should be clarified. Before discussing the concept of “phase” I need to notice some details of the model. The diagram in Figure 1-8 shows the complete transition process of the ZRC model. In this diagram, the basic parameter for distinguishing the three phases is the proportion of farming in the total economy. This proportion increases constantly through time. During the availability phase, for instance, the proportion of farming is stipulated to be less than 5%, so the economy remains dominantly foraging. In this phase, the farming economy, even though it is less than 5%, is the result of contact and exchange between farmers and foragers. In the substitution phase, farming has increased continually from 5% to 50% and strongly competes with foraging. The consolidation phase means that farming has increased beyond 50% and up to 100%, and finally becomes dominant in the economy.

In my understanding of the details of the ZRC model, the term “phase” comprises two implications, the temporal and spatial. From the temporal implication, the “phase” indicates a period in transition process. For instance, the availability phase is the early period when “farmers and foragers are developing contacts” (Zvelebil 1998: 10-11). In Zvelebil’s viewpoint, the availability phase is a period in which farming economy initially emerged in forager society through contact with farmers. Here, two circumstances are involved in the ZRC model. One is that foragers in the model should be located next to farmers, which means the ZRC model describes a transition process in which farming economy expands into forager’s territory, the secondary agricultural area. Another is that foragers have met the requirement of farming economy in the aspects of technology and natural resources and so farming economy will develop if foragers choose to, which is primary agricultural area.

The temporal implication of the three phases indicates a complete process of transition to farming. As supplementary food procurement or for other uses, hunting and gathering continues within the farming economy in a very low proportion during the consolidation phase compared to the entirely predominant agricultural and pastoral economy. For instance, the temporal implication of the three phases can be seen in northern Italy, where all three phases occurred between 6500 and 6000 years BP. The availability phase is before the 6500 years BP, then came the substitution phase and after about 6200 years BP the consolidation phase (Figure 1-9).

“Phase” also has a spatial implication. This is when within a single period, the contact region between foragers and farmers can be divided into three subregions and each subregion reflects one stage of the phase. For example, the Baltic area of northern Europe, around 2000 years BC, became a contact zone between farmers and foragers. Most areas of south Finland became an availability region and ready to adopt a farming economy. The substitution region covered Estonia, Latvia and some areas of south Finland and the consolidation region was the area south to the coast of Baltic Sea (Zvelebil 1998:19).

In my view, this temporal meaning of the “phase” in the ZRC model is also applicable to a primary agricultural area even though Zvelebil (1998:19) emphasised that the model only describes a secondary agriculture. For example, in a primary agricultural area, the availability phase is the period, when some conditions, such as natural resources and human technologies have developed among indigenous foragers and so they are ready to either develop or adopt a farming economy. Some discoveries of agricultural origins in China, a primary agricultural area, could represent each phase of the transition to farming. As addressed previously, in a region of agricultural origins, the availability phase could be understood as a period when the original foragers begin to develop plant cultivation and start to learn the technology of cultivating independently in a suitable natural environment. The possible example for this phase is the Xianrendong site in China, where rice domestication began about 14,000 to 11,000 years BP (Zhang, Chi 2000). Similarly in the next two phases, farming increases during the substitution and this may be represented by the archaeological discovery in the Cishan (Hebei Administration et al. 1981) and Jiahu site (Henan Wenyansuo 1999). Finally, it must be said that the consolidation phase, when foragers become the farmers (including domestic animal herding), can be seen in the Banpo society (Chinese Academy 1963). I will discuss the three sites found in China representing the three phases in Chapter 3.

1.3.3.2 The relationship between model and data

Similarly to other theoretical constructs, the ZRC model is a hypothetic form to describe a transition process in a completely ideal frame. Because in the real world the ideal frame may not be present in full, any attempt at searching for a perfect fit between archaeological data and this model is unreasonable. There is always variation between theoretic model and actual data even if at times this variation is very small. The difference between the ZRC model and archaeological data in Europe is one such example of a close fit between model and reality.

In Europe, not all the three phases of the ZRC model definitely emerged to form a complete transition process. Sometimes a transition may leap over phases to become an incomplete process. For instance, the substitution phase is less clear in east Europe (Dolukhanov 1986) or may be did not exist. In south Italy around 8,000BP, village farming (consolidation phase) suddenly replaced foraging (possible availability phase), which may indicate that the substitution phase might be too short to be found (Figure 1-9) (Lewthwaite 1986). In Japan, even though the beginning of plant cultivation was during 7300-5600 years BP, farming did not replace foraging until the beginning of rice agriculture at about 3000 BP. In this case, the availability phase continued for more than four thousand years (Rowley-Conwy 1984).

1.3.3.3 The application of the ZRC model

The ZRC model itself is generated from the analysis of archaeological data particularly the faunal data from Demark and Finland (Zvelebil & Rowley-Conwy 1984). To search for "socio-economic changes" by analysing faunal and floral data is the major method of their research. But the measurement of socio-economic changes in the first proposal of the ZRC model did not use the proportion of domesticates in total economies until the second and third discussions by Zvelebil (1986, 1998). To apply the ZRC model requires a method which can provide a proportional results derived from archaeological data. Without this method to measure the change in some objective way, the prospect of testing the model is somewhat unrealistic.

The ZRC model describes three phases, discriminated by the percentage of domesticates in the whole economy in different periods according to the later discussion (Zvelebil 1986, 1998). Besides the different proportion of domesticates between the three phases (Figure 1-8) Zvelebil (1998:11) has made two additions to the definition of the three phases:

1. Faunal and palaeobotanical remains on the regional scale reflect the economy of a Community;
2. The shift to economy dependence on domesticates will be linked to broader socio-economic changes within society.

On the other words, the percentage of faunal and floral remains in a regional scale should reflect economic complexes in a community. Also, dependence on a farming economy should link to a socio-economic change reflected in the archaeological record.

As Zvelebil stated, this model is a "heuristic device" allowing archaeologists "to monitor the agricultural transition at a finer level of resolution" (Zvelebil 1998:11). As a model, it should be testable and adjustable according to archaeological discoveries during the evaluation procedure. Testable means that the percentage of farming economy can be obtained from common archaeological data. Adjustable implies that data may be different to the model's predictions, and the model can be modified by the data.

In fact, it is difficult to transfer common archaeological data into a percentage of the economy. What an archaeologist usually sees in archaeological complexes is the fragmentary remain of fauna and flora and broken constructions and artefacts. We need an effective method to move from common archaeological data into an economy. Zvelebil (1998:11) has indicated that the accurate accounting of the subsistence that represented proportions of the economy "can be rarely, if ever, met in full". From his viewpoint, on the one hand the percentages given in the diagram (Figure 1-8) of the

ZRC model are merely a theoretical assumption that should only be used as a simplified image. On the other hand, even if we have developed a variety of new technologies in order to retrieve as much subsistence information as we can from ancient deposits, such as seed recovery, residue and usewear analysis, even phytolith and taphonomic study, a full mathematical accounting of subsistence in a prehistoric society would never be achieved. The reason for this is the unlimited information required by a full study but only limited funding and times to acquire it. Under these circumstances, an effective methodological framework is required and this framework should be able to make the ZRC model or other theoretical hypotheses into an assessable level and to be evaluated in archaeological practice. In this thesis, I will establish and explain this framework in next Chapter.

1.4 COMPARISON OF CONDITIONS IN THE EXPERIMENTAL REGION

The model selected for this thesis is proposed by Zvelebil and Rowley-Conwy (1984). In this thesis I call it the Z (Zvelebil) R (Rowley) C (Conwy) model. This model is based on the data derived from a secondary agricultural area around Baltic region in northern Europe. My experimental region of northeast China shares some common features with the Baltic area. For example, they are both including some secondary farming areas located north (the Baltic) and northeast (northeast China) of the primary agricultural area. Both in the Baltic and most regions of northeast China, natural resources appropriate for farming have been available since the early Holocene, except the Mongolian plateau in the northwest region of northeast China where the environmental conditions are not appropriate for the farming economy throughout the Holocene. The agricultural transition both in the Baltic and northeast China was very slow compared to the primary agricultural area such as southern Europe and the Yellow and Yangtze River region in China. These similarities between the two regions suggest that northeast China is a suitable area for testing the ZRC model.

On other hand, there are some differences in the archaeological background of the two regions that need to be noted prior to the research. Firstly, as a part of Chinese archaeology, northeast China is the area with less development in its archaeological practice compared to the archaeology in Baltic area. For instance, in local Chinese archaeological practice the samples of fauna and flora are not usually collected in most excavations. Also, the theory guiding the archaeological study is still strongly influenced by traditional Marxism. Thus most local Chinese archaeologists still interpret their discoveries simply as proving Engles' social evolutionism rather than adopting or developing an alternative theory. Additionally a direct connection between archaeological assemblages and ethnic groups is regularly claimed by archaeologists in northeast China.

Secondly, unlike northern Europe where palaeoenvironmental study has long been employed, in northeast China environmental study has just started. There was little development of environmental archaeology in northeast China. Even though there are many Chinese scientific palaeoenvironmental studies in print, archaeological research in northeast China still lacks environmental references.

Thirdly, because of some conservative approaches and the misuse of terminologies, some reports from the earlier research, such as before the late 1990s, written by Chinese archaeologists are usually with some problems. Besides, during the more than three decades of isolation from the world, particularly during the Cultural Revolution, Chinese archaeologists created many terms with similar names to the Western but with different meanings. For example, the term microlithic in Chinese documents may only indicate stone artefacts of small size (Nelson 1995). Also the term Bronze Age does not necessarily indicate the development of bronze metallurgy and may only mean the discovery of a bronze artefact, without analysis of where or how it was produced. Similarly, the term Neolithic may only means the assemblage contains pottery or polished stone tools.

Moreover, like most peripheral regions of China, in northeast China the study of cultural context is not as mature as in northern Europe. The succession of archaeological assemblages and their chronology has not been established in many subregions. Several gaps still exist in both the temporal and spatial approach according to the current data. Because of massive construction projects a large number of the new discoveries have been unearthed and many local archaeologists are working on the basics of these, such as the chronology and the context between assemblages. This situation is encouraging research to be even more conservative than it used to be due to the insufficient financial support and the limited time for archaeological rescue fieldwork.

The geographical background is also somewhat different. Baltic region is a peninsula partially separated by the oceans from the mainland Europe. But northeast China, as a conjunction area, directly connects with central China, Siberia and Russian Far East, the Korean peninsula, as well as the Japanese archipelago. These multiple directions of geographical connection would have to allow prehistoric societies a wide range of contacts. This multi-dimensional connection between prehistoric societies should be reflected in the context of archaeological assemblages. In northeast China, as the centre of the Northeast Asia, the connexions between archaeological assemblages would be expected to be more complicated than in northern Europe.

These differences between the two regions outlined above require some particular approaches in this thesis. Firstly, a reassessment of Chinese archaeology and archaeological study in northeast China, particularly before the late 1990s is needed. This reassessment will clarify the Chinese documents that I work with. It is important to assess the level of reliability of the Chinese documents prior to the research. Secondly, a reconstruction of past environments, particularly in the Holocene in northeast China is also required by this study because the study on transition to farming is based on the background of the past environment. Thirdly, the analysis of archaeological assemblages in northeast China is required due to the immature studies in the areas of cultural tradition, chronology, domestic crops and prehistoric economy. Another requirement for this study is to acquire some references from the neighbouring areas of northeast China due to the geographical connections in this area.

1.5 OVERVIEW OF THE THESIS

This research will test the applicability of the ZRC model to northeast China. As one of the purposes of this research, an outline of the process of transition to farming in northeast China will be generated Through the modification of the ZRC model by the new data, a new model of transition to farming will be established to match the evidence of northeast China. There are several steps are involved in this thesis:

Introduction (Background and the model) (Chapter 1)

Chinese archaeology and transition research (Chapter 2)

Research methodology (Chapter 3)

Environmental reconstruction in northeast China (Chapter 4)

Case study 1, The Liao River regions (Chapter 5)

Case study 2, The Liaodong peninsula (Chapter 6)

Case study 3, Central northeast China (Chapter 7)

Case study 4, The Changbaishan area (Chapter 8)

Overview of transition to farming in northeast China (Chapter 9)

Conclusion (Chapter 10)

This thesis is assembled with two volumes. All text is in Volume One and illustrations, tables and appendixes are in Volume Two following the order appearing in each chapter.

1.6 SUMMARY

Northeast China is an appropriate region to demonstrate the ZRC model of transition to farming through prehistoric archaeology. This thesis is based on reconstruction of past environment and analysis the current archaeological discoveries in northeast China. It will draw an inference of the process of transition to farming in northeast China from reinterpretation of the written documents related to the faunal and floral remains collected in previous fieldwork. By comparing the transition model to the archaeological evidence in northeast China, this thesis aims to exemplify and modify the proposed model through the data analysis. Moreover, through the investigation of archaeological discoveries across northeast China, this thesis attempts to establish a tentative model of transition process, as well as to explain the possible motivation of adopting farming economy from a regional perspective of northeast China.

CHAPTER 2. CHINESE ARCHAEOLOGY AND TRANSITION RESEARCH

2.1. INTRODUCTION

Research into the transition to farming in the past involves at least three elements: ecology, technology and motivation. Almost all the research into agricultural transition relates to these three elements because these three elements reflect the basic conditions required by the transition process. The first element is ecology, which means the suitability of ecological conditions for farming activities. Such factors as the natural environment, temperature, soil, water and sunlight should be appropriate for plant growing, and if transition is local, wild plants should be also available for human domestication. The second, technology, means that the prehistoric community understood the technique, the skill and the knowledge of plant growing and the seasonal changes of the environment, and is ready to go through the process of domestication. The third, motivation, is the reason why humans determined to replace foraging by farming, to take the risk of abandoning the traditional way and chose an alternative but not an easier way of food procurement.

These three conditions, ecology, technology and motivation that resulted in the transition can also be described as external (ecological) and internal (socio-political) conditions in summarising past studies (Table 2-1).

We may assume that as one of the results of the interaction between human and environment, the transition to farming should meet these basic requirements of ecology, technology and motivation. In other word, foraging would persist if these basic requirements were not met, or the transition to farming would not be completed if the requirements were not fully met. The three elements of ecology, technology and motivation are the major considerations in past research worldwide. In this Chapter, I will review some previous studies into transition to farming both in the West and China.

At first, I will evaluate the theory and method in Chinese archaeology in section 2. This evaluation only focuses on the subject relating to my study rather than a complete assessment of Chinese archaeology. In order to recognise the influence of the Chinese paradigm in research on the transition to farming it is therefore necessary to evaluate Chinese archaeology. Section 3, 4 and 5 are the review of transition studies in the west, China and northeast China. A short summary in section 6 will complete the Chapter.

2.2 CHINESE ARCHAEOLOGY

Chinese archaeology has significantly improved in last decade, particularly in the level of state institutions and international collaborative projects. However, method and theory in the traditional Chinese archaeology, as I discussed in Chapter 1, was less developed than in the West before the late 1990s, which has affected the research on the transition to farming in China in the last half century. To study the transition to farming in China requires attention to the great deal of Chinese literature published before the late 1990s, because there are relatively a small number of articles published after 1990s either in Chinese or English. The large numbers of field excavation report, which were printed before the late 1990s contain a great deal of data for archaeological research. These reports were written under the influence from the theory and method of traditional Chinese archaeology. Also after the late 1990s, some provincial and local institutions are still less developed in archaeological study compared to the state level and collaborative teams. These provincial and local institutions are carrying out fieldwork every year both salvage or academic observation and excavation. The data reported from their fieldwork are still a considerable number in the academic publications every year. In addition, Chinese archaeological fieldwork report and publications have its own regulations, including the way to record and publish data and some of these regulations are very different to the West. Thus, the evaluation of successes and shortcomings of Chinese archaeology, especially the aspects related to the study on transition to farming, has become an essential task in this thesis before undertaking any further discussion.

In this section, I will review the traditional Chinese archaeological methods and theories briefly by analysing its concepts of stratigraphy, typology, context of some terminologies and some structural problems affecting archaeological fieldwork.

2.2.1 Stratigraphy and typology

Chinese archaeology was similar to the West in its method and theory during its pioneer time. Modern Chinese archaeology began in the 1920s (Chen, Xingcan 1997:76), which is almost a half-century later than the West (Olsen 1987:283). During that period, the archaeologists in China, either foreigners from the West or the Chinese educated in the West, were working on all archaeological projects using the same method and theory of the West.

Archaeology based on fieldwork is the indication of the beginning of modern archaeology in China. Chinese stratigraphy and typology developed along with the practice of field observation and excavation. Based on specific loess deposits and the particular prehistoric material remains in northern China, Chinese archaeologists have developed a Chinese version of stratigraphy and typology since modern Chinese archaeology began (Yu, Weichao 1999:80). For example, the excavation in Hougang in 1931, has changed the way of excavation from artificial "level layers" to "natural layers" (Chen, Xingcan 1997:227-230). As early as the 1940s, based on the prevours typological studies, Su, Beingqi (1948) has analysed the pottery tripod *Li* found in the Doujitai site and generated a fundamental method for typological research in his paper "*Analysis of Pottery Li*" (Yu, Weichao 1999:80; Chen, Xingcan 1997:325-328). His studies have become the basic method for finally forming the Chinese typology and Chinese paradigm in the 1980s.

After the isolation of Mainland China from the West in the 1950s, Chinese stratigraphy and typology continued to develop following its own direction. Intensified fieldworks were conducted in some specific regions such as the middle Yellow River areas in north China. Political demands from officials accelerated archaeological research in this region. Chinese people including officials believed that this region is related to the Chinese national origins and research into national origins would encourage "patriotism" for the whole nation. Isolation did not slow down

Chinese archaeological research, but intensified the development of Chinese stratigraphy and typology. This development occurred in isolation without reference to western archaeology and without the experience of fieldwork out of Mainland China. Nelson (1995: 4) has described how "China was cut off from the west for an entire generation, with a deliberate policy of developing on its own." Zhang Zhongpei (1983) illustrated these two methods, stratigraphy and typology, as a pair of wheels on which archaeology rides as a vehicle. In his description, the vehicle cannot move without the wheels and archaeology would not develop without the knowledge of stratigraphy and typology. This description emphasises the importance of stratigraphy and typology among Chinese archaeologists.

Although Chinese archaeologists have developed own stratigraphy and typology they share most principal concepts with the West (e.g. Gamble 2001:60-61; Yu, Weichao 1987; Zhang, Zhongpei 1983). The basic rules of stratigraphy and typology are no different between China and the West. The major purpose of the two methods in both China and the West is to attempt to correctly recover the process of deposition and material remains in their correct sequence and chronology. There are three features, however, which appear to be slightly different from the West, that need to be noticed in Chinese archaeology.

The first feature is the rule of identifying the unit of deposit in excavation. One of principles of stratigraphy in both Chinese and western archaeology is that the more units of deposition that can be identified during excavation, the greater the accuracy of stratigraphical data achieved. Depending on different texture of the soil, such as colours, types and components in deposit, archaeologists distinguish different units of deposit. There will be no chance to recover lost data if several different depositional units are mixed together during the excavation. The artefacts mixed up between the different depositional units would affect the subsequent analysis (Zhang, Zhongpei 1983). But on the other hand, if an excavator over considered the difference within the colour, type and components of deposit and pursued an infinite division, the principle would lead to an unlimited number of units. During excavation in China, archaeologists often discover a number of ash pits with only a few centimetres deep due to overemphasising the principle. For example during excavation of the Yuanbaogou site, Jilin province, excavators reported two ash pits "H1" and "H2"

(Jilin Kaogusuo 1989:1067-1068, Figure 3, 4). These two “pits” are very likely to be shallow hollows on ancient ground. This unnecessary division of these hollows in the report could easily to make confusion for readers that they would think that ancient people intentionally dug them for some purposes.

The second feature is the rule of typological study. In general, typology must be based on stratigraphic analysis if the stratigraphic information is available, or based on absolute chronology (Zhang, Zhongpei 1983:189). Without reference to stratigraphy and absolute chronology, the results of typological analysis are less reliable. In Chinese archaeology, even when results are based on stratigraphic and absolute chronology, it is still necessary for them to be corroborated or modified repeatedly in future fieldwork. Usually this result is relatively reliable and has already been well discussed. Similarly to the first feature, however, Chinese archaeologists sometimes over consider the corroboration and modification, so that the studies become an endless discussion. For instance in the discussion about the Chahai and Xinglongwa site (Liaoning Kaogusuo 1994a:19), because the researcher over considered the difference between the artefacts in these two sites and overlooked the high level of the similarities, this one integrated culture was unreasonably divided into two cultures. And this discussion still continues and seems far from over (Ren, Shinan 1994; Liaoning Kaogusuo 1994a).

The third feature is about the code used in field reports to record the units of deposit and artefacts. Unlike the West, in China there is a code system authorised by the academic circle for recording artefacts and deposit units. Under this system, archaeologists must use a capital letter of Chinese *Pinyin* together with a number to label the deposit unit and artefact. For example, the code for a house must use the capital letter “F” and if recording “house number one” should write the code “F1”, and similarly, “M” for burial, “Z” for cooking place, “H” for ash pit, etc. This regulation has led to writing field reports as if filling up a form. It is easy to read the report if one can understand the code. But if excavator uses the wrong code, a reader would be misled by the mistake. For instance, an empty burial pit may occasionally be recorded as an ash pit with “H” in report, but the letter “H” has already told reader that it is a ash pit, e.g. “H2016” in the Xiaolaha site (Heilongjiang Kaogusuo et al.

1998). Besides, sometimes, some deposit units cannot easily be categorised by the given names in the list.

Regardless of the difference between China and the West, the two methods of stratigraphy and typology should not be overlooked in archaeological research. The two methods are basic and fundamental skills required by every level of research either in the field or laboratory. In China, during the 1980s, the implication of fieldwork legislation issued by state officials has led to the two methods becoming a minimum assumed knowledge required in both archaeological education and field practice. For instance, one of the core courses required for undergraduate students is two periods of field practice. The first field practice is three months during the second year of university. The major purpose for the first field training is to learn the basic skill of stratigraphy, to learn how to control the process of excavation in a small test pit, usually 25 square metres. The second period is six months field practice during the fourth year, before graduation. During the second time, students learn how to manage a hundred square metres test pit and teach other four second-year students during their first time field training. At the end of the field training, fourth year student must learn how to write a formal excavation report and how to undertake typological analysis. The emphasising of stratigraphic and typological training in China has led to an improvement in the basic skill of archaeological fieldwork. Through this fieldwork, Chinese archaeologists have provided a reliable archaeological database for further study.

In the history of western archaeology, however, relying on and describing only the results of these two methods, stratigraphy and typology, are questioned by “New Archaeologists”. Around 1960s in the United States of America, the “New Archaeology” considered articles primarily based on these methods “insipid descriptive writing” (Chang 1995).

As in pre-1960s in the USA, “insipid descriptive writing” has become the regular style in Chinese archaeological publication. The reason for this is the particular three features of Chinese studies in stratigraphy and typology before the late 1990s. Chinese archaeologists have over-emphasised the capabilities of these methods. One result of that is endless analysis and argument about the context of artefacts and endless discussion of similarities between different archaeological assemblages. The publications of archaeology in China reveal a heavy impress of typological and chronological discussions but lack environmental and economic analysis. Similarly, field reports in China usually contain a massive description of stratigraphy and artefacts. The artefacts in the report are divided into several levels of category, sub-category, etc. but with little information of fauna and flora. Although Chinese archaeologists do study prehistoric economy and environment, their studies are usually without scientific analysis of fauna and flora. For instance, there are many archaeological excavations conducted each year in China, but only very small numbers of excavations intentionally collect botanic remains. Some excavations even neglect animal bones. This behaviour in China possibly is similar to the West in a century ago or even earlier.

After the late 1990s, Chinese archaeology has begun to adopt some new methods and techniques, such as GIS intensive survey and settlement pattern research, floatation recovery and residue analysis either through the international collaborative projects or by themselves (Liu, Li and Chen, Xingcan 1999:329). There are some advanced theoretical studies in relation to the Chinese stratigraphy and typology (e.g. Zhao, Hui 1992, He, Nu 1999). Referring to the endless discussion of Chinese typology, for instance, Bing (2000:164) has argued that if typological analysis is not able to generate a further interpretation in the social evolution of prehistoric society, then typology has lost its significance and purpose. Bing’s question has explored one of the shortcomings in Chinese archaeology. This adoption of new methods from the West and theoretical improvements in the method and theory in Chinese archaeology indicates a delight future that Chinese archaeology has quickly caught up with the world.

2.2.2 Content of terminologies

Terminologies used in Chinese archaeology were usually adopted from the west by Chinese scholars who were educated overseas during the early twentieth-century (Tu 1999:109). These terminologies adopted from the west are still used in current Chinese archaeological practice and theory. However, a long period of isolation from the rest of the world has led Chinese scholars to develop some new terminologies in their methodological systems. By changing contexts in some old terms and also creating some new terms in research practice, Chinese archaeology has formed its own system, which is not the same as western archaeological practice. Some terms are created and used by archaeologists in Mainland China only, such as the term *Qu-Xi-Leixing* (Su 1981), which is used to group archaeological remains by regional differences and similarities based on typological analysis.

As with other new terms in Chinese archaeology, the term *Qu-Xi-Leixing* is developed based on the criteria of naming an archaeological "culture" as proposed by influential Chinese archaeologist Xia Nai (1959). Xia was educated in UK, so the term "archaeological culture" that he proposed was apparently adopted from western archaeology. From Xia's criteria for naming an archaeological "culture" in 1950s, to Su's *Qu-Xi-Leixing* in 1980s, this period reveals a history of development in the Chinese methodological system (Zhang, Zhongpei 1999:70). To study Chinese archaeology will inevitably deal with these specific terminologies. Even though some terms, such as *Qu-Xi-Leixing*, have been used to fit into the purpose of regionalist practice, to over emphasise the significance of the discoveries in local archaeological research as Falkenhausen (1995) pointed out, it is necessary to explain these terms if the research is dealing with Chinese archaeology.

In addition, in this thesis, I will continue to use some terms from Chinese archaeology, particularly in quoting articles written by Chinese scholars and also in discussing relationships between archaeological remains. In considering some terms used in this thesis, such as "culture", "cultural system" and "*Variant*" (sub-group within a "culture") and also frequently used in Chinese archaeological publications, I will explain the contents of these terms used in Chinese archaeology.

2.2.2.1 Culture

As I mentioned above, the term "culture" used in Chinese archaeology was adopted from western terminology in the beginning of twentieth century and has continued in use. By using this term, Chinese archaeologists have developed their own meanings based on this western terminology. When this term "culture" was introduced into China, the meaning of this term was similar to the concept in the west around early twentieth century (Trigger 1989:161-167). The term "culture" was called "unit" in Willey and Phillips' argument (Willey and Philips 1958:12). In western archaeology, "culture" is used to name a group of archaeological discoveries with similarities in all aspects from a certain period and region, such as artefacts and settlement patterns and all other evidence indicating human activities in this period and region. These similarities may indicate the identity of a specific group of ancient people in historical and anthropological perspective (Willey and Philips 1958:14).

This meaning of "culture" used in Chinese archaeology, particularly in research practice, has been changed since the late 1950s. Xia, Nai (1959), who was one of the most influential archaeologists in Chinese archaeology, has promoted his criterion of "culture" in archaeological study in China. In his criterion, an archaeological "culture" means a group of similar archaeological remains found in several sites, including artefacts, house, storage, burial and all traces marked by human activities. These remains are usually with distinguishing characters to others and associated together in deposit (Xia, Nai 1959). This criterion should represent the current definition of "culture" used in Chinese archaeology. Literally, this criterion is not substantially different from the west. However, in Chinese prehistoric archaeology, particularly in the period when pottery is the basic artefact in archaeological remains, the content of "culture" is mainly based on pottery only. Zhang, Zhongpei (1990) has also discussed the term archaeological culture. He suggested that apart from some remains without ceramic products, such as in the Palaeolithic, distinguishing different cultures should be basically by referring to difference of pottery complexes in Chinese prehistoric archaeology.

This highlighting the function of pottery in identifying archaeological cultures in theoretical discussion has led to an overemphasis of pottery function in the definition of archaeological culture in general research practice. For example, Li, Xuelai (1998) has studied the Baijinbao culture, but in his entire article, he discussed merely the pottery of Baijinbao culture. Only using pottery to analyse cultural content sometimes is due to the absence of other evidence such as settlement pattern, burials, faunal and floral remains, etc. but in this situation it is necessary to further explain why one is using pottery only instead of the complete content of "culture". But it seems that no one even attempts to explain why and everyone seems to agree with this pottery definition of culture. This is one of the problems in Chinese archaeology.

In this thesis, I am using term “culture” as well but with the content containing all aspects of archaeological discoveries. I have mentioned this content earlier in this section (Willey and Phillips 1958:14). In my study, I attempt to cover as complete a cultural content as possible. Despite sometimes having to mainly use pottery to illustrate cultural characters, it does not mean that I intentionally define culture based on pottery only. In this situation, I have no alternatives because the documents quoted in my study are usually based on pottery only.

In relation to the term “culture”, to technically name a culture in Chinese archaeology is not based on the earliest deposit in a site. It usually refers to the one deposit with abundant discoveries of artefacts. If a site contains several cultures in different levels each culture will be named by the number of these levels or “phases”, such as the culture of level I (or phase I), and level II. Here, the term “phase” in Chinese archaeology can be used for different periods within one culture, or used for different cultures within one site. Phase I culture is the earliest one in this site. Some times there has several groups of culture within a level, such as Phase (period) I-1 (the first group of period I). Phase I-1 should be the earliest culture in this site. All these names such as Phase I or Phase I-1 are given by archaeologists who carried out excavations. Because of this particular Chinese method to name a culture, sometimes one culture appears to have several names. One name comes from one cultural site and another comes from multi-cultural sites. For example, the Xingcheng culture was found in Xingcheng, Jilin province, and it is also called the Upper Yinggeling (or Yinggeling Phase II) cultures because this culture was also found in second level of the Yinggeling site in Heilongjiang province. Here, regionalism in each province also affects the name of a culture (Falkenhausen 1995). Such as the example above, local archaeologists may use the name of the culture only derived from their provinces, in Heilongjiang called Upper Yinggeling (Yinggeling Phase II) and called Xingcheng in Jilin. In this thesis I will follow the Chinese names of each culture, regardless the difference between the western and Chinese because they have already been used in Chinese and English literatures, particularly in English literature written by Chinese archaeologists.

2.2.2.2 Cultural system – larger group of cultures

Extending from the term "culture", another term, "cultural system" is also used in Chinese archaeology. This term is similar to the combination of "tradition" and "horizon" in American archaeology (Willey and Phillips 1958:31-34). In Chinese archaeology, one "cultural system" includes serial "cultures" and they are connected spatially and temporally to each other. Among these cultures, one should be the major ancestor to another.

Similarly to the term "culture", in Chinese archaeology the criterion of "cultural system" is also based on pottery. Therefore, analysing a cultural system usually is a kind of typological discussion about pottery. For example, the Dawenkou – Longshan system in Shandong province, China, is mainly based on the comparison of pottery between the Dawenkou and Longshan cultures and the Dawenkou culture is ascribed to the ancestor of the Longshan culture (Shandong Kaogusuo 1997). However, in this thesis I will use the term "cultural system" with the same meaning that is in Chinese archaeology but based on a broader content of "culture" as discussed in the previous section.

2.2.2.3 "*Leixing*" (Variant) – subgroup within a culture

Still based on pottery, Chinese archaeologists use the term variant to define smaller groups within a "culture". This term seems similar to the term "locality" defined by Willey and Phillips (1958:18), but is still not the same. In Chinese archaeology, one culture may include many sub groups "Variant" and these sub groups usually are local developments within one archaeological culture. For example, the "Yangshao culture" is named based on the discovery of the Yangshao site. But the "Yangshao culture" includes many different subgroups found in north China, such as the Banpo, Miaodigou, Dahecun and Hougang (Zhang, Zhongpei 1990; Zhang, Zhongpei et al. 1992). People call these subgroups "*Leixing*" (Variant) in Chinese archaeology.

Based on different understandings of the criteria of "culture" and subgroup "Variant", some archaeologists even name these subgroups within the culture separately instead of the large "Yangshao culture" (Zhang, Zhongpei 1990). Referring to my term “culture” in this thesis, they very likely belong to different cultures and should be named as Banpo, Miaodigou, Dahecun and Hougang cultures respectively. Lin has argued about meaning of “Variant” and suggested using the term “Variant” in the initial period of recognition of a “culture”. When knowledge about this culture is accumulated along with further archaeological discoveries, this “Variant” should become a “culture” (Lin 1989: 1985). So the understanding of the term “Variant” and using it for different persons is not the same. In this thesis I will follow Lin’s argument using term “culture” to instead the ambiguous term “Variant”. And if there are some subgroups within a culture I will use the term “subgroup” to describe them.

Apart from the content of three terms, some misuse of these terms should also be noticed. One of the misuses is that different “cultures” named in Chinese documents may represent only a single “culture” and these different “cultures” are in fact the difference between different sites within one culture. As I discussed earlier, the remains found in the Chahai site should belong to the “Xinglongwa” culture but the reporter overemphasised the differences between potteries found in the Chahai and Xinglongwa sites and unnecessarily divided them into two “cultures”. However, while the reporter may understand that these two “cultures” need to be merged into one, because these two sites are located in the two different administrative regions, Xinglongwa in Inner Mongolia and Chahai in the Liaoning province, local archaeologists usually exaggerate the differences between remains found in two different sites and persist separating them into two cultures with different names. This regionalist behaviour has led to a bewildered and confused situation for both Chinese and western archaeologists (Falkenhausen 1995).

In summary, term “culture”, “cultural system” and subgroup will be used in this thesis and the definition of these terms is not dependent on only the pottery, but is based on the general criteria of “culture” as used in western archaeology, which considers all aspects of archaeological remains including pottery and other artefacts, house and storage remains and all traces marked by human activities, as well as the evidence of fauna and flora indicating human adaptation to the environment.

2.2.3 Structural problems affecting fieldwork

Another difficulty in Chinese archaeology is the separation between Palaeolithic and Neolithic research. Palaeolithic archaeology in China has been separated from the Archaeological Institute of the Chinese Academy of Social Science. Palaeolithic study is seen as a natural science and usually carried out by the Institute of Palaeo-vertebrate and Palaeo-anthropology in the Chinese Academy of Science. This arrangement has some positive outcomes such as making it easier for Pleistocene archaeologists to establish their research projects since these are based in the natural science like geology, geography and physical anthropology. Also landscape and environmental issues are always naturally involved in their studies, which is similar to the West. For instance, in the excavation in the Xianrendong site in Jilin (Jiang 1996), animal bones and pollens have been carefully collected and studied.

The negative output of this arrangement, however, is also critical because the two groups of scholars work only on their own interests, one with Palaeolithic period and the other with the period thereafter. For example, during the excavation of the Gezidong site (northeast China), the last (highest) horizon comprised artefacts indicating several periods of human activities (Sun, Shoudao 1996:146). But the deposit after the Palaeolithic period was neglected because it was out of their research interests and expertise. The excavator of this site simply dug this Holocene deposit up and then abandoned these levels. Another example, in the Xianrendong site in Jilin, the Holocene deposit was not carefully excavated because the excavator’s attention was on the Palaeolithic deposit (Jiang, Peng 1996:205). This research behaviour has left many incomplete field reports in Chinese publications. These incomplete reports have formed a gap of missing data in the archaeological sequence, which has become a critical problem in transition research in China.

2.3 TRANSITION RESEARCH IN THE WEST

In general understanding, three basic conditions: ecology, technology and motivation have led to transition to farming. There are many different explanations of why this transition to farming occurred. Lu (1999) has summarised these explanations into three main reasons: alteration of ecology, pressure of population, and evolution with natural selection. Many researchers persist in supporting one of the three explanations and arguing against the others. Actually, these three explanations all reflect the motivation of adopting agriculture from different perspectives. That is why Lu has noted that a single explanation seems to be oversimplified when attempting to address such a worldwide issue (Lu 1999:2).

Price et al. (1995:5-6) have pointed out that the transition process of foraging to farming is a “global phenomenon [which] requires a general explanation” and the general explanation should be “plausible, simple, causal, verifiable and global”. In reflecting on this suggestion, there are thirty-seven different explanations for prehistoric foragers adopting agriculture listed in the paper presented by Price and Gebauer (1992). In general, it is possible to say that there are various reasons leading to the transition, and the causality of this transition should be generated from the complex backgrounds in different regions of the world. Without regional studies, any hypotheses involving universal models or explanations are premature.

In considering the basic reason for the transition to farming, the survival of human societies would have to be the major purpose. Here the survival of a society in requirement of food production should have different contents for different societies. For instance, an early period of egalitarian society may only require the daily food supply for keeping each individual alive or with very limit social, ritual activities. But for a relative complex society, it may require not only the food for each individual physical alive but also more demands from frequent ritual and social activities, together with the requirement for supporting special craft persons and numbers of labours working on monumental constructions.

Ecological changes may reduce basic food supply for keeping each individual person alive in society and become the time of stress, which would force this society to change the way of food procurement. For a complex society, this change also reduces the resources or food surplus, which is necessary for keeping this complex society alive. Such changes may also force this society change economic strategies to search for new resource and become partially or wholly adaptation in agricultural economy. However, whether to adopt agriculture is finally decided by human society, by the motivation of the community. This motivation may vary in different circumstances, therefore the reason for transition to agriculture should also be various in different regions.

Thus the attempt to search for universal models and explanations should be based on regional studies. Independent regional studies are critical rather than searching for universal models and explanations. Without serious regional investigations, the universal model or the general explanation presented above will be merely a hypothesis that has not been tested by archaeological fieldwork.

In the regional studies, the study of the process is the priority in the research of transition to farming. There are several different hypothetical models about the process of transition to farming. For example, the “wave of advance” model illustrates the process of farming expansion from west Asia to Europe (e.g. Ammerman et al. 1971). This model describes a form in which advantageous genes spread out among human groups (Ammerman et al. 1973: 347). In this model, prehistoric agriculture is seen as the “advantageous gene” in human societies, which could propagate into other societies in other areas through a “wave of advance”. However, farming economy may not be superior to others, such as hunting, fishing and gathering in different circumstances and different historical background. Presumably, if hunting, fishing and gathering economy had met the social needs, including the needs other than subsistence such as ritual and social activities, a society would not have to take a risk to change the traditional economy.

Based on the study of agricultural expansion from Southeast Asia to Pacific islands, Bellwood (2002) has argued that this expansion would have to involve farmer migration to the new area (Bellwood 2002). Agricultural expansion due to migration of farmers may appropriate for the situation in one region, such as Austronesia, but may not applied for others because to ascribe the farming expansion to human migration requires the physiological evidence such as the study in skeletal morphology or even DNA research. In the DNA studies in south Europe showing the agricultural expansion possibly involved no farmers migration but through a cultural interaction (Renfrew 2002). Based on this DNA study, Renfrew proposed “the staged population interaction wave of advance model” (the SPIWA model) to modified “wave of advance” model that I discussed earlier. The SPIWA model means “cultural diffusion would be see the innovation of farming as being passed from one group to the next without subsequent movement of farming population". So farming expansion involved movement of farming population may applied to some regions such as west Europe and Austronesia but may not applied to south Europe (Renfrew 2002). Therefore, regional study of transition to farming is significant prior to any generalised theoretical models.

Among regional investigations, Zvelebil and Rowley-Conwy (1984) have proposed an "availability model" to approach the transition process of agricultural expansion in north Europe based on the increase in farming economy in hunting/gathering society. As stated in the previous Chapter, they suggested there were three phases in the transition process from the archaeological discoveries in the Baltic area, the availability, substitution and consolidation phase, called the ZRC model in this thesis. Because of the DNA and other updated studies such as residue and dietary analysis are still rare in northeast China, so the farmer migration cannot be identified in this region. I will focus on the change in farming economy through time to close look the process of transition to farming in northeast China. The ZRC model based on the observation of increase in farming economy will be applied to this new area, northeast China, through the investigations of regional archaeological discoveries.

2.4 TRANSITION RESEARCH IN CHINA

Considering the shortcomings in the past Chinese archaeology before the late 1990s, the study of the transition to farming in Mainland China has remained a developing period. Only scattered fieldwork has made specific studies such as domestic crop recovery uncommon in most local fieldwork. The actual research level particularly in the local institutions is less developed than in the West, as shown, for example, by the journal *Agricultural Archaeology* starting only in 1985. Some discussions in relation to the origins of Chinese agriculture in this journal usually reveal nothing further than speculation.

Lu, T. L. (1999) is the first Chinese archaeologist using western methodology, such as using the results from environmental studies and the evidence of crops remains to study the transition to farming in China. She has systematically analysed the transition process in relation to both millet and rice agriculture in China. Based on her studies of Chinese agricultural origins, she suggested that agricultural origins in the world were connected to the worldwide Holocene environmental change. This change has made a significant impact on human societies, such as decrease of natural resources, increase of population and decline of wild food diversity. She also quotes the ancient Chinese documents to support her opinion (Lu, T. L. 1999:139). Her analysis seems more discussions in external factors rather than considering both internal and external factors in resulting transition to farming. However, her study in the transition to agriculture is one of the most reliable, systematic, complete and plausible discussions in transition research among Chinese scholars.

Another publication is the book *Agricultural Archaeology* (Chen, Wenhua 1989). Chen describes the origins of Chinese agriculture in a model of three stages, the imitation stage first, slash and burn second, and "*Si* " plough agriculture last. Specific artefacts in the archaeological complexes are described as an indication of each stage in his study. Similar opinion has been repeated in several of his articles (Chen 1989, 1981). I consider his research as a typical transition study in China because his studies mainly based on written records and some archaeological data without elaborated systematic analysis using updated technologies and methods such as flotation method and residue analysis. Chen's model relates to a process of tool development used for farming activities, which is important for my tool analysis (in Chapter 3) in this thesis. It is therefore necessary to discuss some details of Chen's model.

2.4.1 Imitation stage

It is reasonable to presume that the beginning of plant domestication is from occasionally imitating the natural process of wild plant growing within prehistoric societies. Based on this assumption, Chen suggested that the first stage of transition to farming is the imitation stage. People saw wild plants growing through every season, dropping the seeds on the ground and then germinating, growing and bearing the seeds ready for next seasonal circulation. Simply copying the process of wild plant growing would have led to the accumulation of knowledge and techniques in relation to plant cultivation. This stage is the period that prehistoric societies learn the knowledge and skill of cultivation, which resulted in technological preparation for the transition to farming. However, in his discussion, an individual curiosity becomes the major explanation for the beginning of plant domestication. Such explanation may be too simplistic without ethnic references and the evidence of botanic analysis in the fieldwork.

Chen has assumed that tools possibly invented in this stage should relate to the activities of simply sowing and collecting, such as a digging tool (Figure 2-1) and knife. It is possible that there were some digging tools made of soft material such as wood or bamboo for making holes on ground in order to sow seeds in the soil. These soft material tools would not be preserved till today except in some particular environments such as peat bog on wetland or in an extremely dry climate like desert. It is difficult to find this kind of tool archaeologically so that it is difficult to identify this stage of cultivation in the field through digging tools alone.

I consider that one modern example, plant cultivation among Aboriginal Australians before European arrival, may be similar to this stage. There was no fully developed agriculture (Smith 1985). Aboriginal Australians developed grindstones and top stones as well as simple wooden stakes for digging (Smith 1988). An archaeological example may be the Xiachuan site in China. In this site, although there is no evidence such as domestic crops showing actual plant cultivation, since no floatation or residue analysis have been carried out, some grindstones and top stones were found in the upper phase, which has a similar tool complex to aboriginal Australian before contact with European. Carbon dating indicates the period was from 24,000BP to 16,000BP that is late Upper Pleistocene. Archaeologist has also assigned this site to the imitation stage based on some discoveries of stone tools assumed to be for gathering (Shi, Xingbang 2000). However, this assumption needs to be clarified by a further investigation.

2.4.2 Slash and Burn Stage

To slash down trees and burn them before planting is the second stage in Chen's model. Fire would reduce the grass or weeds overgrowing in the next planting season and the ashes could fertilise the soil. In western research, Rowley-Conwy (1981) has failed to find this type of agriculture in prehistoric temperate Europe, where there is little evidence that would indicate it, such as rapid increase in ashes and charcoal showing reduction of forest. However, some documents from Qing Dynasty (AD1644-1911) recorded that the ethnic group "*Dulong*", who lived in Yunnan province used the slash and burn for farming activity in local agriculture (Chen 1989:335-336). Similar records describing this practice in different ethnic groups are also found in Chinese literature of the Qing Dynasty.

Unlike Rowley-Conwy, Chen did not look for the evidence of slash and burn cultivation in the field, but he presumed that in this stage the tools developed were particularly for wood chopping or cutting such as stone-axe or stone-adze. However, even though large number of wood cutting tools have been discovered in many sites in China, it is difficult to identify them with "slash and burn" farming. There is no analysis of charcoal deposits in any site, making it difficult to find this stage of cultivation. If merely relying on the discovery of tool kits and without data on the accumulation of charcoal and ash, identifying whether slash and burn cultivation activity occurred is impossible. In addition, slash and burn cultivation may not be a necessary stage in the transition process in every region. It may be a particular environmental adaptation in some areas.

2.4.3 "*Si*" tilling agriculture

The "*Si*" in modern Chinese writing is " 耜"or "耒" which means a hand holding the handle of digging tool. This digging tool in modern Chinese writing is a slightly improved version from the original form of a simple wood stake, because of a crosspiece of wood fixed on the digging end. When people start digging, they could put more force on the stake by pushing on the crosspiece with a foot (Figure2-1, 2-2). Chen has argued that the "*Si*" was used for agriculture as a plough during Shang dynasty due to the ancient Chinese writing "*Si*" being discovered in the records of the Shang Dynasty (16th-11th Century BC) (Figure 2-2). However, the writing "*Si*" looks more like a digging tool in the imitation stage than a plough. Chen believes that the plough was possibly originated from a digging tool, and once a pulling rope was applied to it for making furrows in cultivated field, the digging tool became a plough. In Chen's theory, the "*Si*" is an initial form of plough compared to the mature plough described with a new writing " *Li* (犁)" after 800BC. "*Li*" describes a mature plough with a cow “牛” in it, because the plough was pulled by a domestic cow or horse. When the initial plough “*Si*” was invented before the Shang Dynasty, the writing still kept the old form like a digging tool.

Chen indicates that the beginning of the “*Si*” tilling agriculture has been recognised as early as 6000BC at sites such as Hemudu, Cishan and Peiligang in China (Figure 2-4). He has identified many tools as “*Si*” in these sites (Figure 2-3). He believes that these sites belong to the “*Si*” tilling agriculture not only because of the discovery of the tool “*Si*” but also the finding of remains of domestic crops, rice and millet unearthed during the excavations, showing the prehistoric agricultural economies.

Chen presumed that tools used in this stage were not only the “*Si*” but also the tools already used during the last two stages, such as the knife or sickle for harvesting, grindstone and top stone for processing. However, there is a lack of analysis of tool wear in China, which is needed in order to identify the tools that were used for agriculture. Due to the increase in production, sufficient and well-constructed storage for preserving food in this period should be revealed in the archaeological record. For instance, in the Cishan site, eighty-eight pit storages were found and most contained millet (domesticated foxtail) remains. The total capacity of the storages was around fifty tonnes of millet (Chen, Wenhua 1989).

Chen’s model may not appropriately describe the process of agricultural transition in the Yangtze and Yellow River areas because it mainly depends on the assumed toolkits of planting and seems less reliable if we considering unreliability of identifying tool function without usewear and residue analysis. However, changes in tool complexes may indicate the different stages of transition to farming if tool function is derived from the result of usewear analysis.

Apart from Chen’s model, some studies of agricultural origins in China are also influential, such as An, Zhimin (1988), Shi, Xingbang (2000, 1992) and Yan, Wenming (2000a, b; 1992). An, Zhimin (1988) suggested that in China, at least has two major centres of agricultural origins, the Mid and Lower Yangtze River area for rice, and the Yellow River for millet, which certainly need further investigation.

Yan's study of rice agriculture in China is based on new discoveries. He specifies that there are two areas of rice origin, the middle Yangtze River in China, with a possible date as early as 12000BC, and India (Yan, Wenming 2000a: 3). His opinion is similar to the "marginal theory" argued by Price et al. (1995: 7) that the origin of agriculture is usually located at a marginal zone where the environment changed from one of abundant food resources to a relatively poor area. He says that both in China and India the origin of rice agriculture was located at the northern periphery of wild rice distribution, because during the Upper Pleistocene glaciation in these regions the winter is longer than in the south, so the prehistoric people there needed to keep more food for passing the long winter, and the supply of wild rice from limited growing area was far from enough to meet daily needs. This situation has resulted in agriculture moving towards north (Yan, Wenming 2000a:9).

Similarly to Yan, Wenming's interpretation, the Japanese archaeologist Yoshinori has compared western Asia and China, and attributed the emergence of agriculture to food shortages during the Late Pleistocene when climate change resulted in the extinction of mammoths in these areas. This directly affected hunting efficiency and forced prehistoric society to search for alternative ways of food procurement (Yoshinori 2000:23). Both Yan and Yoshinori are trying to explain the motivations of ancient communities in adopting a farming economy. But their arguments are still speculation. For example, merely based on limited environmental studies, Yoshinori has suggested that, the same as western Asia, rice origins in China was in a boundary of forest and grassland. This suggestion has simply used rice agriculture to represent entire agricultural origins, which at least ignores the origin of millet agriculture in the north. If we consider the millet agricultural origins in China, his suggestions have to be changed (Yoshinori 2000:25, Figure 6). His simple environmental studies in such large area are necessary to be restudied. For the study of agricultural origins in eastern Asia requires numbers of studies in each small region with accumulated evidence of flora and fauna.

Yan, Wenming (1992) has also suggested that agriculture become a social activity only when the society realises the necessity of crops and storability was important not only in the process of selecting plant cultivation. This storability may also responsible for the agricultural transition because the lack of plant food supply during the winter (Yan, Wenming 1992:123). These assumptions are reasonable in the individual causality of agriculture but less convinced if from the perspective of society level as a whole, which should answer why a society have to choose farming economy if the resource was relatively sufficient, such as rice agriculture in the Middle and Lower Yangtze River areas.

Shi, Xingbang (1992), similarly to Yan, Wenming's point, has ascribed the process of transition to farming in north China to the long period of productive theory rather than any necessity of socio-political needs. However, a long term plantation or cultivation is not necessary to subsequently result in agricultural transition, such as Jomon in Japan, local plant cultivation for food has a long time before the rice agriculture arrived but it never became agricultural production (Imamura 1996).

As a common understanding, the "slash and burn" is another word for the "shifting" agriculture, which may due to the avoidance of degeneration of crops (Fogg 1983). However, Chinese archaeologists believe that the terms of "slash and burn" is different to shifting agriculture in farming activities. An, Zhimin (1988) argued that shifting agriculture occurred in the north, the Yellow River area and slash and burn in the south, the Yangtze River area. He explained that because north China is grassland, prehistoric agriculture was likely to be shifting moving to new fields after a few years in the same field, while forested southern China might use the slash and burn method (An, Zhimin 1988:378). Similarly, Shi, Xingbang (2000:25) has indicated that the Yellow River prehistoric agriculture was a "shifting" or "slash and burn" cultivation. In fact, the argument of both An and Shi did not answer what exact shifting or slash and burn is, because slash and burn method sometimes is used in grassland agriculture as well in north China. This explanation of "slash and burn" method reflects a misuse of the term in Chinese archaeology.

2.5 TRANSITION RESEARCH IN NORTHEAST CHINA

In relation to this thesis, I am going to review more about the current studies of transition to farming in northeast China, including the studies carried out by both

Chinese and western archaeologists. The term "Neolithic" used in Chinese archaeology and related to transition research need to be discussed as well.

2.5.1 Current research and viewpoints

Crawford is the first archaeologist to search for evidence of domestic crops in northeast China as part of research into the transition to farming. Based on his experience in research in East Asian archaeology, he argued that East Asia urgently requires a large archaeological database on plant husbandry (Crawford 1992:31). He has also suggested that in northeast China, research on the Holocene environment, such as rainfall, temperature and level of moisture, is needed to study the beginning of agriculture. He has pointed out the beginning of agriculture in northern China is similar to the Near East. The environment changed ten thousand years ago with a decrease of rainfall, an increase in evaporation and retreat of the forest. The beginning of agriculture in the Near East "may serve as valuable hypotheses to be exemplified in north China." (Crawford 1992:29). Shelach (2000:364) has re-categorised the area of "north China" to a larger area. In his definition, north China not only includes central China, but also the Qinghai and Gansu provinces in the northwest, Inner Mongolia in the northern centre and northeast China in the northeast (Figure 2-5). These regions share some common features in relation to the Holocene environment, such as a decreasing rainfall and vegetation from the southeast region (northeast China) to the northwest (Crawford 1992, 10). This large area across the northern China tends to be an arid or semi-arid environment with desert (zone 5 in Figure 2-5) or semidesert and steppe (zone 3 in Figure 2.5), grasslands with forests in northeast China (zone 1, 2, 4 in Figure 2.5). These suggestions should become the significant references prior to the research of transition to agriculture in northeast China.

There is no specific study of the transition to farming in northeast China. Some suggestions in relation to agriculture in this region need to be noticed. Nelson (1995:251) has suggested that northeast China is possibly the place for early agriculture discoveries, because she believes that in the past, northeast China provided sufficient environmental conditions for agriculture. Similarly to this, Shelach (2000:380) also suggested that the millet was possibly "cultivated or even domesticated in northeast China" and it is very likely that "some components of the agricultural system of north China were domesticated first in the northeast". If their suggestions were correct, northeast China would become another area of agricultural origin apart from north China. This, however, needs to be clarified in further studies. It is possible that some crops might be domesticated first then cultivated in a limited amount in northeast China, as Shelach (2000:380) suggested, but full development of agriculture in the form of a large quantity of crop farming did not emerge in the early period around 8-7000BP in northeast China as we see by referring to the small amount of crop discoveries in the early period. Based on faunal and floral remains, Li, Xinwei (2003) has pointed out that hunting and gathering should be the major food supply during the Xinglongwa and Zhaobaogou period. Referring to these opinions, further study focusing on evidence of plant domestication and full investigation of economic styles is necessary, otherwise, research into the transition to farming in northeast China will remain unclear.

2.5.2 The Issue of "Neolithic"

As is typical of Chinese archaeology, archaeologists in northeast China define Neolithic assemblages and an agricultural economy based simply on discoveries of polished stone tools and ceramics without any evidence of domestic plants (Nelson 1995). This misuse of terminology is quite common in transition research in northeast China. For instance, in the eastern area of northeast China, pottery was unearthed at the Xinkailiu site dated to about 6000BP. At this site, a large number of excavated storage pits were found. There are several levels of fish bones arranged at the bottom of the storage pits. No domestic plants were reported. The excavator pointed out that Xinkailiu is an undoubted Neolithic site because it contains pottery and polished stone tools (Heilongjiang Kaogudui 1979).

It may not be a problem that the term "Neolithic" simply indicates the presence of pottery in some regions such as central and north China, because ceramics emerged there almost at the same time as, or earlier than domestic crops, such as the Xianrendong site (Zhang, Chi 2000), even though this domestication did not meet the full meaning of agriculture. However, the term "Neolithic" becomes problematic once it applies to northeast China since the adoption of plant domestication in this region is later than the beginning of ceramics at about 8000 BP e.g. the Xinle site (Shenyang Administration 1985).

Some areas in northeast China have no Neolithic period according to the economic criteria of Neolithic. Dealing with this situation, a new term the “hunting-fishing Neolithic” has been suggested in Chinese archaeology (Zhang, Zhongpei 1997:10) referring to the dilemma of using “Neolithic” for foraging societies with pottery and polish stone tools but no farming economy. Presumably, equivalent to the “hunting-fishing Neolithic” for foraging, the term “agricultural Neolithic” for farming and “pastoral Neolithic” for herding would be used if people insist on using the old terminology of “Neolithic” without considering the conventional criteria of it. However, this new concept may not be easily accepted either by Chinese or Western archaeologists. The reason for non-acceptance is the lack of explanation as to why such a change should be made and what the basic context of the new term is. Therefore, this new term has made little improvement in transition research in northeast China.

2.6 SUMMARY

The study of the transition from foraging to farming has involved a wide range of disciplines. This subject requires archaeologists to study from different perspectives. The three elements, ecology, technology and motivation, reflect the basic conditions that are required by the transition to farming in prehistoric societies. Different preferences of research interest, such as emphasising one condition over another, have resulted in different viewpoints in the past. For instance, different regional backgrounds and various preferences of research interest intensify this differentiation in the outcome of research such as in Chen’s study. The past conservative method and theory continuing practise in some local Chinese archaeology and the three features of over-emphasis in Chinese stratigraphy and typology have reduced the reliability of transition research in China. Neither Chen’s model nor Yan and Yoshinori’s explanation cannot compare to Lu’s systematic study. Because the former seems more speculation rather than systematic studies. In northeast China, transition research has just begun and is hypothetical rather than archaeologically based.

CHAPTER 3. RESEARCH METHODOLOGY

3.1 INTRODUCTION

The major task of my study is to use the model-testing method and also consider all the aspects of ecology, technology and motivation in a regional perspective on the transition to farming. To achieve this task, in this Chapter, I will explain how to develop my methodological framework.

In section 2, I will state my methodological framework developed in this study. The framework is comprised of evidence of domesticates, the result of tool statistics, environmental conditions and all archaeological discoveries such as shelter and storage construction, and ceramic production. The process of tool categorising and generating a tool complex diagram will be explained in section 3. Section 4 is about how to interpret the result of tool statistics and followed by the implication of statistics in section 5. In section 6, a baseline of tool complexes reflecting the process of transition to farming will be established based mainly on the archaeological data from north and China. Section 7 is a short summary.

3.2 DEVELOPING A METHODOLOGICAL FRAMEWORK

As Zvelebil (1998) indicated, the percentage of wild or domestic fauna and flora in the archaeological remains will reflect the style of economy if the calculation is based on a regional scale analysis. However, he did not show how to establish a regional scale. One of the examples of study in prehistoric economy is the research of the late Jomon economy in northern Japan by Crawford (1995), which involved many results of the studies of fauna and flora. But this study is based on a long period of study involving many disciplines, which is not usually what has happened in all archaeological areas. In northeast China, multi-disciplinary research is just beginning and less development than the studies in Japan. Most archaeological publications are generated from past fieldworks before the late 1990s. It is difficult to find data referring to the faunal and floral remains in archaeological reports. It is also difficult to determine the percentage of domestic remains because of the lack of this study as discussed in Chapter 2. Certainly, reliable statistics must be derived from the correct calculation of faunal and floral remains. But it is difficult to achieve this even under the best conditions. There are greater problems in such an analysis in northeast China because of the poor natural conditions of preservation, the uninformed attitude of excavators and the lack of recovery skills in local archaeological studies.

Although working with limited data, archaeological study is always attempting to obtain maximum information from it and methodological framework is crucial under this circumstances. In northeast China, because the lack of updated study method in local archaeology, the data collected from field usually contain little faunal and floral information. However, if we consider a methodological framework involving all possible aspects, such as the evidence of domesticates, the level of technology related to farming economies, tool complexes analysis together with the environmental background, an outline of the transition to farming in northeast China can be drawn.

In this framework, a crucial part is to collect the evidence of domestic crops and animals from previous research. These are the basic data of my research because no matter how much the percentage of economy is, it clearly suggests that some uses of domesticates have occurred. As part of this, some of my fieldwork aimed to investigate if there were domestic seeds in some selected sites. These sites are directly linked to periods suspected to be part of transition process.

There is almost no reliable information related to domestic animals in the period before 4000 years BP in northeast China. Only a few data about domestic crops found in northeast China can be collected from field reports in Chinese publications. Because of the conventional method of excavation, with less interest in the recovery of faunal and floral remains and a lack of recovery skills, very few soil samples are taken or analysed during excavations. Consequently, the chance to discover domestic crops occurs only when a relatively large concentration of crops is preserved in deposits.

I should explain how domestic crops, which are quoted in this thesis, are identified in archaeological studies of northeast China. Usually, archaeologists report seed discoveries in the field excavation report. Plant seeds found during excavation are normally identified by some specialists working in botanic or agricultural areas. The identification report is rarely attached to the field report. So readers only follow what the excavators publish. For example, during the second excavation of the Xinle site in northeast China, plant seeds were unearthed. Some specialists from Liaoning Agricultural Academy identified that these seeds are broomcorn millet. There is no identification report except a few words of description of the seeds written by excavators, such as the size of the seeds vary from 0.15-0.2 cm (Shenyang Administration 1978:221). However, this discovery and similar seed discoveries in other sites have been widely quoted by Chinese archaeologists (e.g. Shi, Xingbang 2000:32; An, Zhimin 1988:373; Yan, Wenming 2000b).

I also need to explain how these seeds are dated because almost none of the dates are derived from directly dating the seeds. For instance, one of the earliest domestic seeds in northeast China were found in the Xinle site (Shenyang Administration 1985). The date for these seeds is a C14 date (6620±150) on charcoal recovered from the same house with the seeds. Again, these dates are widely quoted by archaeologists in China (e.g. Shi, Xingbang 2000:32; An, Zhimin 1988:373; Yan, Wenming 2000b). In this thesis I still quote these dates but with calibration using Intcal98, because they are the only available chronological data for domestic seeds in northeast China. Such as the date of 6620±150, after calibration is 5666-5468BC or 7417-7615BP (with 68.3% probability) (Stuiver, M. et al. 1998a; 1998b). This calibration method has been applied to all C14 dates in this thesis.

The second part of my framework is using the level of technology reflected by archaeological discoveries to ascertain the level of economy. This comparison will help me to exemplify the economic style. For instance, in the Xianrendong site in south China, about 11000 BP, archaeologists found a cave deposit with one of the earliest examples of ceramic and domestic rice remains (Jiangxi Administration 1963; Zhang 2000). Domesticates were discovered from the Banpo site around 6000BP in north China as well. Even though both sites have domesticates, the material complexes reflected different levels of technology. The lower level of technology is in the Xianrendong site, which features a cave shelter and initial ceramic production. This is compared to Banpo which has well-constructed houses, storages, village settlements, and a wide range of well-made ceramic products (Chinese Academy 1963). On the basic of a comparison of technology only, archaeologists would assume that the Xianrendong site reflects an incipient agriculture compared to the Banpo with a predominant farming economy.

The third part of my framework is tool analysis. As a particular indicator of technology, a sequence of tool discoveries through time usually reveals a replacement process of human technology and reflects different economic activities. Foragers use tools for hunting, fishing and gathering and farmers have tools for crop cultivation. The social process of the transition from foraging to farming should have an impact on the tool making technology. In other words, a process of tool replacement or improvement in shape in relation to a particular function may reflect a socio-economic change such as the transition to farming. The alteration of tool complexes in the archaeological record may reflect the process of prehistoric economic transition.

For example, Lu, T. L. (2002:11) has studied the process of millet cultivation in the Yellow River Valley of north China by an actual experiment. She found that only few tools were needed for millet cultivation, such as an axe for land clearing, or even no axe if there were few trees, one flake (or reaping knife) for harvesting. She also suggested that grinding slabs and rollers are sufficient for grain processing. Her experiments not only indicated how simple were tools for millet cultivation and processing but also suggested a category of tools particularly for millet cultivation and processing: flake (reaping knife), axe (if necessary), slabs and rollers (should include grindstone). Somehow she did not mention about tools for digging and ploughing, which are necessary for millet or any plant cultivation. However, in Lu's experiment the amount of millet that these few tools could produce is not clear, which is significant in analysing the proportion of cultivation in the entire economy. Recent use-wear studies on the stone tools found in the Zhaobaogou site have shown that is possible to identify tool functions through microscopic analysis (Wang, Xiaoqing 2004, 2002). In addition, as I addressed in Chapter two, Chen, Wenhua (1989) has described three stages of transition to agriculture in China merely based on tools. Even though his tool categories were not based on use-wear analysis, his studies implicate a connection between the changes of tool technology and economy. Also Lu's experiments and Wang's use-wear studies, have suggested that economies were related to tool functions and, the change of tool complexes should reflect the change of economies.

To find the changes in tool complexes in a prehistoric society through archaeological discoveries in order to find the economic changes is the one of the basic methodologies in archaeological study. The particular feature of tool analysis in my framework is to turn this general methodology into an analytical tool, based on numeric counts.

My analysis of tools is to calculate the percentage of each tool in the tool complex. Each categorization of tool is based on its major function. Even though some tools may be multifunctional, being used for a wide range of purposes, most will have a basic purpose and function. For example, an arrowhead or spear point is mainly used for hunting and sometimes it might be used for fishing, fighting or even for killing domestic animals. However, it is mainly used for hunting. Except when used for human fighting in a battle, it is almost entirely used for catching animals. Harpoons might be similar to spears in their ancillary feature, but the major function is fishing. Net sinkers and fishhooks are used only for fishing. Knives and sickles may be used as a killing weapon for human fighting or animal hunting, but the major functions are used for plant collecting or harvesting. Therefore, in general terms, tools have their major functions and most other functions are usually related to their major functions. Arrowheads, for instance, are mainly for hunting but may extend to fishing, and the extended function of fishing is related to the major function of hunting. This tool analysis based on the major function will provide a diagrammatic model describing different economies, which is important in my framework for studying the economic transition from foraging to farming. This particular method of tool analysis developed in my research will be explained in detail in the next section.

The last part of my framework is the environmental background, which is a necessary condition for the study of any transition to farming. Firstly, the environmental background is a key issue to answer the question of whether natural resources are sufficient for adopting farming economy. Secondly, a farming economy may not be adopted even when there are sufficient resources, because subsistence is supplied sufficiently from the wild rather than domesticates, or the societies do not intention to change their economic strategies in adopting agricultural economy. Without the environmental background these two parameters cannot be counted and the process of the transition to farming will be unclear.

The results of tool analysis together with the evidence of domesticates and the level of technology other than tools will provide some measures to analyse socio-economic change under a specific environmental background. This socio-economic change will form a regional model of the transition to farming in northeast China. This process, from tool analysis to the regional model of transition to farming, is the methodological framework in my study. I note that even though this method may not be the best way to proceed compared to a study based on relatively complete evidence of fauna and flora, such as the study of Crawford (1995), it is a method applicable for most archaeological regions with limited evidence of fauna and flora such as in northeast China. In the late Chapters of each case study, this framework will be appear with the order as environmental reconstruction first, followed with the summary of archaeological chronology, then tool complexes analysis and archaeological discoveries other than tools, finally the economic types and the pattern of transition to farming.

3.3 THE PROCESS OF TOOL ANALYSIS

There are two steps involved in the process of tool analysis in this thesis: categorising tools by major functions and calculating the percentage of each category of tools.

3.3.1 Categorising tools by possible functions

In order to correctly classify the major function of tools, two references are used in my study. First, I have consulted the categories of tool in studies of Jomon archaeology. Second, some sites discovered in China with foraging or farming economies are used as a direct reference for tool classification.

3.3.1.1 The Jomon studies

The method of categorising tool function in relation to economic activities has already been applied in past research in Jomon archaeology in Japan. Based on results of use wear, residue and botanic studies, Imamura (1996:101-103) has summarised several categories of tools in Jomon society. In his categorization, hunting tools include arrowheads, spearheads and some scrapers for skinning and butchering. He also categorizes tools related to plant gathering, including “coarse tanged scraper” possibly used as a reaping knife for collecting, “chipped stone axe” (spade) for digging in collect root food and top stone together with grindstone for processing (Figure 3-1). It is possible that these digging tools were used also for constructing purpose such as house or storage (Wang, Xiaoqing 2002), as I pointed out earlier, having multiple functions. In Jomon culture these digging tools may be one of the important gathering tools for root food collecting. Similar shape of these digging tools is also found in northeast China. Use-wear studies in the Zhaobaogou site have ensured they were used as digging tools (Wang 2002’ 2004). Although they may be used for house construction, used for collecting edible root like in the Jomon societies is also possible. Various fishing tools such as hooks, harpoons and net-sinkers described in his discussion indicate the fishing aspect of economy in Jomon societies (Imamura 1996:74-75) (Figure 3-2). Because most of his studies are based on the result of use wear and botanic analysis, the categories of tool function are quite reliable. Coming from a neighbouring area, these categories of tool function are significant for my research using tool analysis in northeast China.

Based on the analysis of tool functions and categories in Jomon society (Figure 3-1 & 3-2), I use four categories, hunting, fishing, woodcutting and gathering in my study. These four categories are related to the major activities of both foraging and farming economies. I have taken off “handiworking” (Craft working) in Imamura’s classification because of the unclear relationship with foraging or farming activities. Some processing tools in Jomon are related to plant food resource reflecting the plant food processing activities. In order to emphasise the plant food collecting and processing activity to distinguish them from hunting and fishing tools in the entire economy, I have added these “processing” tools into the gathering tools and used “gathering” to describe all. Woodcutting tools will be included in my study because they are not only indicating woodworks, such as timberworks required by house construction, and some wooden tools or objects, but may also relate to some farming practices such as slash and burn. After reorganising the classification of tools, there are only four types of tool in my category: hunting, fishing, gathering and woodcutting.

3.3.1.2 Data from specific sites in China

I have calculated 138 tool complexes in both north and northeast China based on the 74 sites, consisting more than 130 phases or deposit layers (Appendix 1). Three sites have been selected for discussion here. These are not only the examples for demonstrating my method but also representing farming and foraging dominant economies. One is the Xinkailiu site located in northeast China (Heilongjiang Kaogudui 1979), which reflects a typical foraging style of economy. The other two are the Banpo and Jiahu sites in central and north China. That farming economy was dominant in Banpo sites has been broadly accepted (Chinese Academy 1963). Domestic rice discovery indicates the farming economy existed in Jiahu society (Henan Wenyansuo 1999).

3.3.1.2.1 Xinkailiu site (foraging)

The Xinkailiu site has been assigned to a typical foraging economy due to a wide range of wild animals in a rather complete list of faunal remains (Table 3-1). Even though no domesticates have been discovered in this site, as I addressed in Chapter 2, it is still called Neolithic in the Chinese literature because of the discoveries of polished stone tools and pottery.

The tools unearthed in this site are have been fully reported. Comparing these tools to the Jomon discoveries in Figure 3-1 and 3-2, hunting and fishing tools in the Xinkailiu site are almost the same as the Jomon, including arrowheads, spearheads for hunting, and sinkers, harpoons and fishhooks for fishing. Only one grindstone and two digging tools represent gathering tools in the Xinkailiu site is, and they are also similar to those in the Jomon.

Four hundred and forty tools were reported from the Xinkailiu site. Most tool classifications in the report are similar to the Jomon. Some of the names are dubious such as some axes in the report might be used for digging soil when compared to the similar shape of tools in the Jomon study. I have classified one hundred and ninety six tools according to their major functions, hunting, fishing gathering and woodcutting. But the other two hundred and forty four, like scrapers, daggers, needles and awls, may be used for a wide range of tasks and are not counted for my study (Table 3-2). This method of tool clarification will be applied to all tools used in this thesis.

Hunting tools in the Xinkailiu site include arrowheads, spearheads and bolas and total one hundred and thirty six. Most arrowheads reported in the Xinkailiu site were made by pressure flaking methods and only several were polished. The lengths of arrowheads vary from 1.7cm to 6.5cm (Figure 3-3). Thirteen spearheads were unearthed in this site (Figure3-4).

Similar to the Jomon (Figure 3-2), fishing tools were also found in the Xinkailiu site (Figure 3-5). They are easily identified due to the particular fishing function, such as net-sinkers, harpoons and hooks. Some arrowheads may also be used for fishing but the basic function should be for hunting. Net-sinkers are usually a small pebble or a piece of ceramic with a groove on the two opposite ends, apparently for tying to the fishing net. Fishhooks are quite complex and usually semi-circular in shape and with a small thorn fixed to it to act as a barb avoid fish escaping. Fishhooks have not much changed since they were invented thousands of years ago. Unlike the fishhooks, harpoons are various in shape (Figure 3-5). A common shape of harpoons is spear-like but with several back-facing thorns in one or both sides that serve the same purpose as the single backward thorn on fishhooks. The simple shape of harpoon found in the Xinkailiu site may indicate a less sophisticated fishing activity than in the Jomon society (Figure 3-5). Fishing nets are certainly an important tool for fishing but are rarely preserved. Only the discoveries of net-sinkers indicate fishing nets once existed.

From the reference of Japanese archaeology, the gathering tools in Jomon societies usually include the “large tanged stone scrapers” that may be used as a harvesting knife, grindstones and top stones, and the “chipped stone axe” (hoe). Use wear study has shown that the “chipped stone axe” (hoe) was used for digging soil, which may be related to edible root collecting. Similar digging tools have been found in many places in China (Figure 3-6).

At least two stone tools that were reported as “axe” in the Xinkailiu site might be used for digging (Figure 3-7). Compared to the similar shape of digging tool “chipped stone axe” (Imamura 1996:103) in the Jomon study (Figure 3-1), these two stone tools in the Xinkailiu site possibly have the same function as the “chipped stone axe”. This kind of digging tool was related to plant food gathering activities such as root collecting or house construction in Jomon societies. It is easy to put this tool into the category of axe in Chinese reports. How many digging tools have been reported as axes in the Xinkailiu site is unknown. From the illustrations in the report, I can only identify these two “axes” as possibly used for digging.

There are thirty-three wood cutting tools were also found in the Xinkailiu site, including twenty-two axes and eleven adzes. These woodcutting tools are usually well polished (Figure 3-8). As I mentioned, this number may include some digging tools because the report has put all possible digging tools into the category of axe. This digging tool in Jomon archaeology is called chipped stone “axe”, which indicate the similarity between digging tool and actual axe.

3.3.1.2.2 Tools in farming societies

Gathering tools are used both in gathering and farming economies. It is almost imposable to distinguish tools used by gathering and farming. The proportion of gathering tools may only indicate the percentage of plant food gathering in all activities of food procurement. However, if we have evidence of domesticates, such as crop seeds, these gathering tools can be identified as gathering and farming tools. The amount of crop seeds is also the reference to decide the proportion of farming in total economies. In my study, I use the term “gathering” tool in both foraging and farming societies because I cannot pre-distinguish farming and gathering tool without analysing hunting/gathering and farming economies.

Gathering tools found in the two sites, Banpo and Jiahu, include hoes, knives and sickles, and grindstones and top stones (Figure 3-9). The digging tool hoe usually has a wide but slim body sharpened on one end. Knives for collecting plants are usually made of a slice of stone or ceramic with long rectangular shape, some with a groove in each end. One of the sides is sharpened for cutting plants. The sickle is a complex tool for farming because it is a composite tool with a long handle on one side, which makes it easy to use for harvesting. Even though there is no evidence directly showing the handle with it, similar tools made of metal in later periods suggest they are used with handles. Some sickles found in the Jiahu site show some particular features such as the sharpened edge being processed as a jigsaw, which may be easier for cutting the plant than the normal straight edge. Grindstones are various in shapes, usually including two types. One is relatively flat and the top stone used with it is relative long. Grindstones of the second type usually have a small depression in the middle of their surface and are of irregular shape. In the Jiahu site, some grindstones have been deliberately made with four short legs underneath. However, these two types of grindstones are both used for plant food processing (Figure 3-9).

Woodcutting, hunting and fishing tools in farming societies, e.g. Banpo and Jiahu, are similar to the same type in foraging societies. For example in the Banpo site, there are axes, adzes or chisels for woodcutting, arrowheads for hunting, and fishhooks and harpoons for fishing (Figure 3-10).

3.3.2 Calculating the percentage of tools

Calculation of tool percentages is based on the number of tools in each category from excavation reports. For example, the tool complex in the Xinkailiu site comprises 136 hunting, 24 fishing, 3 gathering and 33 woodcutting tools out the total of 196 (Table 3-3). The percentage of each category is calculated based on the total number of four categories. In the example of the Xinkailiu site, the percentage of hunting tool is 69.4%, fishing is 12.2%, gathering is 1.5% and woodcutting is 16.8% (Table 3-3).

Another example is the Banpo site. There are 6347 tools found in the Banpo site in the four categories. The results of calculation come out with 294 (4.6%) hunting, 350 (5.5%) fishing, 4271 (67.3%) gathering and 1432 (22.6%) woodcutting (Table 3-3).

Table 3-5 is the result of Jiahu tools, which used the same calculation method as Banpo and Xinkailiu. Table 3-3, 3-4 and 3-5 are the basic form of statistics used in this thesis. Based on these tables, I have transferred these percentages into the form of diagram (Figure 3-11).

These diagrams show some differences between the tool complexes. The important difference is that the category with the highest percentage in the Xinkailiu site becomes the smallest in the Banpo site. Thus, hunting tools comprise two thirds of the

Xinkailiu tools but less than 5% in the Banpo. In contrast, gathering tools form two thirds of the Banpo assemblage but are barely visible in the Xinkailiu site. Woodcutting is similar in the two examples, which may imply that foraging may require as much woodcutting as farming. These two diagrams imply different economic styles. The diagram of Jiahu seems at a middle position between Banpo and Xinkailiu, which may reflect a tool complex in the middle process of transition to farming.

3.4 INTERPRETATION OF THE STATISTICAL RESULTS

In the statistics of the Banpo sites, because we all know the discoveries of domestic seeds, so the Banpo diagram should indicate a farming economy. But if dealing with a new sample, such like the samples collected in northeast China in later Chapters, even though the results have shown a high percentage of gathering tools, a farming economy cannot be assured unless the evidence of domestic crops is available. That is one of the reasons why I need a framework in this thesis. But in general, a high percentage of gathering tools must reflect a large amount of gathering activities indicating a high demand on plant subsistence in a society. Similarly, the percentage of hunting-fishing tools in relation to the hunting /fishing activities should reflect the amount of hunting/fishing in the economy, while a reduction in hunting/fishing tools would suggest the decrease of hunting/fishing in the economy.

However, to correctly understand this statistical method and its implications is even more important than the actual statistics. Some aspects that affect a correct interpretation of the results of statistics need to be noticed, such as the number of tools presented in statistics.

3.4.1 Number of tools

In order to increase the accuracy of statistical analysis, it is necessary to obtain large amounts of data. Small numbers of tools will affect the accuracy of the result. In the Nanzhuangtou site (Baoding Administration et al. 1992; Guo, Ruihai et al. 2000), for example, only 15 tools were found, so that the statistics for such small number of tools in this site are unreliable (Figure 3-13). Even though the diagram of Nanzhuangtou looks similar to the Xianrendong (Figure 3-13), which may indicate a similar economic style as some archaeologists have presumed (Guo, Ruihai et al. 2000:62), the similarity may be simply chance. If new discoveries in the Nanzhuangtou site increase the number of tools, the result may not be the same as we have now. Therefore, I will select sites similarly to these three examples with a relatively large numbers of tools. The number of tools found in northeast China is relative smaller than it in north China. For example, the largest number is 807 in northeast China found in the Dazuizi III (Appendix 1) compared to 6347 in north China derived from the Banpo site (Appendix 1). Also some sites even with small number of tool, such as only 5 in Zuojiashan II (Appendix 1), are used in tool analysis because it is the only available data for this culture or period.

3.4.2 Meaning of the results

A high percentage of gathering tools should reflect a high frequency using them it in daily life within a society. This high frequency of using gathering tools indicates that the society may have heavily depended on the plant food supply. Similarly, a low percentage of hunting and fishing tools indicates a low requirement of hunting and fishing.

The indications of my diagrams are limited. Firstly, the percentage of a tool does not directly represent the ratio of this activity in the economy. In the example of Banpo, the fact that two-thirds of the tools were for gathering does not mean farming formed exactly two-thirds of the entire economy. In order to analyse the components of a prehistoric economy, I use this proportion as an approximation of the economy. Secondly, only a small percentage of gathering tools related to plant cultivation during the early stage of transition to farming or even none of them related to cultivation among foraging society. So the percentage of farming economy in these circumstances only depends on estimation, presumably setting this percentage at less than 5%. Similarly to this, the percentage of farming in the economy has been assumed to be close to the number of gathering tools in the late stage, close to the period when farming is the dominant economy. Thirdly, the percentage of tasks is not precise since some tools do not preserve. The obvious example is fishing nets that are rarely preserved. For net fishing activities, the only discovery is the net sinkers. Moreover, without proper use-wear analysis, the function of tools will not be determined clearly, which will reduce the reliability of calculations. That is why I refer to Jomon archaeology in my statistics. Besides, tools have different use-lives, some used for many years after being produced but some may be discarded quickly, so that rates of discard vary between categories. Also multifunctionality of tools may allow one tool to fit into various categories, which also limits the accuracy of the statistics.

3.5 THE IMPLICATION OF STATISTICS WITHIN THE FRAMEWORK

To correctly understand the implication of the statistics requires them to be read in conjunction with several studies in the framework, such as the evidence of domesticates, environmental conditions and archaeological discoveries other than tools.

The evidence of domesticates indicates that “gathering tools” were used in a farming activities. The tool diagram of Banpo (Figure 3-13) is very likely to represent a typical farming economy in north China since it is supported by the discoveries of domesticates. Given limited data and incomplete evidence of fauna and flora, the tools diagram has provided a possible way to measure the prehistoric economy. It also provides an applicable method to test the ZRC model in my study.

Another aspect, the environment, is significant in understanding the implication of this diagram. For example in the Banpo site, environmental reconstruction based on the studies of summer monsoon and pollen data reveals a warmer but drier climate than in the previous period (An, Z. et al. 2000; Ke, Zhenghong et al. 1990), which suggests a possibility of a farming economy mainly using such species as millet which would survive naturally in a drier climate without specific water resource. The discoveries of millet remains in the Banpo site are correlated to the environmental condition. Small game hunting is also possible, because the environmental study has shown the existence of forest suitable for small animals. But the animals may not be the predominant food resource due to the very small amount of forest with a low density of trees, which could not support large numbers of animals. Fishing is not a major economic activity due to the low percentage of fishing tools. But the percentage of fishing tools suggests the fishing occurred as a freshwater resource. The low percentage of fishing tools also challenges a conventional assumption for the Banpo society. Chinese archaeologists believe that there is a high component of fishing activities in the Banpo communities based on the fish painting on the pottery (Chinese Academy 1963:224; Banpo Museum et al. 1988:349), but this may not be so.

Archaeological discoveries other than tools are also important for interpreting the diagram in my framework. For instance, the tool diagram of the Xianrendong site (c.12000BP) is very similar to that of Banpo (c.6000 BP) (Figure 3-13). Does this similarity indicate a similar economy? If we look at these two diagrams in relation to their archaeological background, we will find the similarity between tool statistics does not indicate a similar economic style. The similarity between these two sites only indicates the high percentage of plant subsistence in both sites. The substantial distinction between these two sites, as noted previously, is that the Banpo site is a well-developed village settlement with substantial house construction but the Xianrendong is only a cave shelter. The Banpo site contains a flourishing ceramic production indicated by various designs of painted pottery, while very little pottery is found in the Xianrendong site and it is assigned to an initial period of ceramics. The Banpo site has many storage pits but no storage was discovered in the Xianrendong site. Discoveries of various crop seeds were made at the Banpo site but at the Xianrendong site only a small amount of domestic rice was found from the phytolith study (Table 3-6). These distinctions between the two sites suggest that they are different in economic forms. Banpo is dominated by an agricultural economy but the Xianrendong site shows only a beginning of plant cultivation with a large amount of wild rice in its subsistence pattern.

3.6 BASELINE DIAGRAM FOR EACH PHASE

3.6.1 Why I need baseline diagram

One of the important steps in this thesis, prior to the actual study in northeast China, is to use the results of study in primary agricultural areas, both south and north China, to establish a sequence of diagrams. These diagrams reflect the three phases in the ZRC model applied to the primary agricultural area, which is the baseline for my research in northeast China. The baseline of the diagrams has to be obtained from south and north China, because there are more reliable data available and more mature studies than in northeast China. These studies have been widely accepted by archaeologists worldwide (Crawford et al. 1998; Higham et al. 1998; Lu, T. L. 1999; Pei 1998; Zhang, J. 1998; Zhao, Z. J. et al. 1998). Even though the analysis of faunal and floral remains less developed than in the West, at least there are more results and discoveries in relation to the transition to farming than in northeast China. The comparison between the baseline and each case study in northeast china will indicate the difference or similarity between regional study and the ZRC model.

3.6.2 Diagrams of the baseline

The ideal sites to represent the three phases of the ZRC model would be found in north China next to my study area of northeast China. Additionally, they would be better located in a small region. However, it is difficult to find sites to satisfy the ideal requirements. In north China, the beginning of plant cultivation has been assumed to be in the early Holocene but there is little archaeological data (Guo, Ruihai et al. 2000; Shi, Xingbang 2000:26). There is no evidence of domesticates old than 8000 BP. This may be, as suggested earlier, because of the lack of seed recovery and lack of phytolith study in China. For establishing the initial availability economy baseline I have to use an example from south China, the Xianrendong site found in the Yangtze River area (Jiangxi Administration 1963; Zhao, Z. J. et al. 1998). Total four sites: Xianrendong (supplemented by the Diaotonghuan site), Jiahu, Cishan and Banpo are selected for establishing the baseline.

Identifying domestic rice through phytolith study has been controversial. However, many improvements have been made based on the study of the Diaotonghuan and Xianrendong site (Zhang, Chi 2000; Zhao, Z. J. et al. 1998). A rock shelter site, Diaotonghuan, was found in 80 metres away from the cave site of Xianrendong (Zhao, Z. J. et al 1998). Evidence of domestic and wild rice has been found in both Xianrendong and Diaotonghuan by phytolith studies during the third and fourth excavation seasons in the 1990s (Zhang, Chi 2000). This discovery indicates that rice domestication has occurred associated with wild rice gathering around 14000-10000 BP in this area (Zhang, Chi 2000:48; Zhao, Z. J. et al. 1998).

These two sites have been occupied through the period from wild rice collection to the beginning of rice cultivation (Zhao, Z. J. et al. 1998). The Diaotonghuan site provided an earlier deposit compared to the Xianrendong site. In this earliest deposit around 17000 BP, the result of phytolith analysis shows only the wild rice remains (*Oryza nivara*). The precise number of rice remains is not available. So I have drawn a table based on the literature descriptions (Table 3-6). The amount of the wild rice remains increased between 17000 BP and 14000 BP. From 14000 to 10000 BP, domestic rice (*Oryza sativa*) began to be found and continually increased through time. This deposit of the Xianrendong site is a typical example of the availability phase marked by beginning of rice cultivation (Table 3-6).

Information about the discoveries of tools during recent excavations is still unavailable. But the tools in the horizons before 10,000 BP in this site were excavated and reported in the 1960s and 1970s (Jiangxi Administration 1963; Jiangxi Museum 1976). Using this data I have drawn a diagram of the Xianrendong tool complex (Figure 3-13 left).

The diagram of Xianrendong (c.12000 BP) is unexpectedly similar to the Banpo (c.6000 BP) (Figure 3-14). In both gathering tools are in the highest proportion. The differences are minor, such as a greater percentage of woodcutting and less hunting in Banpo than in Xianrendong. This similarity between the availability (Xianrendong) and consolidation phase (Banpo) reflect a similar amount of plant subsistence in both two phases, one with the wild and another with the domestic.

The diagrams indicating the substitution phase are generated from the Cishan and Jiahu sites around 9000 BP. The diagram of Cishan reveals a similar percentage of hunting and fishing tools to gathering tools (Figure 3-14). Total hunting and fishing is 27.4% compared to 22% of gathering tools. The diagram of the Jiahu site shows a similarity in the pattern of hunting/fishing and gathering with the Cishan diagram. If we remove the number of woodcutting tools and recalculate the percentage, the two diagram patterns are very similar (Figure 3-15).

The difference number of woodcutting between the two diagrams may imply variation of environmental background. At the Jiahu site large quantities of rice remains were unearthed whereas at Cishan millet was found. These two types of agriculture were obviously supported by different environments, millet growing in a cold and dry climate and rice in warm and wet. I have already said that the ideal sites for my baseline should located in north China. But because the ideal site in the north is not available, so I have to use the Xianrendong site from the south. In order to connect the data from the south to the north, I use a comparison between two sites, Jiahu in the south and Cishan in the north. As the diagram patterns indicated (Figure 3-16), even though the two sites reflect two different agricultural crops and are located in two different regions, the tool complexes are very similar. The similarity of the tool complexes between these two sites suggests that the two sites are at a similar transition, the substitution phase. Considering that the ideal location of a comparative site should be in the north and also comparing the similar type of agriculture found at Banpo and Cishan, both sites with large amounts of millet, I have decided to use the Cishan site for the baseline diagram of substitution phase. The diagram of Jiahu, as a supporting role, connects Xianrendong (south) to Cishan and Banpo (north), which make a complete set of baseline diagrams (Figure 3-16).

In compared to the baseline diagrams, in Figure 3-16, the first, Xinkailiu reflects a foraging economy. The rest three are the baseline diagrams reflecting the three phases in the ZRC model. They represent a transition process in the primary agricultural areas in China. The diagram of Xianrendong (second in Figure 3-16) indicates the beginning of the transition period, the availability phase at about 11000BP. This availability phase has fairly small amounts of hunting and fishing in the economy. During this phase, gathering tools are in high percentage and include some digging tools for root collecting and processing tools for wild rice. The diagram of Cishan (Figure 3-16 third), representing the substitution phase with increasing woodworks, may suggest that the increase of domesticates somehow connecting with more woodcutting tools which possibly due to the increasing of woodworks such as house construction or may relate to slash and burn practice. The replacement of harvesting tools such as the emergence of sickles will have increased the efficiency of farming activities. The decreases of wild plant collecting may subsequently decrease the need for gathering tools. The diagram of Banpo (Figure 3-16 fourth) represents the dominant position of farming economy, which has substantially reduced the wild food supply. The diagram of Xinkailiu in the Figure 3-16 (first) is to compare the tool complex in a foraging economy.

3.7 SUMMARY

In this Chapter, I have established my methodology for my framework. Using the method of tool statistics, I have established a sequence of three diagrams showing the three phases of the ZRC model of transition to farming based on Chinese archaeology. These three diagrams are a baseline of my study into the transition to farming in northeast China.

The specific feature of methodology in this thesis is to find a method from old study areas such as south and north China and apply it to a new area like northeast China. The applicable method is generated from previous studies, especially studies in an area nearby the floral and faunal remains of which has been relatively well studied. The process of moving from tool-classification in Jomon and Chinese archaeology to the baseline of the three diagrams reveals the first part of my study, searching for an applicable method. The second part, applying it to northeast China will be taken up in later Chapters.

CHAPTER 4. ENVIRONMENTAL RECONSTRUCTION IN NORTHEAST CHINA

4.1 INTRODUCTION

Under the influence of western archaeology, particularly international collaborated projects of Chinese archaeology, Chinese scholars studying the transition to farming have recently begun to recognise the importance of palaeoenvironmental reconstruction in archaeological inquiry. Before 1980s, Chinese archaeologists usually have neglected environmental studies, even though in some regions data has been available. This has left the record of environment incomplete in archaeological report. In the case of northeast China, for instance, using Palaeo-climatological data to reconstruct past environments is not a common subject for local archaeologists. Crawford (1992) underlined the importance of environmental reconstruction and argued that these studies should occur before the transition to farming could be studied. He has located the beginning of agriculture in north China during the early Holocene and sees this extending into northeast China, Korea and Japan in later periods. He has also called for further data on past rainfall, temperature patterns and other environmental parameters in an attempt to develop a fuller picture of this region. Therefore, the environmental studies are important for archaeological research in northeast China, particularly for studies on transition to farming.

I use this Chapter to demonstrate my studies of environmental reconstruction in northeast China. As part of an introduction of this Chapter, subsection 4.1.1 is an explanation of the reasons why I study past environment in my thesis. I will present two examples of problematic environmental archaeology in northeast China in subsection 4.1.2. A brief description of my environmental study is in subsection 4.1.3. In section 4.2, I will explain methodological approach of my environmental studies. In sections 4.3, 4.4 and 4.5, I will present my environmental studies in four aspects, including land changes, temperature, and precipitation and vegetation alterations since the start of the Holocene. In relation to the research of transition to farming, four questions will be discussed in section 4.6, such as the boundary between the Pleistocene and Holocene, the period of “Holocene Climate Optimum”, possible human migration during the early Holocene and human adaptation to Holocene environment in northeast China. A short conclusion will be in section 4.7.

4.1.1 Reasons for environmental study

Past environments are generally studied to see the dependence of farming economies on the environment. This is because a farming economy cannot exist without the appropriate environment. A study of the transition to farming requires a background of past environments to ensure the possibility of a farming economy in the region. Tisdell (1999) notes that agriculture as an economic activity depends heavily on living organisms and ecosystems. Prehistoric society could have the knowledge about environment through farming practice. Thus the study of transition to farming inevitably requires results from research into past environment.

For my research, the model testing process requires knowledge of the environmental background in northeast China because the ZRC model is also based on environmental study in northern Europe. The three phases of transition process there were supported by appropriate environmental conditions. An inappropriate condition would have led to an unstable transition process. Under this unstable process, a transition to farming would not have been continued. As fundamental to the study of farming economies in China, the research of past environment should be an initial part of the study of transition to farming.

4.1.2 Environmental study in northeast China

Palaeoenvironmental studies in archaeology, particularly in some international collaborative projects involved multidisciplinary studies (e.g. Linduff et al. 2004), are more developed than they are in local archaeological studies in the northeast China. These international collaborative projects have led to a substantial change in Chinese environmental archaeology and achieved successful results. Apart from these multidisciplinary projects, some areas such as northeast China are lack of environmental studies with little attention of environmental reconstruction. There are a few studies in environmental archaeology in northeast China, but sometimes these studies are not very reliable due to the analysing method. Some local archaeologists used to set out to prove a theory rather than generate a new model based on archaeological evidence (as discussed in Chapter 2). A simplistic aspect of environmental archaeology in northeast China is that local archaeologists believe that human settlement and agricultural economy in the past must reflect a warm and humid environment. This means that when archaeologists found the evidence of human habitant and farming economy, they simply and indiscriminately claim that there was a warm and humid environment and sometimes this claim is made without any environmental evidence. This simplistic method has reduced the reliability of environmental studies in northeast China. I will give several examples to illustrate the influence of this theory in Chinese archaeology.

4.1.2.1 Environments in Dongwengenshan

One of the examples of influence from this simplistic method is the environmental analysis at the Dongwengenshan site in northeast China. Ye, Qixiao et al. (1991) have studied the pollen for this site and suggested that around 7500 BP (cal. BP 7744-7871), it was warmer and wetter than the late period in the Dongwengenshan site. They pointed out that because the remains of human occupation have been found in the 7500 years old horizon, so the climate should be warmer and wetter.

However, the pollen diagram presented in their paper revealed a different image (Figure 4-1) (Ye, Qixiao et al. 1991:189). Around 7500 BP, there was about 30% of *Artemisia* and 40% of *Chenopodiaceae* presented in the pollen data, which reflects a very dry climate. If the climate had been wet, as they assumed, these two species would comprise less than 10%, particularly for *Chenopodiaceae* which should be less than 5%, because they survive only in dry conditions (Ren, Guoyu 1998). In the later period, for example around 5000BP (cal.4850-5051), climate was possibly warmer and wetter than in 7500BP due to the lower proportion of *Chenopodiaceae* and slight increase of arboreal pollen such as *Pinus* (Figure 4-1).

4.1.2.2 Environment in Xinle

Some archaeologists attempt to use pollen data to interpret past environments, but they usually ignore the percentage of each pollen type. They usually pay more attention to the species present than to its relative occurrence. For example, at the Xinle site, there is no percentage given for each plant in the report (Liu, Muling 1988).

By depending only on the species, Liu, Muling (1988) suggested that there was a warm and wet climate. Apparently, his suggestion is based on the warm loving species such as *Salix* and *Quercus* in the pollen data. But without the proportion of these species present in total pollens, the actual climate is difficult to analyse. It would be warm but would not be definitely wet. Again, this speculation is influenced by the simplistic method that warm and wet climates reflected by agricultural settlements, since well-constructed houses and domestic plants were found in the Xinle site (Shenyang Administration et al.1985).

4.1.3 My environmental study

There is only a small numbers of isotopic studies available in northeast China (Hong et al. 2001), which elsewhere has been a significant parameter for retrieving past temperature. Therefore, pollen data analysis and some studies in monsoon and hydration level indicated in ancient sediments together with the small number of isotopic studies have become a framework to reconstruct past temperature as well as precipitation and its direct information of vegetation. In order to reconstruct the environment in northeast China, besides the studies of isotope, monsoon and hydration level, I have collected 122 pollen data from various publications (Appendix 2; Figure 4-2 and 4-3). These pollen data are mainly distributed in north and northeast China. Some pollen data in the Russian Far East, Korea and Mongolia were also involved for comparison or reference in my research but not used directly in the Palaeoenvironmental reconstruction which I undertook.

The pollen data collected in my research are not all originally presented well. Some of them are not complete in terms of precise number of grains, date or even large scale of epoch, and precise location of bore hole. For example, the pollen data of Xinle (Liu, Muling 1988) gives only the names of the species with no numbers of grains. Most pollen data have no C14 dates but epochs are marked for each pollen zone distinguished. These data that are presented only with epochs can still be applied in my research unlike some data, which has no C14 date or epochs. I have tried to trace the chronological position from some descriptions of content in the deposits where pollen samples were taken. For instance, the pollen data of Yanjiagang presented by Heilongjiang Administration et al. (1987) have one C14 date, around 22000 derived from a fossil, but this date was not presented in pollen diagram, which gives only the depth of each pollen sample. Comparing the stratigraphy and the descriptions of the report, I decided to put this date on samples 17 to 15, because only these deposits contained fossils. Also, several stratigraphic data from nearby areas were presented in the report (Heilongjiang Administration et al. 1987:96-Figure 25), which were marked with approximate dates on each horizon. The date marked on the similar depth where samples 17 to 15 were taken from is 23,000-21,000BP. The date of 22,000BP was in this range, which indicates my assumption is likely correct.

As with most archaeological sites, almost all pollen data collected from the Chinese literature has no precise location, such as latitude and longitude. What I have done is find a nearby village or some geographical landmarks, like a river bend, small lake etc. to trace the likely latitude and longitude, in order to input all data into a GIS program.

Some pollen data have not been published, but are described in articles. According to these fairly descriptive details, I have established a sequence of pollen diagram. For instance, Xia, Zhengkai et al. (2000) have described pollen data from several sites in the Upper Liao River area with precise percentage of arboreal, none-arboreal and ferns. These pollen data together with some surface pollen references are sufficient to reconstruct the environment for my studies.

What I described above are several examples of how to analyse the pollen data before actually using it and how to retrieve as much information as possible from these data for my research. In fact, every sample I collected and applied has been through this process in order to avoid problems and to achieve more accurate results.

4.1.4 Summary

Environmental reconstruction in northeast China is one of important tasks of my research. This is necessary not only for studies of the transition to farming or the application of the ZRC model into northeast China but also because of the problematic current research in environmental archaeology in northeast China. To establish my methodology of environmental studies requires a framework and synthetic method, and sufficient reliable pollen data. The former has been developed in my studies and the latter has been collected and analysed to become relatively reliable data. In the remainder of this Chapter, I will review the various kinds of Palaeoenvironmental data and synthesize them into a long-term reconstruction. This will avoid current interpretive problems and provide a basic acquaintance with which to review the archaeological data relating to the transition to agriculture. Considering the availability of isotopic and other environmental data for northeast China, this study is a initial work and the results of my environment reconstruction should be modified in the future.

4.2 METHODS AND SPECIFIC ASPECTS IN MY STUDY

In this section, I am going to explain the major aspects involved in my synthetic environmental study and also demonstrate the method used for environmental reconstruction. This environmental reconstruction is focusing on general changes in a large area not in a small region or a local level. Therefore, this reconstruction allows some different results derived from the studies in some small areas or in a local level.

4.2.1 Four aspects

The study of past environment in my study has involved four aspects: land loss caused by an increase in sea level, temperature and precipitation changes, and also vegetation coverage shifting during the Holocene. This environmental reconstruction will provide a basic background for the transition to faming in northeast China. Isotopic data, the studies on monsoon and level of hydration together with pollen data are the basic information used in the study of vegetation coverage. The pollen data in my studies does not include concentrate rate because of the lack of availability, even though pollen concentration rate is significant information (e.g. Liu, Hongyan et al. 2002).

The purpose of study in land loss is to examine its impact on both the environment and human societies, such as the migration of animals and humans, and changes in natural resources. This study is also related to the beginning of plant domestications in China because land loss happened during the early Holocene when plant domestication began. The study of past temperature and precipitation will draw a picture of humidity in this region, which is important for agricultural economies. The analysis of pollen data will generate a picture of vegetation coverage throughout the Holocene.

4.2.2 Methods

Even though pollen data is significant evidence for the study of past environment, neither the species of plants nor the percentage of pollen will necessarily indicate local or regional environment (Lesley 2000; Moore and Webb 1978; Liu, Hongyan et al. 1999; Li, Wenqi 1998). The relationship between pollen representation and actual vegetation and its implication for temperature and precipitation is complicated. Even when dealing with the same pollen data, different methods may generate different outcomes. Also the date that vegetation changes in responding the climate changes may delay up to a few hundred years (Bradley 1999:363-375). Thus how to use pollen data to interpret past environments is critical for my study. I have used a synthetic method including the dates of climate changes indicated in the isotopic data and hydration level even faunal changes. Here, I will emphasise the two major effective methods that both connect to surface pollen for retrieving environmental information.

Although the pollen data will not directly indicate vegetation and environment, it is related to vegetation and environment and widely used in environmental reconstruction (Bradley 1999:370). Figure 4-4 shows the relationship between the surface pollen with the modern vegetation in the Xilin River region of Inner Mongolia. The present vegetation in this area is grassland with a very low density of trees, known as “open woodland steppe” in Chinese palynology. Pollen complexes collected from surfaces have basically reflected its vegetation, such as a high percentage of non-arboreal and quite small amounts of arboreal pollen in general. Ideally, pollen data should be derived from several distanced boreholes in the same area and compared with each other. However, in general, pollen data basically reflects the vegetation in the same area with a radius of less than 10 kilometres. If boreholes are spaced at a distance more than 10 kilometres, pollen data will not always reflect the general vegetation in this area. From Figure 4-4, pollen data only reflects the area less than 10 kilometres.

4.2.2.1 Using surface pollen

The first method of analysis is based on an assumption that similar pollen data should reflect similar vegetation coverage. If we have a reference of surface pollen and modern vegetation, pollen data derived from a deposit that is similar to the reference surface pollen should reflect similar vegetation. But this surface pollen reference in my research must meet two basic requirements. One is that the surface pollen should be collected in or near the study region such as my study area, northeast China. The other requirement is that if environmental reconstruction is for a large region like the entire northeast China, the reference samples of surface pollen and vegetation should include different geographical areas such as mountain and flood plain. In using actual research, it is difficult to meet these requirements since this method of analysing the environment using surface pollen is not common in current environmental studies in northeast China. Fortunately, I have found two examples in the literature and both of them are located in northeast China. The first is for the landscape of the loess plateau, including four palynological sites, Haoluku, Liuzhouwan, Xiaoniuchang and Jiangjunpaozi, located in the southwest corner of northeast China (Liu, Hongyan et al. 1999). The second is the north slope of Baitoushan on the Changbaishan Range in the east of northeast China (Zhou, Kunshu et al. 1984b).

In the first example, Liu, Hongyan et al. (1999) have synthesised four sites and established four vegetation zones:

Zone A: Steppe zone, with 47.3% of *Artemisia*, 25.2% of *Chenopodiaceae* and with only 4.9% of *Betula*.

Zone B: Lower density Woodland-steppe Zone, with 50.6% of *Artemisia*, 14.7% of Chenopodiaceae and 16.3% of Betula.

Zone C: Woodland-grassland Zone, with 36.3% of Artemisia, 5.8% of *Chenopodiaceae* and 39.3% of *Betula*, also 5.1% of *Pinus.*

Zone D: Woodland Zone, with 20.8% of *Artemisia*, 3.1% *Chenopodiaceae* and 36% of *Betula*, also 24.9% *Pinus*. (Liu et al. 1999 Figure 8)

This study has shown the percentage of pollen in the surface soil corresponds to the current vegetation. For instance, if the total pollen percentage of arboreal plants is less than 44.4% (39.3% + 5.1%), the vegetation is basically grassland with a low density of trees, called “woodland-grassland” (Zone C) (Figure 4-5).

The second example is from the Changbaishan Mountains showing a forest landscape (Zhou, Kunshu et al. 1984b). In this example, vegetation changes along with the increase elevation (Figure 4-6). In all sites arboreal pollen is over 50%, showing a forest landscape. Second, as the elevation increases from 500 to 2000 metres, the forest changes from broadleaf mixed with conifer to conifer becoming dominant, then to birch forest. Third, in the high altitude area of mountain slope, surface pollen differs slightly from real vegetation.

This landscape starts from the first vegetation zone in a low altitude area of Changbaishan Mountains, 500-1100 metres above sea level. The vegetation reflected by the surface pollen reveals the same image of actual coverage of the mixed forest landscape. The next zone, 1100-1500 metres, is pine dominant forest reflected by almost 90% pollen of *Pinus*. The third zone, between 1500-1800 metres above sea level, only has 40% of *Abies* pollen, even though the real vegetation in this zone reveals an *Abies* dominant forest. Similar to this, in the fourth zone, there is only 45% *Betula*, yet the surface coverage is a forest with *Betula* predominant. These two vegetation zones indicate a difference between surface pollen and real vegetation. The differences between surface pollen and actual vegetation will be considered in my environmental reconstruction process. In general, however, the vegetation result reflected by surface pollen satisfies requirements for my environmental reconstruction.

4.2.2.2 Using a precipitation model generated from surface pollen

The second method of using modern pollen is to analyse current precipitation and the percentage of pollen present in the surface soil, and to build a model indicating the relationship between these two factors. Based on this model, and using pollen remains collected in palaeoenvironmental deposits, I can outline past precipitation in northeast China. Based on more than 80 samples of surface pollen from north China, Ren, Guoyu (1999, 1998) has established the model to describe this correlation (Figure 4-7).

In his analysis, even though the relationship between pollen and precipitation is not very direct, as the percentage of tree pollen rises from 10% to 95% the annual mean precipitation follows it from 300 up to 800mm. Birch (*Betula)* has a special feature in its pollen representation of almost zero percent when the annual average precipitation is below 450mm, but when the precipitation rises to 500mm or above, the percentage of *Betula* pollen rapidly increases to near 50% of the total. Conversely, *Artemisia* and *Chenopodiaceae* are in inverse proportion to the increase in precipitation. For example, if precipitation is kept between 500-900mm, the pollen percentage of *Artemisia* will remain below 50% or less, and C*henopodiaceae* will stay below 20%. But when the precipitation is reduced to less than 450mm, the pollen percentage of both *Artemisia* and *Chenopodiaceae* will sharply rise to more than 60% (Ren, Guoyu 1999:1).

As part of my methodological framework, besides these two major methods, using the model which relates surface pollen to modern vegetation and precipitation, some results derived from other methods will also be considered in. For example, the analysis of the water level of lakes through time may indicate the history of precipitation in the nearby area (e.g. Wu et al. 1994) and animal complexes in archaeological discoveries may also help to specify environments (e.g. Jin et al. 1984). My environmental study is based on this synthetic analysis including all possible ways to retrieve information from the past.

4.3 HOLOCENE ENVIRONMENT – LAND LOSS IN NORTHEAST ASIA

One of the major events which affected the whole of northeast Asia during the early Holocene was the massive land loss caused by sea level rise. In north and northeast China, environmental changes were directly influenced by this land loss during that period. Environmental reconstruction for this region inevitably involves studies of land changes, because landform was one of the major environmental aspects, particularly in northeast Asia during the early Holocene. These changes occurred at a similar time when agriculture began in China. They may imply some connections between land changes and agriculture economies in this area. The studies of land changes are mainly based on the evidence of sea level changes.

4.3.1. Sea-level changes

Geological evidence, such as bore samples from the seabeds, containing some terrestrial deposits, indicate that the eastern coast of northeast Asia, such as the coasts of Japan, Korea and China have dramatically changed since c.18000 BP. This change led to massive land loss.

At the end of the LGM around 18000 BP, the lowest sea level near the east coast of northeast Asia was about 140-150 metres below the present surface. Around 6000 BP, the highest level was 4 meters above present sea level. There was around 160 meters variation in sea levels from 18000 to 6000 BP. After that the sea level has fluctuated only slightly until today (Qian et al. 1994).

The shape of the Sea of Japan underwent minor change with the sea-level rise because the slope of the shoreline is very steep. For example, at the western coast around Primorye Region, Russian Far East, there was only about 30 kilometres transgression since 17000BP (Kononenko et al. 2000). On the other hand, Bohai and Huanghai were very likely to be a flood plain in about 18000-12000BP, because there are only 18-44 metres of depth on average and 78-140 metres of maximum depth from the present sea surface (Chinese Academy 1999). This flood plain changed into a shallow ocean rapidly in a few thousand years from the termination of the Pleistocene. The transgression in the China Sea was about 1500 kilometres in maximum distance over the last 18000 years. This sea-level change caused the loss of a large amount of land in a short period of time, and it had an inevitable impact on the environment, including fauna and flora.

4.3.1.1 Evidence of sea-level change

The evidence of sea level changes since the last glacial period has been discovered along the coasts of China, Korea and Japan. The first evidence is that marine layers lie over terrestrial layers in seabed deposit corresponding to ocean submerging land during the Holocene. The boundary between the marine and terrestrial layers has become the important indicator of sea level change. This evidence has been found along the China Sea (Zhao, Xitao et al.1979). Secondly, coral reefs are another means by which we can trace sea levels, because coral can survive only on a shallow seabed within several tens of metres depth. After a sea level rise, the coral reef is a indicator of ancient sea level. For example, Zhao, Xitao et al. (1979) have studied the traces of coral reefs around Hainan Island and found that the shoreline indeed changed. Other similar evidence, such as beach-rock, the oyster (*ostracean*) reef and peat sediment is also taken into account for sea level studies (Zhao, Xitao et al. 1985:212).

Bore samples from the seabed of Bohai and Huanghai (Figure 4-8) also indicate the amount of sea-level change. For instance, fresh water peat sediment was found in most areas of Bohai, Huanghai (Niu 1979). Some carbon dates of the fresh water peat indicate that the sea level was 110m below the modern surface around 23000BP, 136m at about 20000BP. At around 17000BP, the sea surface was around 155metres below the present (Wang, Jingtai et al. 1980; National Earthquake Institute 1978). This rate of sea level change was to decrease around 20000BP and possibly in its lowest level around 18000-17000BP. Similarly, in the area between China Sea and the Sea of Japan, the lowest sea level is around 140-150 metres below the present surface at about 18-17000BP.

4.3.1.2 The rate of sea level rise

Scholars generally agree upon time of sea level rise, but there are some variations in the time of starting rising sea level and the amount of sea level rising in different period. According to research on shell mounds on the seabed of Bohai and Huanghai, sea level started rising at about 15000 BP. By 12000 BP it had reached 110m below the modern surface. The sea level was 60m below the modern surface in 11000 BP (Wang, Jingtai et al. 1980:304), and in 6000 BP, it was 3 metres above the present surface. In some places like Bohai it may even have reached as high as 4 metres (Zhao, Xitao 1985).

Other studies offer somewhat different results for sea level change in the same area but in different locations. For example, around 12000 BP, sea levels were 50 metres below the present surface, in 11000BP it was 17 metres below the present surface and around 8000 BP reached the same level as now (Chinese Academy 1999:180).

Different amounts of sea-level change have been measured for different areas for the same period. For instance, at 11000 BP, there was a measured 60m below present surface in the middle of Donghai (Wang, Jingtai et al. 1980), but only 17metres depth at the coast of the Jiaodong peninsula (Chinese Academy 1999:180). This difference may be the result of aggradation during the Holocene, when sediment accumulated on the seabed, particularly the seabed near the river mouth on coast. The accumulation of sediment brought from inland by rivers could change the landscape of the seabed, making the seabed higher than it was originally. This should be considered in measuring the depth of the ocean. For example, a core sample from a borehole around the Zhoushan Archipelago (29 ° 40’11’’N, 122 ° 30’48’’E), not far from the estuary of Changjiang (Yangtze), shows about 20 metres of Holocene deposit at 28 metres depth from the present water surface, which means the seabed contour has become 20 metres higher since the Holocene began (Zhang, Yongcang and Shen, H.: 1986).

4.3.1.3 Transgression and regression (sea level drop causing land expansion)

Figure 4.11 shows the major trends in sea level change as measured by different sources are similar throughout the last 18000 years, even though they are not the same in some specific periods. For example, all patterns reach their lowest levels around 18000-14000BP, even when they vary in depth. However, it is almost at the same time, around 10000 BP, that all research shows the sea level reached 40 metres. It was at its highest level of 2-4 metres above the present surface at c.6000 years BP; it has remained relatively stable with only minor fluctuations, till now (Table 4.1).

The bathymetric map remains an important reference for generating the coastline over time, even though the depth of the seabed has been changed in some areas by river deposits. The small amount of rising seabed near the coast of China, as mentioned previously, which is ascribed to the Yellow and the Yangtze River sediments, has not been counted in this measurement. As a result, this bathymetric map may only be used for large-scale analysis (Figure 4-9).

This bathymetric map (Figure 4-9) provides an image of the seabed landscape of the coastal areas in the China Sea and the Sea of Japan (Chinese Map Press 1998). The major physical feature of this seabed landscape is that it is flat and shallow, including

Bohai, Huanghai and Donghai, as well as the small areas around Tatar Strait, off the coastal area of Vladivostok in the Primorye Region in the Russian Far East. These areas are less than 100 metres deep. Only small areas such as the Korea Strait, Tsugaru and the La Perouse Strait are between 100-200 metres deep. These straits may have remained in existence during period of low sea level around the LGM, but would have been very narrow. However the Sea of Japan is quite steep along the coast with usually more than 200 metres depth compared to the China Sea, and should remain as a similar shape as it is today.

Based on the diagram of sea level change in Figure 4-8 and bathymetric map in Figure 4-9, using GIS (Mapinfo) programme, I have produced seven maps (Figure 4-10, 4-11, 4-12) in order to obtain the image of continental shape of the area though the Holocene, encompassing China, Korea, Japan and the south of the Russian Far East. This has changed dramatically since the LGM. At first, during 15000-12000BP, the coastline of the Asian mainland extended from Japan to the southwest. There were not many changes to the shape of the Asian continent between 12000-11500. The straits of La Perouse, Tsugaru, Tsushima and Korea slowly transgressed into the land on both sides of the straits. However, from 11500 to 11000, Cheju Island at the Korean Strait separated from the mainland of Korea, and the size of Mainland "China" as we know it today rapidly decreased. Sakhalin Island was also separated from the continent. From 11000 BP, China continued to decrease in size until 6000BP (Wang, H. & Strydonck 1997). In around 6000BP, northeast Asia reached its maximum decrease in size as the seawater almost cut the Jiaodong Peninsula away from the mainland. Between 6000BP and 4000BP, the continent shape increased a small amount mainly in the coastal area of the northern China, before it became relatively stabilised.

4.3.2 Land changes

According to the maps of land changes (Figure 4-10,11,12), I have calculated the approximate rate of land change in different periods (Table 4-2). Land changes included massive land loss of 1.12×10^6 square kilometres since the last glaciation and a small amount with 1.77×10^5 square kilometres of regaining around 5500 BP. The actual land loss to form the present continent shape is 9.44×10^5 square kilometres.

This land change is one of the major events of environmental change in northeast Asia along the coasts of China, Korea and Japan.

The total land loss of 9.44×10^5 square kilometres (Figure 4-13) is nearly four times size of Great Britain. The average rate of land loss was 118 square kilometres per year if the calculation is based on the total loss of 9.44×10^5 square kilometres. According to my calculation, the maximum rate at which the coastline moved inland was about 146 metres per year in the period around 11000-10500BP (Fig 4-11), or 40cms per day. Small open site 30 metres in diameter would be submerged in less than three months.

There were small amounts of land loss in the Tartar Strait and the Korean Strait. The areas that were around 30 kilometres away from present coasts of Japan were submerged as well. The land loss in these areas would also have had an impact on the local environment even though the land loss was far less than it was in the China Sea.

Lost lands around the Sea of Japan and the China Sea after the LGM were lowland flood plains, possibly with high level of humidity. Many areas, which are now sea near the coast where the depth is less than 140 metres, were lowland plains during the end of the Pleistocene. These plains included the areas of Bohai, Huanghai and most of Donghai, as well as the Korean Strait. The size of the entire plain was more than four times that of Liaoning province in northeast China. Many rivers, particularly the Yangtze and the Yellow Rivers brought fresh water, passing through the plains into the ocean.

Some traces may indicate the possible location of ancient riverbeds, particularly for the Yangtze and Yellow Rivers. For example, a long narrow groove was found on the seabed of Donghai, with one end connecting to the present estuary of the Yangtze River and another end extending into the deep ocean (Chinese Geography Press 1998:60). This groove is very likely to be the ancient Yangtze River course during the lower sea level. Other evidence discovered on the seabed also relates to the river system. One is the river delta sediment found on the seabed of Donghai between the groove and the deep ocean. Its C14 date of 10,000 years ago possibly indicates the estuary of the ancient Yangtze (Wang, Jingtai et al. 1980:Figure 4). Another river estuary deposit has been uncovered near the south end of Cheju Island, with a C14 date of 11000BP(Liu, Zhenxia et al. 1994). Also, river course sediment discovered in a nearby area, with a C14 date around 15000BP (Liu, Zhenxia et al. 1994) may reveal the ancient estuary of the Yellow River (Figure 4-13). These flood plains provided abundant resources for human societies to survive during the period of LGM. But as these flood plains were submerged by the ocean during the early Holocene all fauna including humans and flora in these plains had to move to inland.

4.4.CLIMATE CHANGE SINCE THE LGM

The major aspects of climate change are temperature and precipitation, and they virtually determined vegetation coverage in the past.

4.4.1 Temperature

Rising sea levels are the one of the results of temperature increase. Some plants extending or animals retreating to the further north also indicate the increase in temperature, such as Oak (Figure 4-14) and mammoth (Figure 4-15). Table 4-3 lists some results from the studies of annual mean temperature and precipitation in the past based on pollen data. In the table, temperature fluctuation appears as a similar trend over a large area, which means that in north and northeast China, temperature fluctuated similarly in its direction but at different levels. Some areas increased or decreased more or less than others. For example, between 18-11000 BP, temperature reached its lowest level in local history: -10ºC in the high latitude such as north Daxinganling (Guo, Dongxin and Li, Z. 1981) and 0ºC in the low latitude in the south of Liaoning (Chinese Academy 1977). Around 7-5000 BP, temperature achieved its highest level since the last glaciation, about 6-8ºC in the Sanjiang Plain (Xia 1988) and 13ºC in the south Liaoning (Chinese Academy 1977). The temperature slightly decreased after 5500 BP in all areas of north and northeast China shown in Table 4-3. However, an increase of latitude does not necessarily correspond to a drop in temperature, because an increase of elevation also results in a decrease of temperature. For instance, the Sanjiang Plan (Table 4-3) is located at a higher latitude position compared to Gushantun. But at around 18-12000 BP, the temperature was -2 to -4ºC at the Sanjiang Plain (Xia 1988), which was warmer than Gushantun, at around -5ºC.

This was because the altitude at Sanjiang Plain is below 200 metres compared to Gushantun which is more than 600 metres above sea level (Liu, Jinling 1989).

Figure 4-16 and 4-17 illustrate temperature fluctuations since the last glaciation based on data in Table 4-3. They appear to show regional differentiation within northeast China. In the southern area, Shenyang and Liaonan (Liaodong peninsula), the annual average temperature has increased from 0ºC at 12000BP up to around 15ºC at 6000BP before it dropped again to 9ºC at 4000BP. Liaoxi and Changbaishan follow a similar trend in the temperature curve, but Liaoxi seems have a greater increase in temperature, with 8ºC in Liaoxi compared to 5ºC in Changbaishan; then remaining 6ºC and 2ºC respectively. Another similarity in the temperature curve is between Daxinganling and the Sanjang Plain, where the temperature increase started in 12000 BP and reached a peak at c.6000 BP. In the same time frame, the variation in temperature between these two regions was around 7ºC. The Sanjiang Plain, the region with both lower latitude and altitude, was almost 7ºC warmer than Daxinganling for the same period (Figure 4-16, 4-17).

4.4.2 Precipitation

Precipitation during the Holocene has changed dramatically from one region to another. During 9000 BP, for instance, the Sanjiang Plain was similar to the Songliao Plain in latitude and elevation, but the precipitation was different. The annual average was ca.600mm in the Sanjiang Plain, compared to less than 400mm in the Songliao Plain (Guo, Dongxin and Li, Z. 1981; Ren, Guoyu 1999). According to the model in Figure 4-7 and pollen data collected from 122 sites, and also using Ren, Guoyu's (1999) model (Figure 4-7) about pollen distribution and level of humidity in northeast china, I have drawn maps illustrating the general precipitation in northeast China in the past. From these maps, precipitation has a similar overall pattern to the present, with less rainfall in the west and more in the east (Figure 4-18).

In summary, the rainfall was concentrated in the southeast, near the coast. The Sanjiang plain received less rainfall around 12000 BP, and then remained at about 400-500mm during the early and mid Holocene. From 4000BP until the present, the Sanjiang plain received about 600-700mm rainfall. The Daxing'anling Ranges was similar to the Song-Nen Plain and the Liaoxi hilly land, with less than 450mm in annual rainfall through the early and mid Holocene, before slightly increasing to 500mm during the late Holocene.

4.5 SUMMARY OF HOLOCENE VEGETATION

Combining the three aspects of environment, namely land changes, temperature and precipitation generated from pollen data analysis, the fourth aspect, vegetation coverage, will be able to depicted a large area not at local and regional levels. This synthetic method, using pollen data to deduce temperature and precipitation, I aim to fill some gaps in areas where no pollen data is available yet. Even though pollen data usually reflect vegetation less than 10 kilometres around (Figure 4-4), interpolating from available pollen data is still a major method for filling these gaps in environmental studies (Ren, Guoyu 1999), in order to obtain a regional image of past environments. The Holocene is divided into four periods illustrating my interpretation of vegetation coverage: the early Holocene (1) from c11-9000 BP, the early Holocene (2) around 7000BP, the mid Holocene during 6000BP and the late Holocene about 3-2000BP. In order to demonstrate the significant environmental change in the end of the Pleistocene and the beginning of the Holocene, the vegetation in the period of last glacial maximum will be described first.

4.5.1 The LGM (>c.12000 BP)

Figure 4-19 combines the all four aspects, land change, temperature, precipitation and vegetation together in one map. This is an example of my synthetic environmental reconstruction in northeast China to analysis the environment synthetically. For example, the result of land change study has shown that Korea was connected to Asia mainland by land. So the coastal area in the map is different from the present. In general, during the last glacial maximum, the climate in northeast China was cold and dry. Temperature lines indicate precisely how cold in local area possibly was, and the precipitation contour data shows the specifics of local annual rainfall. Taking these two aspects and considering the latitude and elevation, as well as all other aspects which can influence the climate, I can deduce the final vegetation coverage. For instance, the annual mean precipitation in northeast China was possibly less than 400mm and compared to the present pollen model (Figure 4-7), the vegetation in an area with an annual precipitation of less than 400 mm usually appears grassland, particularly in Bohai and Huanghai plains and some river valleys (Figure 4-19).

The dry climate is caused by lower levels of rainfall. But because the temperature was cold, with a annual mean temperature possibly below 0°C, so evaporation should remain a very low level, particularly in areas of higher latitude and elevation such as northern northeast China. Consequently, soil would retain water sufficiently support some arboreal species such as *Picea* and *Abies,* which possibly formed some small forests in some areas. Some researchers have suggested that the Huanghai and Bohai plains contained some deserts and steppe vegetation zones (Yu, G. et al. 2000:659), although the precipitation was relative higher than other areas in northeast China, at about 5-700mm in annual average. Wu et al. (1994) have studied the monsoon during the LGM in northeast Asia and pointed out that most areas of the Huanghai and Bohai plains received less than 700 mm annual rainfall. With the strong monsoon winds from the west inland bringing dry air during the summer, this would have to increase the level of evaporation in this area and result in a regional desertification.

Under a strong monsoon and lower rainfall, steppe vegetation and desert would have extended into most areas of southern northeast China as well as the Amur River region in the Russian Far East. But coniferous forests might grow along the river valley and coastal areas of the Sea of Japan at the Primorye and Amur regions (Grichuk 1984:176:Figure 17-14). However, in most areas of the Amur River region, desert and semidesert would have to be predominant due to an annual rainfall of less than 300 mm. In addition, because of relatively dry weather wetlands including bogs that are present today did not develop until the early Holocene (Leng et al. 1997:177:Figure 1), when the climate became slightly warmer and wetter.

4.5.2 Early Holocene [1] (c. 11-9000 BP.)

Compared to LGM vegetation, an obvious change during the early Holocene was the sharp increase in arboreal vegetation. A large area of grassland became temperate coniferous broadleaved or mixed needle-leaved and broadleaved deciduous forest, including the northern China plains and Changbaishan and Xiaoxing'anling Mountains. The Mongolian desert during the LGM now became a large steppe area.

Small amount of forest previously in the Amur River valleys extended all over this area, making the desert of the Amur region disappear. Open woodland was well developed in the Daxing'anling area, but grew sparsely at the previous semidesert of the Song-Liao Plains. The steppe lands and desert in the Yellow sea was almost submerged and the Bohai grasslands and desert became an open woodland or forest (Figure 4-20).

4.5.3 Early Holocene [2] (c. 7000 BP.)

The second stage during the early Holocene is at about 7000 years before the present. During this period the arboreal coverage continued to increase. For example, the open woodland in the previous stage of the early Holocene became more forested. Also, subtropical evergreen forests appeared at the southern end of the Japanese archipelago and almost all areas of the Korean Peninsula (Figure 4-21). However, the relatively dry weather in the western part of northeast China created some deserts in the previous grasslands, such as the Kerqin desert in the south (Upper Liao River), and the Song-Nen desert in the middle (the central Song-Liao Plains).

4.5.4 Mid Holocene (c. 6000 BP.)

During the mid Holocene, the vegetation changed only slightly, compared to the previous period. Because the temperature in northeast China reached its highest level since the LGM (Figure 4-15, 4-16), with warm and humid conditions some areas became well forested, such as the Liaodong peninsula and Changbaishan Mountains, as well as the Korean peninsula. But most areas in the west of northeast China, such as the Song-Liao Plains and the Mongolian Plateau were relatively dry, and the vegetation was still steppe land (Figure 4-22).

Warm temperatures during this period meant that many species of plants could survive, either arboreal, like *Betula, Quercus* or non-arboreal, such as *Artemisia* and *Chenopodiaceae.* But on the other hand, the higher temperature resulted in a high level of evaporation, creating dry conditions, and these dry conditions would have restricted some species. For instance, non-arboreal species, such as *Artemisia* and *Chenopodiaceae,* would have been well developed in west and central northeast China, such as West Liaoning and Southeast Inner Mongolia, Song-Liao Plain, and possibly also including the northeast Mongolian Plateau around Hulunbeier as well. Arboreal species like *Betula*, *Quercus* and *Ulmus*, would be relatively restricted in distribution, such as the southern slopes of Changbaishan, Xiaoxing'anling (Ren, Guoyu 1999:Figure 5) and the Lower Amur River area (Khotinskiy 1984:Figure 18-11). This would also have reduced the density of arboreal species in areas where they existed.

4.5.5 Late Holocene (c.2-3000 BP)

Due to the decrease in temperature and the gradual increase in precipitation, northeast China changed its vegetation coverage (Figure 4-23). Broadleaved evergreen forest moved further south. In Japan, this forest was left only in the southern end, while in northern China, this forest totally moved away from the northern Yellow River. The rest of this area remained virtually unchanged. The Sanjiang Plain developed wet bogs because of the increase in rainfall and the drop in temperature (Figure 4-17, 4-18).

4.6 DISCUSSION

4.6.1 Boundary between the Pleistocene and the Holocene

With regards to environmental reconstruction, the boundary between the Pleistocene and Holocene needs to be clarified. To distinguish between the Pleistocene and Holocene is difficult and complicated because the boundary will not be the same in all areas and different methods of defining the boundary will result in different conclusions. In general, global studies have shown that the period from 18000BP to 11000 BP was the transition period from the Pleistocene to the Holocene. This period contains the termination of the Pleistocene from the last glacial maximum (LGM) (Roberts 1998:72-76). Usually, the temperature increase starting after the LGM is the turning point indicating the beginning of the Holocene. In other word, it was the boundary between these two epochs (Roberts 1998:73). This turning point, the date when the temperature began to rise at the end of LGM, is therefore critical in exploring the boundary between the Pleistocene and Holocene.

There are different starts to this turning point in different areas of the world. For instance, the beginning of the temperature increase was 13000 BP in Britain and Ireland, according to records of insects (Roberts, 1998), while in Russia the possible time of the temperature rise was about 11000BP, according to the study of peat bog deposits (Leng, etal. 1997). Some researchers assign the Pleistocene-Holocene transition starting as early as 21000BP in northern Spain (e.g. Craighead 1999). In Chile, it is said to have been from about 12600 to 9000 BP (Borrero 1999), and in Florida, USA, it is thought to begin at 10000 BP (Peres 1999). In the Great Lakes of northern America, it began at 12700BP (Tankersley 1999). In Canada, evidence indicating the boundary have placed it at different times, such as re-establishment of vegetation at c.12000 BP and the migration of the animals around 11500 BP in the Calgary area, 11000 BP near Admonton, and 10500 BP in the Peace River (Driver 1999).

In northern China, the pollen data reveals diverse results for the beginning of the Holocene for different regions. In Inner Mongolia, some pollen diagrams show that the temperature began to rise about 10500–12000BP and at around 11700 BP at the Lower Yellow River area (Xu,Qinghai et al. 1996: 20-23, Figure 3, 5). The pollen data from Diaojiaohaizi, Inner Mongolia, indicates that the temperature may have increased by 10200 BP (Zhang, Lansheng et al. 1997; Yang, Zhirong 1998: Figure 1). Also, Xia, Yumei (1988) has pointed out that the Holocene started at 12000 BP in the Sanjiang plain of northeast China, but the pollen data has shown that temperature started rising possibly at around 10500 BP, which is later than he mentioned. However, in the pollen diagrams presented by Xia, Yumei (1988:Figure 1, 2), there is no significant change in pollen numbers at the bottom of the section dated around 10500BP, which indicates that the bottom of the section might not reach the deposits of the LGM. This only means that the Holocene in the Sanjiang Plain may start earlier than 10500 BP, but no evidence indicates when it began. In the Changbaishan area, the pollen section at Gushantun (Gu 2) illustrates that the number of pollen grains started to increase in 13000 BP (Liu, Jinling 1989), which possibly indicates the beginning of the Holocene. But Liu still argues that the beginning of the Holocene occurred before 10000 BP rather than considering 13000 BP as indicated by pollen data. He did not give any explanation for this (Liu, Jinling 1989:507).

Another source of evidence is the Qingshantou site, where two sites with faunal data have appeared in a sequence of deposits. One represents the Upper Pleistocene animals around 12000BP and another indicates a Holocene fauna above the

Pleistocene deposit with a radiocarbon date about 11000BP (Li, Xikun et al. 1984:6). Hence, Li has suggested that the boundary between the Pleistocene and the Holocene at Qingshantou was within 10000-10500 BP (Li, Xikun et al. 1984:12). Using a similar method, Russian archaeologists have suggested that in the Baikal area, this boundary was less than 10000 BP (Khenzykhenova and Alexeeva 1999). In the far north of northeast China, at the Zhalainuoer site, a C14 date shows that the beginning of the Holocene was no later than 12000 (Li, Xingguo et al. 1982:Figure 2). The data derived from Genhe, Daxinganling indicates that the Holocene began at 10300 BP (Na et al. 1997).

To combine the dates shown above, the beginning of the Holocene in northeast China may have commenced in the period between 12000-11000BP (Table 4-4 and Figure 4-24). However, if we consider the possible delay in the fauna and flora component responding to the temperature increase, the correct date for the beginning of the Holocene would be earlier than the result derived from the studies of changing flora. For this reason, the Holocene may have started as early as 12000BP in most areas of northeast China, with the dates indicating that the beginning of temperature increases may have been slightly earlier in the south than in the north of northeast China. In addition, the temperature began to rise earlier in the coastal area than inland (Figure 4-24).

4.6.2 “Holocene Climate Optimum”

After the Holocene began, the temperature started to increase worldwide, reaching its peak during the mid Holocene. In most regions in Europe during the mid Holocene, the weather was warmer and the increase in rainfall and climate were more conducive than previous periods in terms of plant growing, animal breeding and human inhabitation. This particular period is called the “Holocene Climate Optimum”(HCO) (Burroughs 2001:98-99).

In Chinese palaeo-climatology, however, some scholars have called the “Holocene Great Warm Period (GWP-全新世大暖期)” instead of “Holocene Climate Optimum”. The “Holocene Great Warm Period (GWP) is only used to describe a period during the Holocene with the warmest temperature around 6000BP. But in Chinese palaeo-climatological study, some scientists have replaced HCO with GWP. This misuse of the terminology came from the confused definition of the Holocene Climate Optimum Period in Mainland China. Wu et al. (1994) have pointed out that some Chinese scientists study the Holocene Climate Optimum merely using the temperature change and ignoring rainfall and humidity (or aridity). This might explain why they have used the term “Holocene Great Warm Period” in Chinese palaeo-climatology. Wu has corrected this mistake in his paper by using the “Holocene Climate Optimum (全新世气候适宜期)” instead of the “Great Warm Period”.

To recognize the Holocene Climate Optimum requires evidence of both temperature and moisture. A high temperature alone cannot represent the Holocene Climate Optimum, because some regions could be associated with a high level of aridity when temperature was high during the mid Holocene. In some regions of northeast China, such as the southwest regions, because high temperature caused aridity, the Holocene Climate Optimum did not occur. This arid zone was similar to the west Mongolian plateau today, with dry climate and semidesert or desert landscape. Such an arid zone could only support small numbers of animal and plants.

Instead of thinking that Holocene Climate Optimum occurred all the areas of northeast China, temperature associated with humidity must be considered. This is the standard method to identify this particular period according to the original definition in European palaeo-climatology (Burroughs 2001). For example, at the period of the highest mean temperature during the mid Holocene, the southern end of Liaodong Peninsula, Sanjiang Plain, and the southern slope of Changbaishan Ranges and Daxing’anling Mountains, had relatively high levels of humidity. Thus during the Holocene Climate Optimum, these three regions were covered by high-density deciduous broadleaved or mixture of conifer forests. However, in the lowland at the centre of the Sanjiang Plain, peat bog or wetland well developed because the lower elevation and lower temperature compared to the southeast.

At the same time, the rest of the area in northeast China, such as the Upper Liao River area, Song-Nen Plain and eastern Inner Mongolian Plateau, encountered a relatively dry period associated with high temperature. These areas had already suffered aridity during the end of Pleistocene but recovered slightly during the early Holocene. The higher temperatures and low level of rainfall during the mid Holocene around 6000BP (Liu, Hongyan et al. 2002) even aggravated this dry environment. For example, in the western Liaoning and the Lower Nenjiang River areas, the high level of aridity, with an annual mean precipitation of less than 400mm (Figure 4-18), developed a desert landscape (Figure 4-21). Today, this landscape still survives in the Kerqin desert in west Liaoning and the Song-Nen desert in the Lower Nenjiang River area (Ren, Guoyu 1999, 1998).

In summary, a regional approach to the Holocene Climate Optimum in northeast China indicates that some areas like the southwest region may not satisfy the criteria of Holocene Climate Optimum in full, because the highest temperature was not associated with higher level precipitation. Some regions in northeast China with high levels of aridity caused by high temperature and low rainfall during the mid Holocene would have led to difficult environment for plants and animals to survive.

4.6.3 Human migration during the early Holocene (before 8000 BP)

Together with the use of ceramics and village settlement, around 8000 BP microlithic stone artefacts became one of the major archaeological remains in northeast China. The reason for the change from a small stone tool tradition to microlithic technique during the early Holocene is not known, largely because there is a lack of archaeological data from c.12000 BP to c.8000 BP. But the increase in human habitation, indicated by the rising density of archaeological sites and the sophisticated context of archaeological assemblages, has suggested that changes in technology, economy and even social structure occurred. Coincidently, all these changes happened after the significant environmental changes of the early Holocene. For instance, the rising temperature worldwide in the early Holocene resulted in a massive rise in sea level. Northeast Asia in general lost huge coastal plains, a total of 944,000 square kilometres, due to the rapid rise in sea level (Figure 4-13, 4-14, 4-15 and Table 4-2). Also, the increased temperature would have led to a movement of fauna such as mammoth and woolly rhinoceroses, which could only survive in extreme cold weather (Figure 4-17). Apparently, these huge animals left the coastal grasslands and swamps, such as the Huanghai and Bohai Plains formed during the LGM period, and moved northwards to north and northeast China, or even further north. The Huanghai and Bohai Plains, where these animals once lived and bred, became too warm for them to survive and eventually turned to ocean. Inland, in north and northeast China, as well as the Korean peninsula, new fauna with modern species replaced the LGM fauna, an event which took around 2000 years to complete during the early Holocene. Fossils found in the Qingshantou site dated to about 13000 BP is very likely to represent the latest faunal remains in the Upper Pleistocene (Jin, Cangzhu et al. 1984). After the Holocene began, the Upper Pleistocene fauna was completely extinct in northeast China.

At the same time, human migration would have been occurred through northeast Asia. The rise in sea and subsequent submergence of the coastal plains during the early Holocene not only pushed fauna moving north but also forced human groups to move inland. The pursuit of huge mammals like mammoth and rhinoceroses may also encouraged human groups to move north. The Pleistocene hunters may have followed mammals moving north and northeast in to Siberia, or to the coastal areas of the Ochotsk and Bering Seas (Figure 4-25).

4.6.4 Human adaptation to the early Holocene environment in northeast China

As a prelude to the beginning of agriculture in northeast Asia, the early Holocene human and animal migration in a rapidly changing environment would have a significant impact on north China. Some human groups from previous coastal plains must have unified with inland groups, which increased the local population and forced them to share natural resources. The decrease and eventually disappearance of huge mammals, such as mammoth and woolly rhinoceros, that once were possibly the major subsistence for Palaeolithic hunters in northeast China, would have led to a decrease in traditional food resources. The additional population caused by immigration from the south would have accelerated this reduction in food supply. In order to continue an adequate food supply in a new environment, human groups would have to change their economic strategies to search for new ways of providing food, such as increasing the percentage of small game hunting with the increase in the number of small animals, and increasing gathering activities in order to supplement food supplies.

Another significant alternative for inland human groups was the exploitation of freshwater resources, particularly fishing. Along the banks of rivers or lakes, human groups would find abundant fresh water resources especially fish. Which period that inland human groups in northeast China started to exploit the fresh water resource is unknown. However, there is no evidence that humans exploited fish as a major subsistence resource during the Pleistocene. Regular fishing activity in northeast China might have occurred during the transition period from the Upper Pleistocene to the early Holocene. Either fishing skills were learnt from maritime fishing groups, or they were developed locally, once fishing activities, together with other freshwater resources were added to the food supply, the inland human group would have found how easy and effective they were. The freshwater resource eventually became a major economy of some groups in northeast China during the early Holocene, particularly groups located in the regions near the coasts, rivers and lakes.

The change in stone tool technology from simple large or small flake tools to bifacial and microlithic technology reflected the socio-economic change that occurred in northeast China during the early Holocene. There are two possible reasons for this change. First, it was very likely caused by the strong influence from neighbouring regions of northeast China, such as Siberia and the Amur River area (Jia, Lanpo 1986). Second, alternative ways of food procurement, such as fishing and small animal hunting or intensive gathering, in order to adapt to a new environment would have required new tools. Many changes, including possible changes in social structure, were a reaction to the new environment both in north and northeast China. For instance, the wedged microcore indicates intentional core preparation for producing microblades and some of the microblades were combined with bone holders forming specific composite tools. It is unlikely this composite tool tradition was developed locally because of the later date of microblades in northeast China compared with the neighbouring areas. The earliest date of this composite tool in northeast China is around 8000 BP in the Xinglongwa site (Chinese Academy IMT 1997:19:Figure 19). It is likely that this date is not the earliest in northeast China because of the small number of sites and less attention in the early Holocene (Figure 1-6 in Chapter 1). Nevertheless, there is no sign of this tool or the typical microblade tool in the sites dated prior to this such as the sites of Qingshangtou (Li, Xikun et al. 1984) and

Daxingtun (Huang 1984) dated about 13000-12000BP. The earliest date of this tool would have to be in the period between 10000 and 8000 BP. This composite tool is usually related to the microblade technology. The microblade technology found both in Siberia and north China began almost ten thousand years earlier than in northeast China at about 20000BP (Larichev et al. 1990; Lu, T. L. 1998; An, Zhimin 1978). The extension of microblades technology may indicate the possibility of migration from northern steppe to the south, including northeast China. During the beginning of the Holocene, small animal hunting and freshwater resource exploiting, as well as intensive plant food gathering in the Holocene environment, meant that human settlers in northeast China quickly adopted new tool technology, including composite tools appropriate to the needs of these diverse food procurement and social activities.

4.7 CONCLUSION

I have demonstrated my environmental reconstruction for northeast China in this Chapter. Through this demonstration I have discussed the general method of using synthetic method to retrieve past environmental information. In particular, the important studies of surface pollen data against modern vegetation and the precipitation model generated from surface pollen, which are fundamental methodologies used in current palynology have been applied in my environmental study. This has made the results of reconstruction more accurate. However, because my studies of environment are mainly based on pollen data from literature, this can only be an approximate reconstruction.

The discussions in section 4.6 actually involved several questions, which are closely related to my studies. Particularly, the questions in sub-sections 4.6.2, 4.6.3 and 4.6.4 are connected to human activities and ecosystems, including prehistoric economic styles. Discussion of the boundary between the Pleistocene and Holocene seems not directly related to my study, but this boundary is the indicator of environmental change, from an extreme cold to relatively warm. At the same period, the early plant domestication started in East Asia, including north China. I therefore prefer to look at many possibilities and various factor in relation to transition to farming rather than ignoring some potential chances to find connections between environmental changes and agricultural transitions. That is why I have clarified the boundary between the Pleistocene and the Holocene.

CHAPTER 5. CASE STUDY (1): THE LIAO RIVER AREA

5.1 INTRODUCTION

In this Chapter, I am going to apply my framework to the Liao River area in northeast China. This is the first case study in my thesis and is the best region for my research particularly the Upper Liao River region because more archaeological fieldwork and studies have been done compared to other regions in northeast China. I will use tool analysis combined with information from archaeological discoveries other than tools to establish a model of transition to farming in this area. In section 5.2, I discuss some details of environmental reconstruction in this region. Section 5.3 is a brief summary of archaeological studies in this area. Tool complexes in this area will be analysed in section 5.4 and some discussions about archaeological discoveries other than tools will be in section 5.5. In section 5.6, a regional model of transition to farming will be generated.

The Liao River region is located in the southwest of northeast China. It includes west Liaoning and southeast Inner Mongolia (Figure 5-1). This region is close to north China, which is one of the areas of Chinese agricultural origins, characterised by millet dominant cultivation.

Comparing these two regions, north China and the Liao River area, the earliest discoveries of domestic crops are from a similar time, around 8-7000BP, e.g. Cishan (Hebei Administration 1981) in north China, Zhaobaogou (Liu Guoxiang et al 2004; Chinese Academy IMT 2004) and Xinle (Shenyang Administration et al.1985) in the Liao River area. But the number of sites containing crop remains and the quantity of seeds is different. In the Liao River area, the sites contain a relative small amount of domestic seeds compared to numbers of sites containing a large amount of millet remains in north China. Even though this situation could be changed if floatation method have implicated in all excavations in both north and northeast China. And some archaeologists strongly believe that the Liao River area is the another agricultural origin (Yan, Wenming 2000a, 2000b), the actual situation of transition research in the Liao River area remains unclear because of the little evidence of domestic plants.

Geographically, the Liao River region comprises two sub-regions, the Upper Liao River with mountain slopes and the Lower Liao River area with a flood plain called Lower Liao River plain (Figure 5-2). The Upper Liao River area is a mountainous slope from 1000 metres above sea level in the west down to 200 metres in the east, with total length of about 400 km. The Lower Liao River plain is located east of the Upper region and is about 110 metres above sea level. The south end of the Lower region is the coast of the Bohai Bay. The vegetation of the Upper Liao River area is forest or open woodland while the Lower Liao River tends to be covered by grass in most periods of the Holocene.

Archaeologically, we should discuss these two subregions separately. Nevertheless, due to the lack of archaeological data in the Lower region, I have to put these two regions together in one regional study.

5.2 ENVIRONMENTAL RECONSTRUCTION OF LIAO RIVER REGION

With the reference of the studies in monsoon, isotopic and hydration level, two groups of pollen data are used in the environmental reconstruction in this region: one is the surface pollen (Li, Wenqi 1998; Liu, Hongyan et al. 1999)(Figure 4-7, 4-8) and the other is collected from several sites around Upper Liao River region (Xia, Zhengkai et al. 2000) (Figure 5-3).

Pollen data from the surface of the loess reveals a low density of trees with *Artemisia* dominant grassland (Figure 4-7). By comparison, arboreal pollen in the deposits from archaeological sites (Figure 5-4) has increased twice since the early Holocene. The first increase was before about 7000 BP, during the Zhaobaogou period, with arboreal pollen over 45%, suggesting a “woodland grassland” landscape. At the same time, fern pollen also increased indicating a relative warm and humid climate than previous period. Similar result derived from the studies of summer monsoon in northeast Asia also supports this (An, Zhimin et al. 2000).

In the second increase, during the Lower Xiajiadian period around 4000 BP, arboreal pollen was near 20 %, suggesting a “woodland steppe” compared to the results from surface pollen studies (Liu, Hongyan et al. 1999) discussed in Chapter 4 (Figure 4-8). Overall the vegetation coverage through time in the Liao River region was mainly grassland. *Artemisia* was the major species of non-arboreal plant, which should indicate a relative dry climate in most of the Holocene.

From c.7800 to 6400, about 1500 years, pollen analysis suggests a dramatic climate change. Around 8000 BP, the climate was dry and cool (Figure 5-5). The annual average temperature was similar to present, having increased at least 2°C compared to c.10000BP. But the rainfall in about 8000BP was not much changed compared to c.10000BP (Figure 5-6). But then, around 7000 BP, temperature appears to have increased by around 5°C and rainfall by about 50 mm, while the landscape became woodland–grassland. This increase of rainfall was likely caused by summer monsoon from ocean in the south (Liu, Hongyan et al. 2000). Around 6300 BP, temperature was very high. The warmest temperature combined with a stable rainfall would have resulted in a very dry climate.

Ferns usually survive under the shadow of trees and require sufficient moisture (Purves et al. 1995:558-559). The changes in the percentage of fern pollen also indicate the analysis above. For instance, from c.7800 BP to 6400 BP indicated the humidity levels in this period; dry at first then wetter and finally dry again. Around 6000 BP might have been the warmest and driest climate in the entire Holocene. After c.5500 BP, temperature decreased slightly and annual average rainfall increased to 500mm. This environmental condition at least should be as good as around 7000BP for tree growing and some trees did grow back on mountain slopes but the percentage of arboreal pollen shows that the density of trees was not as high as around 7000 BP. Why did increased rainfall and a warm temperature not raise the level of arboreal pollen to at least that found c.7000BP? One of the reasons was possibly human disturbance in that the increase of farming practice needed tree clearing. This assumption is similar to the result of Ren, Guoyu (1997)'s study about the pollen profiles after 3100BP in this area. He has ascribed the lower level of arboreal pollen after c. 3100 BP to local farming practice. Different vegetation results deduced from pollen data and climate after 5500BP possibly suggest the same reasons as Ren has assumed, that farming practice was responsible for lower level of tree pollen.

However, whether it was in fact connected to local farming activities will be discussed in later sections.

According to the pollen data and also considering previous studies of palaeo-climatology (e.g. Xia, Zhengkai et al. 2000; Liu, Hongyan et al. 2000; Ren, Guoyu 2000, 1999, 1998), I have sketched an overview of vegetation coverage in the Liao River region (Figure 5-7, 5-8, 5-9, 5-10, 5-11, 5-12).

The environmental reconstruction discussed above is mainly based on the data from the Upper Liao River area. Environmental changes in the two sub-areas, the Upper and Lower Liao River areas, should not be the same even though they would be very close. As a transition zone, the Upper Liao River area is close to the northwest dry with desert-steppe coverage and high altitude, but the Lower Liao River area is next to the southeast humid area with forest coverage as well as being less than 200 kilometres south to the coast since the early Holocene. Presumably, the Lower Liao River area would have a more humid climate and relative stable weather compared to the Upper. High temperature during the mid Holocene may also result a dry climate but this would not be as severe as in the Upper area. The humidity recovery after the mid Holocene dry period would also be better than in the Upper area. These assumptions will be modified if pollen data become available in the future, but in this thesis I have to use this as the basic environmental conditions to serve the transition research.

5.3 SUMMARY OF THE ARCHAEOLOGICAL CHRONOLOGY

In the space of this thesis I can give only a brief summary of the archaeological cultural sequences in this area. Typological analysis of archaeological cultures and their chronological positions in northeast China are still continuing (Zhu, Yanping 1997) and need further study. In most areas of northeast China, constructing cultural history based on the analysis of stratigraphy and context of artefacts is still the major task of local archaeology. Recognising new traditions of material culture and their chronologies through fieldwork continues to be carried out in local research. Based on the archaeological data collected from the literature and through my own experience of typological studies (e.g. Jia, Weiming 1986, 1985), I have summarised the archaeological chronology in the two sub-regions: the Upper Liao River in the northwest and the Lower Liao River in the southeast (Figure 5-13).

5.3.1 The Upper Liao River Region

Six archaeological periods have been identified represented by each culture in this area (Figure 5-12). There are also some sub-groups within a culture (Zhu, Yanping 1997) (Table 5-2). But these six are the major cultures in this region.

The first, from the LGM to the early Holocene (c. 12000-10000 BP), is represented by the Bajianfang site (Liaoning Museum 1973). During this period, archaeological data only shows that the tradition of small stone tools, which are without typical micro-stone tool technology such as wedged cores for producing microblades, are predominant. However, few archaeological data are available yet (see Figure 5-7). The climate in this period was cold and dry with desert or semi-desert in most areas north of 41° N. Grassland was only developed in the south (Figure 5-7). The broad distribution of desert or semidesert in the Liao River area would limit human use of the area during the beginning of the Holocene.

The second period, around 8000 BP, is represented by the Xinglongwa culture. In this period, settled villages comprised many houses built close together (Figure 5-14). Ceramics includes cylindrical pots decorated with impressed zigzag patterns. Stone tools include stone axes, adzes and digging tools, and also knives formed by numbers of microblades fitted on bone handles (Chinese academy IMT 1997, Yang, Hu and Liu, Guoxiang 1997). This knife formed combining microblades and bone handle could be used as reaping knife for plant food collection (Anderson 1999). Recent use-wear analysis has assured this possibility (Wang, Xiaoqing 2004, 2004). During this period, the climate was still dry but temperature increased to about equivalent to the present (Figure 5-5). Because the temperature increased about 3-4°C compared to 1000 years earlier, the grassland in the south of 41° N became open woodland. Most desert and semi-desert in last period turned to grassland. The Xinglongwa culture is usually found in the open woodland area (Figure 5-8).

The third period, around 7000 BP, is called Zhaobaogou culture. Villages were similar to the last period with many rectangular houses in a small area (Liu,Guoxiang 2000;

Zhao, Binfu 1991; Chinese Academy 1997, 1987). Along with the slightly changing shape and design of decoration on cylindrical pots, colour painting on pottery started in this period but with very small numbers (Chinese Academy 1997:138). Tools formed by microblades and bones are still used and more digging tools with well-designed shapes were found (Figure 5-13). The temperature in this period increased to around 1-2ºC higher than present. At the same time, annual precipitation slightly increased to between 450 to 500 mm in compared to 400mm in last period. Consequently, the relatively humid and warm climate led to an increase of trees and changed the open-woodland into forest. The more than 40% fern pollen that is found during this period also indicates an increase of trees and a humid climate under the shadow of trees (Figure 5-4, 5-6). This temperate forest replaced most of the open woodland of the last period (Figure 5-9).

The fourth, Hongshan around 6000BP, culture saw more painted pots, and digging and harvesting tools (Chinese Academy IMT 1997, 1982, 1979; Chinese Academy ITM et al. 1998; Inner Mongolian Kaogusuo 1993,1994; Balinyouqi Museum 1987). Large monumental constructions were found in the south of this region (Liaoning Kaogusuo 1997a, 1997b 1994b, 1986). Many exquisite jade objects were discovered in this period (Liu, Guoxiang 1998; Lu,Jun 1998). The climate was warmer and drier. A temperature more than 5°C higher than present (Figure 5.5) combined with a similar annual average precipitation of 450mm (Figure 5-6), led to the driest environment since the Holocene began. High-density forest during the last period returned to open-woodland again or an even lower density of arboreal plants (Figure 5-10).

Next, around 5000 BP, the culture of Xiaoheyan appeared. A new shape of pottery "*Dou*" appeared as well as new collecting tools such as the composite knife (Li, Gongdu 1980; Liaoning Kaogusuo et al. 1998, 1977). Because most archaeological data are derived from burials, the material cultural tradition derived from archaeological data is incomplete. Temperature was cooler than in the last period, at least 1°C lower than previous period. Precipitation was similar to the period with 450mm annual average. Compared to the last period, the vegetation did not change much as most mountain slopes were covered by open-woodland and grassland (Figure 5-11).

The sixth period is the Lower Xiajiadian culture, around 4000 BP. During this period, a new cooking pot, tripod "*Li*", appeared and bronze artefacts, including weapons are found. Circular houses emerged and village settlements became fortress surrounded with walls. A large amount of crop remains, including broomcorn millet, was found in several sites and some were unearthed in the cooking pot tripod "*Li*" or "*Yan*" (the second left pottery in the Lower Xiajiadian period in Figure 5-5) (Chinese Academy IMT 1974, 1975, 1979, 1996; Liu, Jinxiang 1975; Zhu, Yonggang 1987, 1991b, 1998a,). The climate was cool and slightly wetter than before, similar to present. Vegetation was still similar to the last period with woodland covering most slopes (Figure 5-12).

5.3.2 The Lower Liao River Region

Even though the traditions of material culture in this area have been divided into several groups (Zhu, Yonggang 1998a; 1993; 1991b; Zhu, Yanping 1997; Zhu, Yonggang et al. 1997), similarly to the Upper Liao River area, many gaps between these groups have made the picture of cultural traditions incomplete. A very initial table is generated from the literature by my studies (Table 5-3).

There are only five major periods, represented by Lower Xinle (Xinle II), Pianpu (Santang), Xishan, Gaotaishan and Upper Xinle cultures, which can be identified from literature about the Lower Liao River region because archaeological data has shown little about human inhabitation during the early Holocene (Figure 5-15). For comparison to the LGM environment, I use the data from the first period of Upper Liao River in this region (the first period in Figure 5-15). I assume that the tradition during the LGM in this region was similar to the Upper Liao River area. For instance, chipped stone tools, particularly the small stone tools with no signs of microblade technology were predominant. The human inhabitants mainly utilised natural shelter, such as caves. The environment was cold and dry. Most areas in this region tended to be grassland and some areas to the north might appear semidesert. The present Bohai Bay was above sea level and became extensive grassland (Figure 5-5).

Skipping the period during the early Holocene due to the gap addressed in Chapter 3, the second period started with the Lower Xinle (Xinle I) culture dated to around 7000BP (Shenyang Administration 1978) (Table 5-4). Archaeological data shows that rectangular pit houses emerged and domesticated seeds of broomcorn millet were unearthed during this period. Pottery found in village settlements is also decorated with some zigzag designs but these are different to the tradition in the Upper Liao River area. Stone tools found in Xinle comprise microblades and polished tools. The environment around 7000 BP was warmer, with annual average temperatures about 7°C higher than about 10000BP (Figure 4-16). But precipitation was not high, being around 500mm in annual average (Figure 4-17). Relatively higher temperatures would cause high-level evaporation and led to a dry environment. Under this dry regime, the vegetation remained grassland (Figure 5-8).

The third period is the Pianpu culture represented by the Santang site including the Santang layer I, II and III (Liaoning Kaogusuo et al. 1992). The layer I in the Zhaogongjie site also belongs to this culture and this period (Chinese Academy Dongbei Team 1989). The date of Pianpu is *Variant* is around 6000-5000 BP. House shape was still a rectangular pit. But pottery was made with unique shapes and decorations, such as thick lips and many vertical clay bands on surface (Figure 5-15). Climate was warmer, possibly 2 °C (Figure 4-16) higher than the last period. Rainfall slightly increased to around 550mm (Figure 4-17). High evaporation would have resulted from this high temperature. Therefore, most areas were still covered by grassland in this period (Figure 5-9 and 5-10).

The Xishan culture is dated to around 4500 BP (Xu, Yulin et al. 1992). Pottery developed new shapes and new styles, such as tripod pottery, a short pot with flat bottom and three short legs, and *Dou,* like a large goblet, appeared. These new styles of pottery were similar in design to the pottery found in the Jiaodong peninsular. This tradition of pottery is named Longshan culture. The discoveries of the Jiaodong pottery tradition in northeast China suggests that cultural exchanges existed between these two regions across the Bohai bay. This cultural exchange indicates the contact between the farmers in north China and the human settlers in northeast China, and possibly represents migration from north to northeast China.

Temperature was slightly lower compared to the last period, similarly to the present (Figure 4-16). Even though it was still warm, precipitation continually increased to higher than 500mm annual average (Figure 4-18). Relatively lower evaporation resulting from the decrease of temperature combining with the increase of rainfall brought the first wet climate for this region since the early Holocene.

The fifth is around 4000 BP, and is represented by the Gaotaishan culture (Shenyang Administration 1982). Decoration almost disappeared in all categories of pottery. Similarly to the Upper Liao River, circular houses and new cooking pots emerged in this region during this period. Both circular houses and tripod cooking pots were adopted from Lower Xiajiadian culture located in the Upper Liao River area. Environment was wetter than before with increase of rainfall and decreased temperature (Figure 4-16 and 4-17).

5.4. TOOL COMPLEXES

Usewear analysis has been applied on stone tools found in the Xinglongwa and Zhaobaogou sites, in the Upper Liao River area (Wang, Xiaoqing 2002). As I discussed in Chapter 3, Wang Xiaoqing (2002:142) has found the different functions in the same tools in his studies. For example, spade shape stone tools found in Xinglongwa were possibly involved digging, chopping and scratching animal skin. Also, he described that the microblades found in Zhaobaogou possibly used for harvesting domestic plant (Wang, Xiaoqing 2002:144). Here we need the reference derived from the local modern plant experiment. For instance, in the archaeological site of Arjoune, both domestic and wild barley were recovered. To determine whether the “sickle” harvested wild or domestic barley requires the experiment on both plants in different seasons, such as still green, dried (Unger-Hamilton 1988:245). If the used marks show some differences between domestic and wild then the different marks may become the reference of distinguishing the tools used on harvesting domestic or wild plants. Similarly in the Zhaobaogou site, it is necessary to provide local reference, using the tools made of local raw materials and harvesting local domestic or wild plants. However, without residue analysis, the study merely depending on the morphological comparison of the used marks and traces is questionable. The reliable result may combine both residue and usewear analysis. Otherwise, the traces and marks on the stone tools may provide unreliable information.

Using my method of tool analysis to categorise tools discovered in different sites in this region, I have found that tool complexes tend to be similar in the same tradition even they are discovered in different sites. For instance, there are two sites, Xinglongwa and Chahai with close cultural tradition, which were assigned to one material culture of Xinglongwa. Even though these two sites are separated by more than 100 kilometres, their tool complexes are similar (Figure 5-16 & 17). Both sites have a large amount of gathering tools, Chahai with over 90% and Xinglongwa with 60%.

This phenomenon also can be found in other traditions. For example the Xiaoshan (Figure 5-18) and Zhaobaogou sites (Figure 5-19) in the Zhaobaogou culture show similarities even though the percentage of each category is not the same. In both sites, the highest percentage is of hunting tools. Similar examples occur in the Hongshan (Figure 5-20 & 21) and Lower Xiajiadian culture (Figure 5-23). In the Lower Liao River region, Xinle sites (Figure 5-25) and Santang sites (Figure 5-26) appear to be similar situation. Thus ancient people from similar periods and tradition may have similar tool complexes, as required by similar economic types in a similar natural environment.

Some differences between tool complexes also appear in the two sub-regions. In the Upper Liao River area, the number of tools in tool complexes fluctuated through time. For example, gathering tools was very high during the Xinglongwa period, c.8000BP, and then dropped dramatically around Zhaobaogou, c. 7000BP, before gradually increasing around Hongshan, c. 6000 BP. During the Xiaoheyan period (c.5000BP) this number dropped again before a substantial increase during the Lower Xiajiadian period (c.4000BP). In Lower Liao River region, during the Xinle (c.7000 BP) and Pianpu (c.5500BP) culture periods, the number of hunting tools was high. But the number of gathering tools increased consistently through Santang (c.5500BP), Xishan (c.4500BP) (Figure 5-27) and became dominant in Xinle period II (c.3500) (Figure 5-28).

However, tool complexes in the Xiaoheyan period are quite abnormal compared to the previous periods since its hunting tools suddenly increased (Figure 5-22). There are at least three possible reasons to explain this. First, the tool complexes of Xiaoheyan were based on the data collected from two burial sites, which might be strongly influenced by custom, cult, religion or even personal preference. Burial tool complexes may not properly reflect actual tools used in daily life. Second, during the Xiaoheyan period, domestic animals may be present, so the increase of hunting tools might be caused by frequently using them for killing or butchering domestic animals. Third, the increase of hunting tools in the Xiaoheyan period may indeed reflect a higher proportion of hunting economy, which may be caused by either the influence or actual immigration of hunting groups from further north. There is insufficient data to decide the actual reason. However, various herding economies found during the Lower Xiajiadian period indicates that animal herding began earlier than this and presumably emerged during the Xiaoheyan period (Chinese Academy IMT 1996, 1979, 1975, 1974; Liu, Guanmin 1992).

Comparing these tool complexes with the baseline of north China (Figure 3-16), which I discussed in Chapter 3, the two areas in the Liao River region tend to show different processes of the transition to farming (Figure 5-29).

In the Upper Liao River Region, the availability period was around c.8000-7000BP, from Xinglongwa to Xiaoshan and Zhaobaogou, and the substitution period was between Zhaobaogou and Xiaoheyan, even if Xiaoheyan saw a drop in gathering tools. The consolidation period should start from c.4000BP, the Lower Xiajiadian period. In this region, the substitution period was more than 3000 years. After the consolidation period began (4000BP), the agricultural economic type of this region seems to be unstable very likely because of the shift to animal herding (Top diagrams in Figure 5-29).

In the Lower Liao River region, this transition process seems more stable than in the Upper Liao River region, even though the sequence of tool complexes is not complete due to the insufficient data, such as the periods of c.8000 and c 6000BP. Gathering tools continually increased from the Xinle period (c.7000BP). The availability period for this region was before the Pianpu period (c.5500BP), and the substitution period was from Pianpu to Xishan period (c.4500). The consolidation period should begin from Gaotaishan period (c.4000), which was similar date to the Upper Liao River region around the Lower Xiajiadian period, but the data for tool proportions in the Gaotaishan period is not available. With the tool complex of Xinle II (c.3500BP), which was later than Gaotaishan, the consolidation period was around 3000BP (Second line in Figure 5-29).

After 3000BP, Chinese empire had forced its political influence into this region as well as the Liaodong peninsular (Zhang, Boquan 1985:44-45) and extended its power into the entire Liao River area after state *Yan* (located in Beijing and northern Hebei) was established during the warrior state (770-256BC). This included redrawing political administrative regions, migration from central China and introducing agricultural economies into this region (Zhang, Boquan 1985:44). After that, the agriculture became the major economy in this region till modern times.

5.5 ARCHAEOLOGICAL DISCOVERIES OTHER THAN TOOL COMPLEXES

In this section, I will discuss some archaeological discoveries reflecting the contacts, influences between farmers and foragers in this region and their effects in the process of transition to farming. I will also discuss the process of social structure in this region and the interrelationships with the process of transition to farming.

5.5.1 Cultural interaction between north and northeast China

Archaeological discoveries other than tool complexes have shown that cultural interaction between in northeast China and central and north China occurred. Cultural contact can be traced back to the early Holocene when microblade technology spread to all regions of northeast Asia, including north and northeast China. This was the early cultural contact among foragers. In the Liao River region in particular, this contact became the prelude to the interaction between farmers in north China and foragers in northeast China. This interaction is indicated by ceramic designs, house construction, and diffusion of specific pottery from north China through the Liao River region to northeast China.

5.5.1.1 The interaction indicated in ceramic designs

Ceramic designs showing the interaction were marked on the painted pottery adopted into this region during 6500BP(Figure 5-30), while the traditional cylindrical pottery in the Liao River region extended into north China around 7000 BP.

Painted pottery began around 7000 BP in north China, e.g. Cishan (Handan Administration et al. 1977), a remain of farming society, and developed diverse patterns in the later period, such as Hougang, also a agricultural community, around 6000 BP (Zhang, Zhongpei et al. 1992). Some Chinese archaeologists argue that the patterns of colour painting in the Hongshan period in the Liao River region were based on its own tradition such as the similar impressed designs during the Zhaobaogou period, and attempt to deny the interaction with north China (Xu, Guoji & Zhu, Yanping 2001). However, unlike the area closed to north China where has developed painted pottery in a similar period, the colour painting was not developed in the further north and northeast of northeast China until very late period. For instance, around 2000-3000BP, the colour painting tradition appeared in the Song-Nen plain and the Changbaishan areas (Heilongjiang Kaogusuo 1988a; Lin, Yun 1985; Jia, Weiming 1985b), which was 3000 years later than the Liao River area. Specific colour painting patterns in the Liao River area may reflect a cultural interaction process between north and northeast China. It is possible that based on its own traditional designs, but using the painting techniques adopted from north China, Hongshan communities have created the designs representing their own culture (Figure 5-30) and based on their own agricultural economy proportional developed since the Xinglongwa culture in this region, at the same time some farming techniques may also have been exchanged from north China into this region accelerating the process of transition to farming.

The contact between these two regions: north China and the Liao River region in northeast China, was two-way. One of the examples of these influences is the tradition of rocker-stamped (or zigzag) design in the Liao River area, this design being usually applied on the surface of cylindrical pots (Figure 5-31). Similar shaped pots with zigzag designs are also found in the cultural complexes in Cishan, north China

(Handan Administration et al. 1977), which indicated the contact in the form of cultural exchanges from the Liao River region to the north China.

5.5.1.2 The contact shown in house construction

Two regions of China have distinctive traditions in the design of house shape, circular originated in north China and rectangular in northeast China. Around 5000 BP, in the Liao River region, circular shaped houses appeared and gradually became dominant in this region after 4000BP (Fig. 5-32).

5.5.1.3 Specific pottery diffusion to northeast China

Several changes in ceramic style, which may suggest cultural contact, appeared after the Hongshan period. First, a pottery *Dou* was adopted from north China, possibly mainly from the Jiaodong Peninsula (Figure 5-33), which can be found in the Xiaoheyan assemblages (c.5000BP). Second, tripod pottery *Li* was introduced into this area by the Lower Xiajiadian period (c.4000BP).

The pottery *Li* was an important cooking ware in north China during 5000BP, and several cooking wares were produced related to this tripod shape of pottery *Li,* such as *Yan*, *Jia*, *He* and *Gui* (Zhang 1999). However, only *Li* and *Yan*, a composite pottery formed by combining of cooking pot *Li* and a steaming pot *Zeng* (Figure 5-34), were introduced into the Liao River region.

Even if the adoption of pottery *Dou* only indicates the new shape or design attracted the craftsperson in this region, introducing the pottery *Li* would have more implications. *Li* and other tripods, such as *Yan* were specific cooking wares. Hunted food, such as meat is easily cooked on a top of normal fire, but for food from crops, it is usually necessary to use a particular pot for cooking. Tripod *Li* and *Yan* (also *Zeng*, Figure 5-34) were possibly invented for cooking millets in north China and introduced into northeast China for the same purpose.

5.5.1.4 The contact shown by metallurgical items

Dating from the Lower Xiajiadian period, the same time as the adoption of tripod *Li*, discoveries of bronze artefacts became common in archaeological fieldwork in this area. This metallurgical technique was also adopted from north China because some bronze items found in the Liao River area are similar in shape to the discoveries in north China, and some pottery found in the Liao River region are decorated with similar patterns on bronze vessels found in Yellow River basin (Shelach 1999:107). These bronze vessels, some with ancient Chinese inscriptions, are also found in the Liao River region. Some archaeologists have argued that these bronze vessels suggest the close connection between the *Yan* state in north China and the Liao River region in northeast China during 3-4000 BP about the Shang and Zhou dynasties (Liaoning Kaogusuo 1998; Liaoning Museum 1979).

5.5.2 Changing social structures and the transition to farming

In this part I will summarise the recent studies in the development of social complexity in the Upper Liao River area. The terminologies used in this part are quoted from former researchers in order to avoid pre-label these societies and overlook the actual stages and possible unique characters in the process of developing social complexity in this area.

Settlement pattern is one of the indicators of social structure, which implicates the development of social complexity. The sequences of settlement patterns should indicate the changes of social structure and social complexity in prehistoric communities (Liu, Li and Chen, Xingcan 2003; Liu, Li 2000). In other words, a change from egalitarian to hierarchic society would have to be reflected in the settlement patterns of archaeological data, including the ranking of houses, villages, burials, monumental constructions, as well as the development leadership strategies in terms of improvement of technology and maintaining economic systems. What is the connection between social changes and economic change such as transition to farming in this area? What social construction was associated with each period of transition to farming? To answer these questions requires the study of social complexity through time.

Shelach (1999) has studied the change of social complexity in this region and summarised the diachronic process of social and political changes. He suggested that the social complexity developed in the Hongshan society was a “group oriented” one and powers of the elite were tied to collective ideology that stressed group solidarity rather than to an individualistic ideology that emphasised personal accumulation of wealth and power (Shelach 1999:84). Li, Xinwei (2003) has illustrated an outline of development of social complexity in the Upper Liao River area. Based on the different ritual ceremonies indicated by archaeological data he has suggested that from Xinglongwa to Hongshan social complexity has developed from “Ritual in house” of Xinglongwa to “Rirual in community” of Zhaobaogou and to “Ritual in sacred space” of Hongshan (Li, Xinwei 2003:65-137). He pointed out that the impression of gaps in archaeological data, particularly during the Xiaoheyan (post Hongshan) period may have to implicate deterioration of social complexity reflected by the sparse distribution of settlement village (Li, Xinwei 2003:227). This deterioration or decline in social complexity was possibly the result of mismanagement of economic resources as Shelach suggested that Hongshan elite had no control over the subsistence base (Shelach 1999:84). Li, Xinwei (2003:227) has further discussed that elite of Hongshan community was unable to maintain or to utilise “all power resources to manage efficient economic reform” (Li, Xinwei 2003:227) under the changes of environment. Shelach and Li have proposed their hypotheses of study into social complexity in the Upper Liao River area. Based on their studies, I will discuss the changes in social structure in relation to the transition to farming through time in this area.

5.5.2.1 From Xinglongwa to Zhaobaogou (before 6000BP)

Based on archaeological discoveries, the Upper Liao River region has developed village settlement at least since 8-7000 BP, such as the Xinglongwa (Figure 5-14) and Chahai site. This village settlement contained many rectangular pit houses, which were similar in size and shape and deliberately built together (Chinese Academy IMT 1997). The one common feature of these houses is no evidence of an entrance based on the remains of house pits and postholes. The house size in Xinglongwa was usually around 50–80 square metres and larger in the early period than later in the Xinglongwa site. Houses of only 15-30 square metres built on the top of a ditch in Xinglongwa have been assigned as later than the houses inside the ditch (Chinese Academy IMT 1997:2). Two large houses, of around 140 square metres each, are located close to the centre of this village settlement. They should have some particular meaning such as communal houses in Xinglongwa societies because they are obviously distinguished from the normal houses. The Chahai site with the same cultural tradition of Xinglongwa, a “dragon” built with piled pebbles, 19.7 metres long, was excavated beside the large house in the centre of the village. This “pebble dragon” should relate to ceremonial activities of the Xinglongwa societies (Chinese Academy IMT 1997:25; Liaoning Kaogusuo 1994a).

Burials were found near the village and some burials found inside houses may have specific ritual implications. For instance in Burial No118 in the Xinglongwa site, two entire pig skeletons, male and female, were buried inside a house and associated with a male human skeleton (Chinese Academy IMT 1997:9). Based on these inside burials Li, Xinwei (2003:65) has named “ritual in house” to represent the level of social complexity in Xinglongwa.

The ranking of houses and burials is obscure since almost all houses (except a large one in the centre of the settlement) and burials are similar in size. Some burials, usually found inside houses in the Xinglongwa site, have relatively large numbers of artefacts, such as burial 118 (Chinese Academy IMT 1997:9). This may imply the person in the burial had a high position in the family. Li, Xinwei (2003:81) has analysed the archaeological data of the Xinglongwa culture and illustrated an understandable image of social construction of the Xinglongwa community. Li, Xinwei (2003:81) used Chang’s (1958) concept of “kinship organization”, to describe that the Xinglongwa society had “high degree of correlation between community plans and kinship organization” and “planed village pattern positively indicated a monolineage community”. He also suggested that ritual might have to played significant role in maintaining this structure but limit in a household level (Li, Xinwei 2003:88). Thus the Xinglongwa society was very likely to be a relatively egalitarian society, and inequality remained in the level of gender, age and position within a single household. Apparently, the economic strategies were also maintained in household level more relying on hunting/gathering although crops cultivation had been developed (Li, Xinwei 2003:230). Transition to farming remained in the availability phase.

There were some changes of settlement pattern during the Zhaobaogou period (c.7000BP) compared to Xinglongwa. All houses appeared to be of rectangular shape as in Xinglongwa, but the size of normal houses decreased, which occurred in the late Xinglongwa period, and the entrance of house became visible in this period. Large houses, such as house No 9 in the Zhaobaogou site (c.88 square metres), are smaller than in the previous period (Chinese Academy IMT 1997:49-50). Houses in settlements can be divided into several groups and each group or each house was built not very close to its neighbours as in Xinglongwa. Village settlements changed from a single village filled with houses concentrated next to each other in Xinglongwa, to a village with several groups of houses in Zhaobaogou (Chinese Academy IMT 1997:5). This change may imply segregation occurring inside the Zhaobaogou society, smaller groups containing several families being divided from large groups. As Li, Xinwei (2003:123) suggested that more complex society than Xinglongwa has developed during the Zhaobaogou period referring to the characters of exchange networks, feasting ceremonies and ideological orientation in the leadership strategies. He used "ritual in community" to named the social complexity in the Zhaobaogou society based on the group-segregation of houses within a village settlement and possibly altar found in the Zhaobaogou site (Li, Xinwei 2003:107). "Ritual in community" of the Zhaobaogou society was more complex than "ritual in house" of Xinglongwa. Social complexity has developed during the Zhaobaogou period and crops cultivation may also increase in the proportion of food supply. The subsistence economy even though remained in the major hunting and gathering the increase of crop cultivation may due to the development social complexity. The development of social complexity would have to require more surplus production in food supply in order to satisfy the increasing frequently social activities such as feasting and other ceremonies. This social change towards to complex society has led to the increase of crop cultivation and the transition to farming appeared the substitution phase.

5.5.2.2 Hongshan (c.6000BP)

During the Hongshan period, one obvious change in social structure is implied by large monumental constructions, including altars, cairns, tombs and one possible temple (the Goddess temple) (Hua & Yang 1998; Liaoning Kaogusuo 1997a, 1997b, 1994b, 1986; Guo & Zhang 1984). Numbers of jade object discovered in the Hongshan complex suggest a higher level of craft technique. Available data for village settlement is the size of some sites discovered in this area (Figure 5-35 and Table 5-5) and burials become important evidence for social and political changes in this period, particularly as it is related to the substitution period of the transition to farming.

Hongshan jade objects have revealed outstanding features. The jade made into circular dragon shapes are the most famous of all objects. According to the type of the head, these jade objects are recognised as pig-dragon, bird-dragon or just dragon (Figure 5-36 left top). Pig-dragon is the dominant design, about 70% in all jade dragon discoveries.

Houses in Hongshan were still of rectangular shape, for example in the Xishuiquan site (Chinese Academy IMT 1982). The mean size of Hongshan houses increased to c.108sqm compared c.88 square metres in Zhaobaogou. According to field observations of Zhangwu County, Hongshan settlement sites have been recorded with a variety of sizes. For instance, Xiaobeigou Reservoir is 1.8 hectares, Luoguoliang 8.3, Lijiawopu Reservoir 4, Ganniudao 0.64, Wangjia 0.6, Dongtuozi 0.1, and Xituozi only 0.025 hectares (Liaoning Kaogusuo et al.1991). On the basis of this small sample, Hongshan sites can be classified into several groups: the large, medium and small. Liu, Jinxiang et al. (1997) have pointed out that in Hongshan settlements, the large size was usually located in the centre of an inhabited area and this large settlement was usually surrounded by medium settlements. Also the medium was surrounded by small villages (Liu, Jinxiang et al. 1997:53).

I turn now to some ritual or ceremonial matters. A construction called “Goddess temple” were discovered at Site I of the Niuheliang area. This “temple” was located in hilly land 600-650m above sea level. A natural or manmade platform, 175m long and 159m wide, was on the top of the hill. The “temple” sits on this platform. In a few square metres test excavation, some building materials and clay sculpture parts were unearthed, including a fired clay female human head, shoulder, arm, breast, hand and some animal shaped parts. Presumably, they were the statues in the “temple” and were falling apart when the temple was destroyed (Liaoning Kaogusuo1986). Near the “Goddess Temple”, several constructions and burials are located on the tops of other hills, about 2-7 kilometres away. These constructions formed a group of ritual monuments in a concentrated area (Guo and Zhang 1984, Guo 1997, 1995). This “temple” and the association of group monumental constructions in such relatively large area indicate the significance of ritual activities within the Hongshan society ritualised social constructure was more complex than ever in the Upper Liao River area.

There are several opinions relating to the level of social complexity in Hongshan community. Chen, Xingcan (1987) has stated a reasonable suggestion that Hongshan did not enter the state level of civilization based on his studies of the origin of civilization. But one local expert, Guo (1995:44-46), strongly believes that Hongshan society had reached the level of an early state, because he thinks that the Hongshan complexes have satisfied his criterion of “Eastern civilization”. In his definition, “Eastern civilization” comprises three major features, altar, temple and cairn in monumental constructions. He has stated that his criterion is different from what he called the criteria of “Western civilisation”, marked by city, writing and knowledge of metallurgy. His opinion represents the exaggeration in regionalist behaviour (Falkenhausen 1995) in some Chinese scholars.

By comparing the different levels of social complexity, Nelson has pointed out: “it (Hongshan) fails to conform to western ideas of chiefdoms or incipient states.”(Nelson 1995:14) Also Shelach has studied Hongshan settlement patterns in his intensive field observations along the Yingjin River area and analysed the social complexity of Hongshan society. By comparing it to Neolithic Wessex of southern England, Shelach concluded that Hongshan public monuments could not be compared to the huge Stonehenge of Neolithic Wessex, which is recognized as a centralized chiefdom society in Renfrew’s (1974) study, so the “group-oriented” elites with emphasised ritual power would be appropriate to describe the level of social complexity in Hongshan communities (Shelach, 1999:84). Shelach’s study has made a significant point in the development of social complexity of the Hongshan community. Similarly to Shelach’s study, Li, Xinwei (2003:137) has suggested that the structure of the Hongshan society was loosely structured local chiefdoms and their coalitions referring to the Earle’s (1991:1-15) concept of chiefdom that a polity that centralise a regional population in the thousands. This loosely chiefdoms coalition heavily relied on ideology and ritual activities to maintain the political power.

To analyse Hongshan social complexity, burials are still be the one of major aspects. Although Hongshan burials are relatively small in number, the hierarchical burial sizes with different amount of jade artefacts together with the “Goddess temple” have been used to draw an outline of its social structures. Dongshanzui and Niuheliang are the major discoveries of Hongshan burials, especially in Niuheliang area with seven sites containing sixty-one burials with cairns, altars and one “temple” (Liaoning Kaogusuo1986, 1997a, 1997b).

By 1998, more than 90 single burials had been excavated in several sites, but only about 50 burials published. Hua and Yang (1998) have analysed the 50 burials and divided them into three types with four classes. The three types actually indicate the three periods of Hongshan burial in time span and the four classes represent the hierarchical construction of Hongshan society.

Seventeen burials in two sites, Niuheliang and Chengzishan, have been recorded accurately and published (Table 5-6). A few large burials are around 400 square metres and such large size may belong to public monument but the position of these burials, which is in the centre of this “monument”, would have to indicate the important social status of these persons. Thus I still count the size 455 square metres for this special burial in following discussion. The burials analysis has shown these are gradually changed in size from 455 to less than 1 square metre. For example, the first group can be divided easily is Z1, Z2, and Z3 of 455, 327.25 and 380sqm respectively. But it is difficult to separate others into two groups. There is no obvious gap between each burial in terms of the size, which may be caused by insufficiency of data. The number of jade objects listed in Table 5-6 is not accurate because incomplete in field reports and also some burials, particularly the larges such as Z3, were randomly unearthed by unknown treasure hunters or other human activities (Lu, Jun 1998).

The analysis of habitation has revealed at least three levels in Hongshan society (Liu, Jinxiang et al. 1997:53) although this assumption is not well supported by current burial data as discussed above (Figure 5-37). So the Hongshan burials need further investigation. Referring to the habitation data, however, the Hongshan society contained different levels and possibly with three levels in its social structure according to the studies of inhabitation, even though the collected data is only a small part of all Hongshan sites (Liu, Jinxiang et al. 1997:53) (Figure 5-37).

Chinese scholars, such as Guo (1995) as discussed earlier, have briefly analysed the differentiation in settlement pattern and burials, as well as the “Goddess temple” and pointed out that Hongshan society has just reached the level of incipient or early state in their definition of state. However, the “temple” has been recognised as showing connections not only to the cult of female worship but also the assumption of matrilineal communal society (Guo 1995), which contrasts to the social evolutionary theory in conservative Chinese archaeology. These have been no explanation to this contrast.

As discussed in the beginning of this section, it is too early to conclude that the Hongshan community had reached the stage of an early state in the level of the social complexity. Firstly, no evidence can be identified as a city or fortress built in Hongshan times except a ditch surrounding houses found in the Xitai site. A higher-level city or fortress is usually seen as the significant symbol of a state. Secondly, no evidence indicates military organizations or actions in relation to social and political competition within the Hongshan society. Thirdly, no evidence has been found to show that one individual had political power over the community. For instance, a big central tomb surrounded by some small burials in Dongshanzui shows nothing that could be recognised as sacrificial phenomena to the central tomb (Guo and Zhang 1984). No primary burial containing multiple bodies, which were possibly buried in the same time, was found in Hongshan period. Primary burials with multi-bodies usually imply that some people in this tomb were buried by force and this usually happened through the social and political competition between different social groups during the initial period of an early state. Multiple bodies found in one tomb in the Hongshan burials are secondary burials only (Liaoning Kaogusuo 1994b, 1986).

The “Goddess Temple” could be a place for people practicing worship of females or worship of a female ancestor, or may be the worship of abundant human reproduction, having more children for the individual or increasing the population in the whole community. However, to simply ascribe the “Goddess temple” construction to the consequence of matrilineal society would be dubious, because of the lack of evidence and comprehensible analysis. Chen, Xingcan (1990) has pointed out that female figures found in the Hongshan culture may indicate early worship in “bumper harvest magic” and female ancestors. This is explanation is plausible for the discoveries of Hongshan female figures and “Goddess temple”.

The three levels of settlement pattern and two classes of burials may indicate two different aspects. The former suggests that a three-tiered social system may have emerged. The latter may indicate the two levels of social positions in the Hongshan communities. However, the monumental constructions and various jade objects indicate social changes towards to more complex in social structure than ever. These social changes were associated with the possible increase in a farming economy, which was in the late substitution period.

Farming economy has obvious increased in Hongshan compared to the previous period. Cultural interaction between Hongshan and its counterpart in north China and environmental changes may the factors causing the increase of crops cultivation due to the changing climate towards to warmer and drier than previous and even more server during the late Hongshan period (Li, Xinwei 2003:137). Subsistence economy depending on the exist amount of crops cultivation combined with hunting and gathering could not sufficiently meet the community needs such as the specialities in Jade, ceramic production and the labours working on the monumental constructions. However, the increase of farming economy in the Hongshan community was more likely as an “active choice by the Hongshan community rather than a passive acceptance” and “it was the ambition of aggrandisers in the Hongshan societies that triggered the transition process from hunting and gathering to agriculture” (Li, Xinwei 2003:138). In comparing to hunting and gathering economy in an environment with relative abundant resources, agricultural economy sometimes may appear many disadvantages such as not efficient and reliable due to the bad seasons and more labours involved in soil preparation, looking after crops during growing, harvesting and processing period. But one advantage of easier to storage may have to be one of the important reasons in replacing meat food from hunting. The implication of farming economy itself may enhance social competition because food resource competition is the important pathway to win in social political competition and to obtain political power (Li, Xinwei 2003:137).

5.5.2.3 After Hongshan (c.5000BP)

The Xiaoheyan period follows the Hongshan. Shelach (1999:85) has argued that population declined in Xiaoheyan compared to Hongshan, since the number of sites discovered is far less than Hongshan. He also suggested that Xiaoheyan was the connection between Hongshan and Lower Xiajiadian based on typological similarities. But no settlement data are available for analysing social complexity in the Xiaoheyan communities.

The reasons that population decline during the Xiaoheyan period may relate to the deterioration of social complexity which may already happen around the late Hongshan period. The political power of Hongshan elites heavily relies on the "over emphasise of ritual inclination of ideological strategies rather than utilising all power resources to manage efficient economic reform". This miss management in control of economy has led to the deterioration of social complexity under the server environmental pressure (Li, Xinwei 2003:201). As indicated in the result of tool complexes analysis, in responding to this deterioration of social complexity, farming economy reduced as well due to the lake of economic strategy which may cause a passive attitude when dealing with the environment pressure. The process of transition to agriculture remained an unstable substitution phase during the Xiaoheyan period..

By the Lower Xiajiadian period (c.4000BP) settlement pattern has dramatically changed. Fortresses with defence walls emerged for the first time in this region (Chinese Academy IMT 1974, 1975; Hao 1996; Liaoning Kaogusuo et al. 1992b; Zhu, Yonggang et al. 1997). Almost all sites of Lower Xiajiadian were protected by defensive walls, which were built by piled rocks. Houses of circular shape were built with stone walls as well. The size of settlement village is various from 0.183 to 3.636 hectares (Shelach 1999:100).

Shelach (1999:124) has suggested two or three levels of political structure in the Lower Xiajiadian communities (Figure 5-38), which is similar to Hongshan communities. However, based on the evidence of defensive walls surrounding the village settlements, Lower Xiajiadian should be more hierarchical and centralised than Hongshan and may be closer to the late period of chiefdoms (Shelach 1999:138).

Associated with this social change, a farming economy became dominant and the transition to farming entered the consolidation period. Along with this social change, the elites in controlling economic strategies is distinguished from the earlier period, such as choosing settlement site to meet economic and political needs, network of trade and particular the subsistence economy e.g. storage pits for crops preservation. Military leadership possibly was the first time appeared in the Upper Liao River area. This military leadership possibly associated with inherited social position and also connected to religious leadership together with economic coordination led to an individual power may over the communities. The strategies in the economic control associated with the cultural interactions with other farming societies in north China has led to the agricultural transition enter the consolidation phase in the Upper Liao River area.

In Upper Xiajiadian (c.3000BP), also social and political structure remained at a similar level as in Lower Xiajiadian because village settlements in Upper Xiajiadian times were similar to in the Lower. Also the number of village settlement in the Upper is less than in the Lower. Here the method of settlement pattern study in approaching the social complexity based mainly on the sedentary sites may have not developed a appropriate methodology and theory to analyse the pastoralist societies with relative mobilised life style. Such pastoralist societies may develop a similar level of social complexity as the agriculturalist. For instance, Upper Xiajiadian possibly developed social complexity just as Lower Xiajiadian or may even more complex but this development of social complexity would not have to be reflected as the same way as Lower Xiajiadian in the settlement patterns of archaeological data. Further investigation is required for the studies of social complexity of Upper Xiajiadian, particularly in the area of burials and writing record. According to the available data, including the Upper Xiajiadian period, the level of social complexity in the Liao River area possibly never approached state level until the Han Empire actually governed this area around 2000 BP (Shelach 1999:176). In addition, the Upper Xiajiadian communities may acculturate the people of pastoralists from steppe zone in the further north (including northeast and northwest). This culturation and cultural interaction may happen during the Lower Xiajiadian period and gradually changed the direction of transition to farming. The traditional herding economy in the northwest and northeast has expanded into the Upper Liao area of northeast China and transition to farming shifting to major animal herding, to the pastoralist.

5.5.3. Summary

From 8000 to 3000BP, social structures in the Liao River area have changed in time, from a relative egalitarian society based on kinship organizations, “ritual in house” of Xinglongwa changed to a society of “ritual in community” with more centralised organization of community associated with more segregation in social stratifications. Hongshan is the first time of social complexity had reached the level of loosely structured local chiefdom coalitions (Li, Xinwei 2003:137) but with no military activities and less development of economic strategies. Military activities and the strategies to control economy in maintain the social, political power did not develop until the Lower and Upper Xiajiadian period.

Associated with the “ritual in house” of Xinglongwa society, the stage of transition to farming is the availability period. During this availability phase, some crops cultivation but not the full meaning of agriculture appeared but hunting/gathering economy predominant. Along with the increase of crops cultivation, more complex society of Zhobaogou became the beginning of substitution phase. During the Hongshan period, the crops cultivation became agricultural economy share the proportion with hunting /gathering in the subsistence economy. This economy chosen by Hongshan community has successfully sustained social complexity of chiefdom coalition before the change of climate. During the Lower Xiajiadian and Upper Xiajiadian period, the social organization changed more centralised chiefdom society. Relating to this chiefdom society, the transition to farming is in the consolidation period with agriculture or domestic animal herding predominant.

These social and economic changes, as mentioned earlier, are also related to some cultural interactions. Although these external factors may not be the major reason for transition to farming but the function of combination with internal factors, such as the needs of social development, had led to the transition to farming occurred. Thus it is worthwhile to analyse these cultural interactions. For instance, ceramic cylindrical vessels with zigzag designs became the indicator of cultural exchange between north and northeast China during Xinglongwa period associated with the transition to farming in the availability phase. There were frequent cultural contacts or exchanges indicated by the designs of painted pottery and jade objects between north and northeast China during the Hongshan period related to the late substitution phase. In the Lower and Upper Xiajiadian period, the designs of painted pottery, and new pottery *Dou*, particular cooking wares *Li* and *Yan*, and also the circular shape of houses indicate more cultural interaction occurred between these two agricultural societies.

5.6. THE PATTERNS OF TRANSITION TO FARMING IN THIS REGION

In this section, I will discuss the patterns of transition to farming in the Liao River area. This discussion includes three aspects: the contrast of patterns between the Upper and Lower Liao River regions based on the changes in tool percentages, environmental changes responding to economic adaptation as reflected in tool complexes and the comparison between these the models in the Liao River area and the baseline model in the Yellow River area.

5.6.1 Contrast between two models in the Liao River area

The transition process in these two sub-regions was not the same. This can be seen in the changing economies indicated by tool complexes. There were three major periods and unstable economies in the Upper region. But in the Lower region, economy from hunting/gathering changed constantly to plant cultivation.

5.6.1.1 The Upper Liao River region

Three periods can be distinguished based on the changes of tool percentage in the Upper Liao River region: the early period from c.8-7000BP, middle period between 7-5000BP and the late period from 5-3000BP (Figure 5-39). Economies were unstable in both the early period, 8-7000BP and the late period about 5-3000BP. A relatively stable period was between c.7-c.5000 BP. This is reflected by the fluctuation in the percentage of tools during the early and the late period and relative steady percentage in the middle period (Figure 5-39).

For example, during the early period around 8-7000BP, economic situation reflected by tool complexes from eight sampling sites shows that the dominant economy frequently changed between gathering and hunting in different sites. Comparing tool complexes in different sites, hunting tool decreased from more than 30% to less than 10 % before back to more than 80% and conversely, gathering tools increased from less than 60% to about 90% before reversing to less than 10%. From second period 7-5000BP, economic style reflected in tool complexes seems relative stable compared to previous period as gathering tools increased continually before dropping during 5000BP. From 5000 to 3000 BP tool percentages are with similar trends to the early period but remain at lower levels of fluctuation.

Apart from hunting and gathering tools, in the Upper Liao River area the percentage of fishing and woodcutting tool is also characteristic based on these eight sites. For instance, fishing has possibly never been the major food supply, because the percentage of fishing tools is almost zero except for around 5% in the Xinglongwa site c.8000BP. In the Chahai site of the Xinglongwa tradition, this percentage is also zero (Figure 5-16). There is no obvious sign in the tool diagrams that could indicate the activities of land clearing. However, the changes in gathering and woodcutting tools may imply some connections between gathering or cultivating activities and woodcutting. For instance, gathering tools increased twice, one in about 7000BP and another in c.4000BP. Each time, the increase in gathering tools was associated with the increase of woodcutting tools. The first increase of gathering and woodcutting tools around 7000BP was at almost the same level between these two categories. Apart from woodcutting tool required by house construction, this increase of woodcutting tools may imply an increase in farming, which likely includes the tools cutting trees for land clearing involved in farming economy (Figure 5-39).

5.6.1.2 The Lower Liao River area

There are only two periods can be distinguished according to the changes of tool percentages in the Lower Liao River: one from 7-4000BP and another after 4000BP. In the first period from 7-4000 BP, tool percentages changed gradually with only small amount of fluctuations but in the second period, after 4000BP, the changes of tool percentage became dramatic (Figure 5-40).

A hunting economy reflected by tool percentage seems to decrease constantly in the Lower Liao River area. For instance, the percentage of hunting tools reduced from more than 80% during 7000BP to less than 70% around 6500 BP then reduced continually to around 50% before c.4000BP, 30% decrease in 3000 years in the first period. However, after c. 4000 BP, the number of hunting tools dropped to less than 10% in about 3500BP, a more than 40% drop in only 500 years. Gathering tools increased slowly with only about 20% rise in the first period of 3000 years. But during 500 years of second period it increased sharply, a more than 30% increase. The increase of gathering tools may imply adding crop cultivation to the economy and the sharp increase during 3500 BP possibly indicates that a farming economy become absolutely dominant.

A fishing industry indicated by fishing tools in the Lower Liao River area has a higher percentage in the economy compared to the Upper Liao River region, even though this number is still small. Similarly to the Upper Liao River area, every increase of woodcutting tools is associated with the increase of gathering tools. This may also indicate some connections between farming activities and timber works.

5.6.2 Tool complexes responding to environmental changes

Through my environmental reconstruction, some changes in economic styles reflected by tool complexes happened at the same times as environmental alternations. This coincidence could indicate the tool complexes responding to environmental changes. For example, there were two times of dramatic environmental changes in the Upper Liao River area since the early Holocene (Figure 5-4). The first change was during 8000 to 7000BP. The environment from 8000BP with cold and dry with grassland and almost no tree coverage changed to warmer and wetter with woodland containing a low density of trees until c.7000BP. After c.7000 BP, the climate became dry and trees disappeared from this area, while temperate steppe became predominant vegetation coverage again (Figure 5-4). In responding to this environmental change, tool complexes also had dramatic changes from mainly gathering tools to hunting tools being predominant (Figure 5-39,40).

The second change occurred around 4000BP. From dry and hot during mid Holocene the climate changed to wetter and cooler. Vegetation also changed to woodland-grassland with very low density of trees compared to grassland predominant in previous period (Figure 5-12). According to the pollen data (Figure 5-4), environmental change in this time was less extreme than the first time. In relation to this change, the number of tool complexes in the Upper Liao River area fluctuated again but not as much as the first time.

Another example of tool complexes possibly responding to environmental changes is the difference shown between the Upper and Lower Liao River areas. As I discussed earlier, environment in the Lower Liao River area was relative stable with more vegetation coverage compared to dry in most times and fluctuation in temperature and rainfall in the Upper area. In responding to the environmental in the Upper region, tool complexes changed fluctuated compared to a relative stable situation in the Lower area in both environment and tool complexes.

5.6.3 Comparison to the transition model in the Yellow River area

Considering the recoveries of crops and using the amount of gathering tools to reflect the proportion of farming economy as discussed in Chapter 3, models of transition from foraging to farming in the Upper and Lower Liao river areas has been generated (Figure 5-39,40). These models have shown some similarities and differences compared to the model in the Yellow River area and the ZRC model (Figure 5-41). The similarities in the models of transition to farming between the Yellow River area and the Upper and Lower Liao River areas can be found in the whole process of transition to farming, including three periods, the availability, substitution and consolidation. These three periods are basically connected with each other. For instance, the pattern of the Yellow River is very similar to the ZRC model. The availability period was before c.9000BP in the Yellow River area, when the substitution period started from. About.6500BP, around the Banpo period in the chronology of the Yellow River area, the consolidation period started. Similarly to this, the pattern of the Upper Liao River area has three periods: the availability period was possibly before 7000BP, when the substitution period started and then c.4000BP around the Lower Xiajiadian period, the consolidation began. In the Lower Liao River area, the availability period was before 7000 BP, when the substitution period began. This lasted until c.3500BP during the Upper Xinle, when the consolidation period started. In addition, the date of the beginning of substitution period is c.9000BP in the Yellow River area, earlier than 7000BP in the Upper and the Lower Liao River areas.

However, the differences are also obvious. First, the time of beginning for each period in the Liao River area is different from the Yellow River area. For example, substitution period stated from c.9000BP in the Yellow River area but from c.7000BP in the Upper and from c.7000BP in the Lower Liao River area. Also the consolidation period began during 6500BP in the Yellow River area, but around 4000BP in the Upper and 3500BP in the Lower Liao River area. The date of the beginning of each period is earlier in the Yellow River area than in the Liao River area. This may reveal the differentiation between an original agriculture area, north China, and a secondary agricultural area, the Liao River area in northeast China, and possibly imply that transition to farming in secondary agricultural areas seriously depends on the central area of agricultural origin.

Second, the time span in each period varies in the two areas, particularly in the substitution period. This time span is longer in the Liao River area than in the Yellow River area. For instance, the substitution period is around 3500 years in the Yellow River area but around 4000 years in the Upper Liao River area. Third, the transition process in the Upper Liao river area possibly reversed twice if tool complexes derived from sample sites reflect economic styles correctly, one during 5500BP and another around 3500BP. This possibility of reverse in transition process cannot be neglected and it may be the result of environmental changes or different societies replace each other with different traditional life styles. Zvelebil (1998) has argued that after the consolidation period, the transition to farming should not reverse in the ZRC model. Even though, the number of the sites containing reliable data for tool complexes is small, the reverse of transition process should be the question for the future studies. Moreover, the highest percentage of farming economy reflected by tool complexes is only 70% in the Liao River area including the Upper and Lower, compared to more than 85% this number in the Yellow River area (Figure 5-41).

5.7 CONCLUSION

The transition to farming in the Liao River area has some specific features. The transition to farming seems to be influenced by both environmental changes and cultural interactions and the cultural interaction seems to accelerate the process of transition. However, socio-political needs may become the substantial motivation to adopt agriculture, such as in the beginning of substitution phase in Zhaobaogou and the late substitution phase in Hongshan. The example of the Upper Liao River area, that each period of transition to farming is related to different stages in social complexity. The availability phase related to the Xinglongwa society with egalitarian “kinship organization” and “ritual in house”, the early substitution to the more segregated “ritual in community” of the Zhaobaogou society and the late substitution phase related to a “loosely chiefdoms coalition” society of Hongshan (Li, Xinwei 2003:65-137). And the consolidation phase related to a society manipulated by chiefdoms with the political power of combing military, ritual, economic leadership (Shelach 1999:138).

To begin with, socio-economic strategies of transition to farming are influenced by both environmental conditions and cultural interactions. For example, in the consolidation period in the Upper Liao River area, from Lower to Upper Xiajiadian, the economies have changed from farming dominant to the combination of farming and herding. This change might be the result of environmental alterations, to an environment more appropriate for herding than farming. But in the same time, new people from further north with a herding tradition possibly merged into farming societies during the Lower and Upper Xiajiadian period. This acculturation process is still one of the possibilities for changing the traditional economies.

Environment is possibly the one of external factors, which brings about changes in food procurement, particularly for the communities who have not been strongly influenced by other farming communities and the relatively hot and dry conditions during the Hongshan period would reduce food resources from natural environment (Figure 5-4). This situation may force the Hongshan societies to change economic strategies to increase food production from domestication as indicated by increases of gathering tools in this period. If the environment was not changed and the elites of

Hongshan society did not have any excessive demands in the subsistence economy to meet their socio-political needs Hongshan societies would not have had to change their traditional food procurement, and hunting would have continued as the dominant economy. During the Xinglongwa period, there were not many trees but large areas of grassland. Animal hunting would be difficult because the forest, the shelter of animals, was not available. So the economic strategy in Xinglongwa societies is to rely heavily on gathering.

Moreover, cultural interaction is other factor, which can sometimes accelerate transition processes if an appropriate natural environment associated with. For instance, the introduced new cooking ware during the Lower Xiajiadian period from farming societies has possibly accelerated the transition process to farming economy, which has already been well developed in this period. This acceleration is also based on an improvement in the natural environment which became wetter than previous period (Figure 5-4).

However, the motivation is the major factor, that social and political needs may have to be the most important factor from internal of the society which has finally decided the orientation of transition to farming.

CHAPTER 6. CASE STUDY (2) THE LIAODONG PENINSULA

6.1 INTRODUCTION

This Chapter comprises six sections. Section 1 is about the background of transition research in the Liaodong peninsula and its connecting area, Jiaodong peninsula of north China. Environmental reconstruction, discussing the four aspects of land change, temperature, precipitation and vegetation in the Liaodong peninsula will be in Section 2. In Section 3, I will discuss the chronological summary in this region followed by an analysis of tool complexes in Section 4. Some discussions about archaeological discoveries other than tool complexes will be added in section 5. The comparison of transition to farming between Liaodong and Yellow River will be in Section 6, followed by a short conclusion.

6.1.1 Geographical and archaeological background of the Liaodong peninsula

The Liao River area discussed in the previous Chapter has been a transitional area between two different environmental zones, semidesert – steppe and woodland since the Holocene began. It is also a terrestrial connection between north and northeast China. Unlike the Liao River area, the Liaodong peninsula is a coastal environment with abundant marine resources. Landscape and environment in this region tended to be different from the Liao River region during the Holocene. The Liaodong peninsula is one of routes through the Bohai Bay connecting north and northeast China. Therefore, I am expecting different results in Liaodong compared to the Liao river area once the ZRC model is applied to the Liaodong peninsula.

In studying the transition to agriculture in northeast China, the Liaodong peninsula is in a similarly important position compared to the Liao River region. The Liaodong peninsula links with north China across the Bohai strait on the southern side of which is the Jiaodong peninsula of north China (Figure 6-1). This Chapter is about the agricultural expansion from Jiaodong to the Liaodong peninsula.

The possibility of agricultural expansion from Jiaodong to Liaodong is based on the geographical features of the Bohai strait, which is a natural connection. The narrowest area in the Bohai strait is less than 150 kilometres and many small islands are distributed across the strait, which form a bridge connecting two sides. The entire area of Bohai Bay was a flood plain during the termination of the Pleistocene. The areas around the Bohai strait were one integrated region around 11000BP (Figure 4-14) even though it has been submerged since the early Holocene.

Cultural contact between the two peninsulas presumably started as early as the late Pleistocene when both peninsulas shared the same flood plain, the Bohai plain. This terrestrial contact would have been closed by rising seawater during the early Holocene, but later, connections continued across the marine channel after marine transportation such as canoes had been invented. The date that terrestrial connection across the Bohai plain ended was possibly about 10000 BP, because the flood plain was submerged around this period. Its reconnection by marine transportation should not be later than 6000BP, as indicated by a similar tradition of ceramic design found on both coasts, e.g. Middle Xiaozhushan (Liaoning Museum et al. 1981) in Liaodong and Zijing layer I (Shandong Museum 1973) in Jiaodong. This contact has never stopped since 6000 BP, as is also supported by some similarities in the cultural traditions through history, even though physical anthropological data indicating migration between these two peninsulas is not available (Chen, Guoqing & Hua, Yubing 1993; Chinese Academy 1999; Liaoning Museum et al. 1981;Wang, Qing 1998; Yantai Administration 1992; Yantai Museum 2000; Yu, Qiong 1990; Zhao, Hui 1995).

6.1.2 Summary of transition to farming in the Jiaodong peninsula

If agriculture spread from north to northeast China and the way of spreading was crossing the Bohai strait, the Jiaodong peninsula is the first step. To summarise the studies on transition to farming in the Jiaodong peninsula is thus necessary prior to the study of the Liaodong peninsula.

There are some questionable viewpoints among Chinese archaeologists in relation to the beginning of agriculture in the Jiaodong peninsula. For example, An, Zhimin (1988) and Yan, Wenming (2000 a, 2000b, 1992) place it in a similar period as the middle of Yellow River, about 7000BP. This interpretation is usually based on the discoveries of inland archaeology, such as domestic millets found in the Beixin and

Dawenkou culture (Fujia and Sanlihe sites in Figure 6-2) located in the west Shandong, next to the Jiaodong peninsula. The Beixin culture is dated to around 7000BP and Dawenkou is dated to around 6000 BP (Shi, Xingbang 2000, 1992; An, Zhimin 1988). Inside the peninsula, however, the earliest discovery of crops, broomcorn millet (*Panicum miliaceum L.*), foxtail millet (*Setaria italica L.*) and rice (*Oryza Sativa*) are in the second layer of the Yangjiaquan site, dated to around 4000BP (Beijing University et al. 2000:202) (Figure 6-2). Another date about 5200BP of domestic crops is found in the Jiaodong peninsula but this date still waiting for further details from excavators (An, Zhimin 1988). Both sites are located in the central area of the Jiaodong peninsula and records expansion of the inland farming traditions, Dawenkou and Longshan. They appear to occur earlier inland around 7-8000BP (An, Zhimin 1988) and extended into the coastal areas later around 4000BP (Figure 6-2), contrary to what An and Yan have suggested.

Distinct from the inland farming traditions of Dawenkou and Longshan, the early human inhabitants in the coastal regions of the Jiaodong peninsula were marked by many shell mound sites dated earlier than 6000BP. In these shell mound sites, a wide range of economies was predominant compared to the inland farming societies. Through the floatation method, archaeologists have found no trace of domestic plants (Chinese Academy 1999). Based on studies of phytolith remains and dietary analysis using proportion of isotope C13 remains in human bone, archaeologists found no evidence of domestic plants in these sites and it was even hard to find any trace of plant subsistence in human diets (Chinese Academy 1999:82, 172). These shell mounds represent the remains of coastal communities during 7000-6000BP. The major subsistence of these foragers was marine resources, particularly shellfish and some terrestrial animals such as deer and wild pig distributed in coastal forests. The Longshan farming economy from inland replaced this coastal foraging economy after about 4000BP (Chinese Academy 1999). Therefore, the expansion of agriculture took almost 3000 years from the inland of north China into the coast of Jiaodong peninsula. Only at this time, around 4000BP, did the expansion of agriculture towards to Liaodong, northeast China across the Bohai strait became possible. But this is based on the assumption that no agricultural economy developed locally in the Liaodong peninsula.

6.1.3 Background of domestic plant discoveries in the Liaodong peninsula

Archaeologists have speculated that agriculture extended from north China to Japan through the Liaodong peninsula and the Korean peninsula, with rice finally becoming the major subsistence after the beginning of the Yayoi period (c.3000BP) in Japan (Yan, Wenming 2000a, 2000b, 1992; Yan, Wenming & Yoshinori 2000). However, this assumption is mainly based on a few discoveries of domestic plants and the study of agricultural expansion in these areas still remains unclear.

The cultivation of broomcorn millet (*Panicum miliaceum*) in the Liaodong peninsula should be earlier than foxtail millet, because, as discussed earlier, carbonised seeds of broomcorn millet found in the Xinle site dated back to 7000BP (Shenyang Administration et al. 1985). It is less than 150 kilometres from Xinle to the coastal area of the Liaodong peninsula. There was a possibility that through exchange between the Xinle and coastal societies of the Liaodong peninsula, broomcorn millet cultivation could emerge in coastal communities as early as 7000BP. However, the date for domestic plants in the Liaodong coast is surprisingly later, around 4500BP (Liaoning Museum et al. 1984) than the Xinle in its neighbouring region. This may suggest a particular coastal economy similarly to the Jiaodong coast where subsistence was sustained by variety of natural resources including marine animal and plants, which were sufficient for local socio-political needs, delayed the take-up of plant domestication.

Rice and broomcorn millet were found in the Dazuizi site of the Liaodong peninsula and dated to about 3100BP (Dalian Kaogusuo 2000). This is the earliest date about rice cultivation so far. It may be earlier than this date if the floatation method is used in future archaeological fieldwork.

In summary, domestic plants in the Liaodong peninsula occur at least about 4500BP with millet cultivation, but the date of rice cultivation may as late as around 3000BP.

6.2 ENVIRONMENTAL RECONSTRUCTION

In order to reconstruct the ancient environment, the following features of the natural environment are important references: physical features, drainage system and elevations.

6.2.1 Major physical features

Liaodong is a nearly triangular peninsula (Figure 6-3). Plains cover most coastal areas. These coastal plains are usually less than 200 metres above sea level and some 10-35 kilometres wide. Hilly lands of 200-800 metres in altitude called Qianshan Mountains are located inland in the peninsula. These are part of the Changbaishan mountain ranges. Many small rivers start from hills and run down to the ocean (Figure 6-3).

6.2.2 Land changes

In Chapter 4, I briefly described land changes along the China Sea since the Holocene began. The Liaodong peninsula is located between Bohai and Huanghai, which very likely were coastal plains during the late Pleistocene and submerged by rising sea in the early Holocene. During the LGM, Liaodong was not a peninsula but was inland plains and hilly land. The nearest coastline was possibly more than 400 kilometres east of Liaodong. The drainage in Liaodong at that time was very likely connected to the Yellow River down through the Bohai and Huanghai plains. The Liao and Yalujiang rivers were possibly tributaries of the Yellow River. The Liaodong hilly land was the dividing range of these two tributaries (Figure 4-13). Terrestrial resources including freshwater resources should be predominant in the natural environment.

From 12000 to 10000 BP, it took less than 2000 years for seawater to fill up the Bohai and Huanghai plains and form the Liaodong peninsula (Figure 4-10, 4-11 and 4-12). Seawater surrounded Liaodong, in the west, south and east. Maritime resources quickly became dominant along the coast of the peninsula. Moreover, because the sea level continued to rise, by around 6000BP both Liaodongwan in Bohai and Korean Bay in Huanghai were extended beyond the present coastline for 30-40 kilometres (Figure 4-12, left). This ocean transgression would have intensified the maritime character of natural environment in the Liaodong peninsula. After 5000 BP, sea level declined and the coastline in Liaodong returned to the present location (Figure 4-12, right).

6.2.3 Climate changes

Seven sites of pollen data, Dagushan, Dalianhuapao, Danandao, Pulandian, Qianyang (Chinese Academy 1977), and Dawan, Yingkou (Liaoning Bureau of Geology 1983) are used for environmental reconstruction in this area. By the analysis of these pollen data, I have generated the changes in temperature and precipitation since the LGM (Table 4-3, Figure 4-18 and Figure 6-4, 6-5).

Figure 6-4 and 6-5 provide a close image of climate changes in the Liaodong peninsula. Precipitation increased sharply from 300mm to 500mm around 10000BP and continued to increase in the late Holocene with around 750mm after a relative stable with 550mm between 10-6000BP(Figure 6-5). The combination of temperature and precipitation will determine the vegetation components.

6.2.4 Vegetation coverage

The pollen diagram derived from the Pulandian site (Figure 4-1) is the major data for environmental reconstruction for this area. I will use this data to reconstruct the regional environment in the Liaodong peninsula.

According to the pollen data of Pulandian and also considering pollen evidence in other sites listed above, around 12000BP the percentage of trees started to slightly increase but non-arboreal pollen was still predominant. The main vegetation during this period was more likely to be grassland throughout the Bohai and Huanghai plains after 12000BP (Figure 6-6).

Around 10000BP, Huanghai plain was reduced quickly due to the rising sea and vegetation changed to open-woodland as a result of the increase of both temperature and precipitation. The Liao River could still join the Yellow River in the south Bohai plain which was covered by grassland with possibly a low density of trees in some areas (Figure 6-7).

Around 8000BP, the temperature increased more than 2ºC compared to the earlier period, but precipitation only slightly increased with less than 500mm annual average. The climate was possible drier than before, which slowed tree growing (Figure 6-8). The coastal area near Liaodong Wan returned to grassland and most areas of Liaodong became open woodland with a lower density of trees.

After c.8000BP, rainfall increased and more trees grew, till c.6000BP. The annual mean temperature was about 13ºC (4ºC above present) and precipitation increased to 550mm around 7000BP, and more than 600mm after 6000BP.This temperature and rainfall resulted in broadleaved forest developing in all the Liaodong peninsula (Figure 6-9). This period can be called the "Holocene Climate Optimum" in the Liaodong peninsula.

Land changes in this period should be noticed. Due to the continuing sea level rise, some lowlands near the coast, such as the Liaodong Wan in the north and the area near the Yalujiang River were submerged by sea. Compared to the present, the sea then extended about 35 kilometres further inland (Figure 6-9). This transgression should intensify the warmer and wetter environment.

Around 4000BP, the pollen percentage of trees and herbs sharply declined and the proportion of fern increased. The increase of fern pollen indicates a wetter and cooler climate. But the temperature analysis does not show a significant decline. There was less than 4ºC decrease in temperature, which is unlikely to stop all trees growing. Besides, pine pollen (*Pinus*) sharply increased (Figure 4-1). This implies that the climate was appropriate for needle-leaved forest to develop. However, total tree pollen decreased to the very small amount of less than 20%. This vegetation result is not readily understandable when compared to the changes in temperature and precipitation. Whether it is the result of human activities, such as farming and wet rice farming in particular, needs to be clarified in further archaeological study because farming activities could result in an increase of open space from forest clearance.

Without considering human impacts, based only on the pollen data, the vegetation in the Liaodong peninsula after c.4000BP should be swampier in the grassland areas but with a lower density of grass. The hilly land of the Liaodong peninsula became open woodland with a very low density of trees (pine) (Figure 6-10).

6.3 SUMMARY OF ARCHAEOLOGICAL CHRONOLOGY

In this section, based on current studies of archaeology, I will make a very summary statement about the archaeological sequence and major cultural systems in this region.

6.3.1 Chronology

There are six periods from 7000BP to 3500 BP representing the archaeological sequence in this region (Figure 6-11; Table 6-1). The Last Glacial Maximum around 18-12000BP was not included in this sequence because of the lack of field discoveries. Cultural traditions as presented in archaeological discoveries are likely to begin with a small stone tool tradition according to a few stone tools found in the Xiaogushan site, which is dated around 18000BP (Zhang, Zhenhong 1985). No data is available between the Upper Pleistocene and the early Holocene about 7000BP.

The earliest discovery during the Holocene is the Lower Xiaozhushan complexes and Layer I in the Houwa site. Cylindrical vessels which represent the local ceramic tradition throughout the history emerged with different shapes and decorations during different periods. Villages were built on shell middens which were located on coast or small island. House design was of irregular rectangular shape (Liaoning Museum et al. 1981).

Around 5500BP, two different cultures appeared at the same time in the Liaodong peninsula: Santang and mid Xiaozhushan. The design on pottery reveals two different traditions of ceramic production. The cylindrical pot decorated with long close vertical clay bands is the major pottery in the Santang culture. This is compared to a few cylindrical pots decorated with incised designs on the top part of pottery emerged in the Mid Xiaozhushan culture. These two traditions located in the same area of southern coast sharing the same natural resources.

At the same time, number of pots of Jiaodong tradition were found in the mid Xiaozhushan pottery complex. Sometimes they were found in the same house remains.

The Jiaodong traditional pottery crossed the Bohai strait and appeared in Liaodong was around 5500BP (Zhu, Yanping 1997). Pottery "*Ding*" and "*Dou*", as well as painted pot was the representative of Jiaodong tradition began to join the Liaodong ceramic complexes and continually appeared in every period until about 2000BP (Liaoning Museum et al. 1981).

However, even after the arrival of Jiaodong tradition and this tradition continued to cross Bohai Bay, at the same time, the Xiaozhushan and Santang cultural systems continued to develop separately and became the Upper Xiaozhushan and Santang II culture. This lasted until about 4000BP, distribution area for these two cultural systems began to separate. The Upper Xiaozhushan remained the same as previous area but Santang II extended to north entering the Lower Liao River area. These two cultural systems both combined with Jiaodong pottery also adopted the reaping knife harvesting techniques from Jiaodong peninsula.

Around 4000BP, the Yueshi culture of the Jiaodong tradition appeared in the Liaodong peninsula. If the arrival of Jiaodong tradition in early periods can be described as several pots merged into the Liaodong traditional pottery complexes, now this new arrival should be expressed as whole cultural complex of Jiaodong tradition moved into Liaodong and formed a village separated from local cultural traditions (Wang, Qing 1998). New shape of tripods arrived in the Liaodong peninsula along with the Yueshi culture.

At the same time, Liaodong has developed local culture as well called the Dazuizi II or Shuangtuozi III (Chinese Academy 1996) culture within the Xiaozhushan cultural system (Dalian Kaogusuo 2000). Bronze artefacts, a weapon "*Ge*" adapted from Central China, were unearthed (Dalian Institute 2000). In the period of between Dazuizi II and III, around 3000BP, the tradition of the Liaodong ceramics is characterised by a local development and partially influence from Yueshi culture of the Jiaodong styles (Ren, Xianghong 1991; Xu, Shouqun 1997).

Around 3000BP, a new type of Bronze complex in Liaodong appeared. This local tradition was developed from previous cultural systems and called "Bronze Dagger" burials in Chinese literature. Burials usually contain the complexes of bronze daggers, specific shapes of necked vessels and a huge tomb built by three large rocks (dolmen) (Xu, Guanghui 1997). The settlement of Bronze Dagger burials was found at the Yinjiacun site (Xu, Guanghui 1997:197). This tradition was distributed in a large region, not only in the Liaodong peninsula, but also in the Lower Liao River plains (Shenyang Museum et al. 1975), and the northwest corner of North Korea (Wang, Wei 1993; Xu, Guanghui 1997; Xu, Yulin 1995). At the same time, another culture called Machengzi developed in the eastern mountainous area. Pottery found in the Machengzi culture is similar to the Bronze Dagger culture (Liaoning Kaogusuo et al. 1994a).

6.3.2 Cultural systems

As I discussed in Chapter 2, “cultural system” is the term used in Chinese archaeology and also used in this thesis containing both meaning of terms “tradition” and “horizon” in American archaeology.

Based mainly on pottery, at least, three cultural systems are distinguished. While each has a central area, they overlap at the edges. The first is the Xiaozhushan-Dazuizi cultural system, including the Lower, Middle and Upper Xiaozhushan, and Layer I, II and III in both Dazuizi and Shuangtuozi, and perhaps also including Machengzi culture (Upper Machengzi). This cultural system was distributed mainly on west coast from the earlier period and extended to the east later. The second is the Houwa II and Machengzi I, distributed along the eastern coast and mountains. The third is the Santang cultural system containing Santang I, II and III also including the Pianpu culture in the Lower Liao River region. This cultural system appeared on the west coast and extended in to the east around Lower Liao River plain. Among these three cultural systems, the first is relatively complete from 7000BP to 3000BP. But other two are only revealed in short periods, such as Houwa II –Machengzi at around 6500BP and Santang which started from about 5500BP and ended before 4000BP.

6.4 TOOL COMPLEXES

Unlike in the Liao River area, the result of tool analysis in the Liaodong peninsula is more variety that may be caused by different cultural systems. In this section, I will briefly describe the tool complexes in a sample of sites and also discuss the differences and similarities between the cultural systems revealed in tool complexes. The analysis of the tool complex sequence will be the last part of this section followed by a short summary.

6.4.1 The Xiaozhushan and the Houwa site

Tool complexes in three periods of the Xiaozhushan site (Liaoning Museum et al.1981) are very similar including Lower (c.7000BP) to Mid (c.6000 BP) and Upper Xiaozhushan (c.4500 BP) (Figure 6-12). These tool complexes appear to indicate a relative stable and consistent economic style. It is noted that there are no fishing tools in Mid Xiaozhushan perhaps the result of incomplete recovery or bad preservation. The proportions of hunting, gathering and woodcutting are almost the same. These complexes imply a wide-ranging subsistence pattern including animal hunting, wild plant gathering, possibly crop harvesting and sometimes fishing. Gathering also includes marine plants and shellfish, for which it is not necessary to use fishing tools.

Domestic seeds were recovered from the Guojiacun site (Liaoning Museum et al. 1984), which belongs to the Upper Xiaozhushan culture. This crop recovery implies that the tool complex of Upper Xiaozhushan may reveal a low level farming economy even though the patterns of tool complexes between the Lower and Upper Xiaozhushan almost the same.

As the same period (c.7000BP), the tool complex of the Houwa I (Xu et al. 1989) in the east side of the Liaodong coast is similar to Lower Xiaozhushan in the west (Figure 6-13). The similarity indicates that around 7000BP, the human settlers along the Liaodong coast had a similar way of food procurement and a similar economic style. This style in the coast is different compared to the inland settlers such as in the Upper Liao River area, where the tool complex contains almost no fishing tools from about 6500BP (e.g. Zhaobaogou) till around 2500BP such as in Upper Xiajiadian (c. 2500), as discussed in Chapter 5.

Similar tool complexes to Lower Xiaozhushan and Houwa I have been discussed in Chapter 3 about reference tool complex in north China, such as Cishan and Jiahu. Tool complexes in Jiahu and Cishan should indicate the substitution phase of the ZRC model, due to the numbers of domestic plants discovered in both Jiahu and Cishan. But no domestic plants are found in the Lower Xiaozhushan and Houwa I. So the interpretation of tool complexes in Lower Xiaozhushan and Houwa I should not be the same as in Jiahu and Cishan even though the patterns look similar.

Another comparison, the Jiaodong peninsula, should also be considered. A farming economy finally replaced coastal hunting, fishing and gathering in the Jiaodong peninsula after c.6000BP (Chinese Academy 1999). The farming expansion from Jiaodong to Liaodong should be after this date. Therefore, before the Mid-Xiaozhushan period, around 6000BP, a large quantity of domestic plants was unlikely to be recovered in the Liaodong peninsula. Small amounts of crops might be found in future fieldwork since broomcorn millet has been found in the Xinle site around 7000BP (Shenyang Administration et al.1985). Therefore, the tool complexes in Lower Xiaozhushan and Houwa I perhaps imply that subsistence was still mainly depending on hunting, gathering and fishing.

The tool complex in Houwa II (Figure 6-14) is very different from Houwa I although the time between these two cultures was less than one thousand years (Figure 6-11). Fishing became predominant with more than two thirds of the total tools and woodcutting seems less important. The inland tool complexes in Machengzi I (Liaoning Kaogusuo et al. 1994a), which is assigned to the same culture as Houwa II (Zhu, Yanping 1997, Chen, Quanjia & Chen, Guoqing 1992), is different from the coastal groups of Houwa. Hunting and gathering tools were more important in Machengzi I than in Houwa II, even though fishing still maintained its predominance. This difference between two tool complexes in the same cultural tradition possibly implies two different environments to which humans adapted. In particular, Houwa II is located on the coast where there are abundant marine resources compared to inland forested and riverine resources in Machengzi I. Also the inland population might be influenced strongly by coastal groups with the same culture and this might result in more fishing tools in Machengzi than other inland communities such as in the Xinglongwa cultural system in the Upper Liao River region. In addition, during Houwa II, around 6500BP, sea level continued to rise (Table 4-2 and Figure 4-12). The Houwa site was possibly surrounded by seawater due to the rising sea level, because it is located less than 20 kilometres inland from the present coast (Figure 6-9). This made it easier for Houwa societies to access marine resources than in the past.

6.4.2 The Santang tool complexes

The Santang site is important for tool analysis (Liaoning Kaogusuo et al. 1992a). This site was found on an island located near the west coast of Liaodong, and less than hundred kilometres from the Xiaozhushan site. The two were of the same period (c. 6000BP) between Mid-Xiaozhushan and Santang I, but of different cultural systems. Tool complexes of Santang I to III are quite different to both Mid Xiaozhushan (Figure 6-12) and Houwa II (Figure 6-14). Within the three Layers of Santang, the tool complexes are almost the same. Averaging the tool calculation in three Layers, hunting tools were more than 2/3, but fishing and gathering less than 15%. Woodcutting was only around 5% (Figure 6-15).

Given the location of the Santang site we can presume marine resources would have been the major subsistence rather than terrestrial animals. The large number of hunting tools in the Santang site might partly used for sea mammal hunting if the faunal data in this site show the evidence of marine mammal hunting instead of catching terrestrial animals. This assumption should be clarified in future studies.

Zhu, Yonggang (1993:150-152) has traced the origin of the Santang tradition based on ceramic patterns, particularly the popular clay-band decoration on vessel surfaces in the Santang pottery. He suggested that the Beixin tradition discovered in Baishicun I (Yantai Administration 1992; Yantai Museum 2000), which is located in the coast of Jiaodong, on the southern side of the Bohai strait, might be one of the ancestors of the specific Santang tradition ceramic decoration. To prove this relation archaeologically may take considerable fieldwork. But the tool complexes of Beixin and Santang are very similar (Figure 6-16), which at least suggests they are similar in economic style or with a similar tradition of food procurement. They both are located on the coast but with a very small amount of fishing. However, the faunal remains in the Baishicun site are fish, shellfish and terrestrial animals but no marine mammals (Yantai Museum 2000:93-95). Even though they lived in a coastal area, terrestrial animals, such as deer, wild pig and fox, which are identified in archaeological sites (Yantai Museum

2000:93-95, Chinese Academy 1999:172) were the major target of hunting activities. This suggests a specific terrestrial animal hunting tradition in the Jiaodong coastal area. In addition, C13 analysis of human bones has indicated plant food was not one of their major food components (Chinese Academy 1999:172). Overall, this tradition looks similar to inland forest foragers relying mainly on animal hunting.

The Santang tradition is very similar to Baishicun I, at least in its economic styles. So one possibility is that during the Mid-Xiaozhushan period around 6000BP, the Santang settlers carried some traditions of Baishicun I and lived in the west coast of Liaodong with the economic style of mainly animal hunting. At the same time, the earlier settlers of Xiaozhushan communities next to the Santang settlers were living in a different economic style, in which gathering was dominant supplemented by hunting and a very small percentage of fishing. Further analysis of the Santang tool complexes will be a later part of the comparison of tool complexes between different sites and different cultural systems.

6.4.3 The Dazuizi/Shuangtuozi tool complexes

After the low level of farming economy in Upper Xiaozhushan (c.4500BP), rice remains were discovered in the Dazuizi site. The Dazuizi/Shuangtuozi culture has been assigned to be generated from the Upper Xiaozhushan culture. Tool complexes seem to indicate the connection to the Upper Xiaozhushan (Figure 6-12 right and 6-17 left). From Upper Xiaozhushan to Dazuizi I, tool complexes changed to proportions similar to the consolidation phase in the ZRC model. For example, the number of gathering tools increased and hunting tools decreased in Dazuizi I. In Dazuizi II and III, gathering tools continued as the highest percentage, and hunting and fishing continually decreased (Figure 6-17 middle and right).

From Lower Xiaozhushan to Dazuizi III, the changes in tool complexes illustrate the transition processes to a farming economy, in terms of the ZRC model, from the availability phasein Lower Xiaozhushan (c.7000BP) to the substitution phase in Mid and Upper Xiaozhushan (c.6000-4500BP) and to the consolidation phase in Dazuizi I, II and III (c.4500-3000BP).

The percentage of wood cutting tools during Dazuizi II and III reveals the highest level in all tool complexes. This circumstance is also found in Shuangtuozi I, II and III (Figure 6-18), which belongs to the same cultural system as the Dazuizi site. This character also appeared in the Machengzi tool complexes of the late period (Figure 6-19). The Machengzi culture that is distributed in the hilly land of central Liaodong has been considered as a possible descendant of the Dazuizi culture. There are more than 60% woodcutting tools in Machengzi. Considered in the light of the conflict between tree pollen and temperature and precipitation after 4000BP in the environmental reconstruction described in section 2 of this Chapter, this high percentage of woodcutting tools may be thought of as for clearing trees for farming or for constructing houses. The lower quantity of tree pollen and higher of fern pollen would be ascribed to the impact of human activities on the local environment.

6.4.4 Comparison between Houwa, Santang and Xiaozhushan

There are some similarities in the proportions of tools between different sites within the same culture with the same types and styles if in the same environmental area. Also some differences appear in the proportion of tool complex between different cultures in the same site or within the same culture but located in different environment. These two phenomena are likely referring to environmental conditions. However, sometimes within the same environment, different tool complexes between two different cultures occur.

In the Lower Xiaozhushan culture, the tool complexes between the different sites of Houwa I (Figure 6-20:up-left) and Lower Xiaozhushan (Figure 6-20:up-right) are similar. This is very likely caused by the same environment, as both Houwa and Xiaozhushan are located on coastal area.

However, tool complex tends to be different between two different cultures Lower Houwa (Figure 6-20:up-left) and Upper Houwa (Figure 6-20:bottom-left) at the same site. Zhu, Yanping (1997) has argued that these two cultures of Houwa belong to the same cultural system and the Upper possibly developed from the Lower. If within the same cultural system, changing the traditional way of food procurement, from major hunting/gathering and a small amount of fishing to fishing absolutely dominant might be the result of environmental change. The Upper Houwa culture is dated to about 6500 to 6000BP, when sea level reached its highest. A change to fishing dominance during this period can easily be ascribed to this rising sea level bringing more marine resources, in particular fish. After 5500 BP, the sea withdrew to the position of the present coastline.

Different tool complex within the same culture may be the result of the environmental difference. The difference in tool complex between Upper Houwa (Figure 6-20 bottom-left) and Machengzi I (Figure 6-20 bottom-right) is the example of this.

Similarly to Houwa, the Santang tool complexes are different to the tool complexes in the Xiaozhushan-Dazuizi cultural system. The differences between the Mid Xiaozhushan and Santang are more important than their similarities (Zhu, Yonggang 1993; Zhu, Yanping 1997). The time span of the Santang culture is from 6000 to 4000BP. The data for tool analysis is available only in the coastal Santang site which contains the early stage from 6000 to 5500 BP. Tool complexes of three levels in this site representing this period have similar patterns with very high proportions of hunting, near 80%, and small amounts of fishing and gathering, around 20% (Figure 6-21). Based on typological studies, Zhu, Yonggang (1993) suggests that the Santang culture later moved inland and became one of the independent cultures in the Lower Liao River area. The sites representing this culture inland are Xishan (Xu, Yulin et al. 1992) and Pianpu (Li, Gongdu & Gao, Meixuan 1998). The tool complexes from the inland aspect of this culture show some changes toward to plant cultivation (Figure 5-26, 5-27). So the differences in tool complexes between the Santang and Mid Xiaozhushan cultures are likely to develop as the result of different cultural traditions rather than the environmental conditions.

The remains found in the Santang site are in the same period and a similar location to Mid Xiaozhushan but are very different in tool complexes. This is very likely to be caused by their different cultural and economic traditions. Presumably, based on different cultural and economic traditions, ancient settlers on the coast of Liaodong had different ways of food procurement even though they were living in a similar environment. This was possible because of the abundance and variety of natural resources, such as fish, shellfish, sea and terrestrial animals, also the large number of plant resources in both land and sea. These abundant and various natural resources provided many options for ancient settlers to continue with different traditions, particularly during 6-5500BP.

6.4.5 The sequence of tool complexes in the Liaodong peninsula

According to the archaeological chronology of Liaodong, the three Layers of Xiaozhushan together with three Layers of Dazuizi/Shuangtuozi comprise the complete and continuous sequence of an archaeological cultural system in the southern coast. This cultural system began around 7000BP and ended about 3500BP (Figure 6-22).

This sequence represents the process of the transition to farming in Liaodong. The first and second diagrams on the left in Figure 6-22 are the Lower and Mid Xiaozhushan period, which is very likely to represent the late stage of the availability phase or the early stage of substitution phase in terms of the ZRC model. The third should be the substitution phase and the remaining three are the consolidation phase.

All diagrams, such as in Figure 6-23, show some trends in the percentage of each tool throughout history. Firstly, total proportion of hunting plus fishing tools is constantly reduced, from more than half in c. 7000BP to less than 17% around 3500BP (Figure .6-24). This trend implies that subsistence through hunting and fishing changed from predominance to an insignificant and subordinate situation. This change became clearer after about 5000BP, when the number of hunting /fishing tool falls sharply for the next c.2500 years. It is likely that hunting /fishing activities were no longer a major method of food procurement and were replaced by domestic crops.

The number of gathering tools remains stable, with less than 15% variation between the stages (Figure 6-25). This relatively stable percentage of gathering tools is similar to central China (Figure 3-17), where this number was higher during the availability phase and reduced a little in the substitution phase (but is associated with a high percentage of woodcutting tools), then turned back to higher proportion again in the consolidation phase.

If woodcutting tools are combined with gathering tools, the difference in gathering activities between the early and late stages is obvious. For example, the numbers of gathering tools are similar between c. 7000 and 3500BP, both with around 40%. But the number of woodcutting tools changed from less 10 % around 7000BP to more than 40% around 3500BP (Figure 6-26).

Apart from tools needed for wood crafting such as furnishing, boat or vehicle making and also house construction, woodcutting tools were presumably involved in some farming activities such as land clearing by cutting trees down. In addition, wood crafting also needed trees for a timber supply. But clearing land for farming was likely the most harmful behaviour for the forest environment. As described earlier, the increase of woodcutting tools perhaps for farming activities may cause the decline in forest. This process is reflected in the abnormal change in pollen data, which indicates that after 5000BP, tree pollen decreased sharply without a dramatic change of climate.

6.4.6 Summary

Tool complexes in the Liaodong peninsular have been represented by the sequence of tool complexes of Xiaozhushan-Dazuizi. This sequence is derived from the successive changes of tool complexes within a continuation of the cultural system. Within this cultural system, changes of tool complexes are gradual and relatively smooth. However, the tool complexes in the Santang culture and Houwa II are different from the Xiaozhushan-Dazuizi cultural system. This difference may suggest that the different cultural systems might use different ways to adapt to the same environment if the natural resources provided sufficient variety, such as the Santang with hunting dominance and Mid Xiaozhushan with gathering (may including crops) combining with hunting in the same period and a similar coastal environment. On other hand, the same culture but with different environmental conditions may cause different economic styles, such as the Houwa II with fishing dominance because it was located on the coast compared to the same culture of Machengzi I located inland with similar percentage of combination of hunting, gathering and fishing.

6.5 ARCHAEOLOGICAL DISCOVERIES OTHER THAN TOOL COMPLEXES

Archaeological discoveries in the Liaodong peninsula have a particular character due to their geographical location. As a conjunction area, Liaodong connects the Jiaodong peninsula across the Bohai strait in the south, attaches to the Korean peninsula in the east, and also links to the Liaoning inland and the Liaoxi region through the Lower Liao River area (Figure 6-1). This particular geographic location implies the possibilities of cultural relations between Liaodong and linking regions, between farmers and foragers. Presumably, cultural interchange between these regions may have started during the early Holocene or even earlier, and continued throughout history. Through this cultural interchange, some technological invention or improvement, particularly some inventions related to farming activities in one area would be diffused to another, and this diffusion might indicate the expansion of crop cultivation.

6.5.1 Cultural interactions between Liaodong and neighbouring areas

Cultural interactions between Liaodong and neighbouring areas show a different character in each millennium. From about 7000BP to 5000BP, cultural interaction was indicated by ceramic design. After c.5000BP till 3000BP, besides the ceramic design, the introduction of the reaping knife and new tripod cooking ware were the major factors showing cultural interaction.

6.5.1.1 Around 7-6000BP

Ceramic design is one of the important indicators of cultural interaction around 7000BP. Nelson & Shan (1997) have summarised the cultural relationships between Liaodong and Korea. They pointed out that some pottery found in Korea has similarities to the discoveries in Liaodong. One of the similarities is the comb-ware design (called "Chulmun" in Korean archaeology), which is the local tradition of ceramic products in Liaodong, as well as in the Liao River or southern northeast China around 7000BP. So the Chulmun design may derive from the influence of Liaodong settlers. However, the shape of vessel is quite different between Korea and Liaodong, flat bottomed in Liaodong and pointed in Korea. So the cultural interaction was unlikely to have been broad and might have remained only in the decoration of pottery. The period of comb-ware pottery is mainly within the Lower and Mid Xiaozhushan around 7-6000BP.

As one of the features of local cultural tradition in Liaodong, comb-ware design, particularly the zigzag pattern, is possibly the result of cultural influence from Zhaobaogou in the Upper Liao River area (Zhu, Yanping 1997:87). Because Zhaobaogou was within the beginning of substitution phase, I have discussed this in Chapter 5, so this contact between Lower Xiaozhushan and Zhaobaogou should also be ascribed to the relationship among foragers as with Liaodong and Korea.

Some vessels decorated with many incised horizontal lines were found in Lower Xiaozhushan probably relate to the tradition of the Lower Xinle culture (Zhu, Yanping 1997). These decorations indicate the contact between Liaodong and Lower Liao River. However, this contact is among foragers because the tool complexes in Xinle suggest it was heavily depending on hunting economy (Figure 5-25).

As I discussed earlier, millet remains may be found as early as the Lower Xiaozhushan period in Liaodong because of the contact between the Lower Xiaozhushan and Xinle culture. Through this similar cultural exchanges crop remains may also be found in Korea as earlier as 7-6000BP. But the crop remains in both the lower Xiaozhushan and Korea are unlikely to be with as large amount based on past archaeological fieldworks (Crawford & Lee 2003). This small amount of crop cultivation in these areas should be seen as the initial plant domestication and cannot be thought as a dominant economy. Therefore, this cultural contact within these regions in northeast Asia should be in the availability phase or the beginning of substitution phase in terms of the ZRC model.

6.5.1.2 Around 5500BP

Apart from the terrestrial neighbours of Liaodong peninsula, after about 6000BP, influence from the north coast of Jiaodong is significant to the Liaodong cultural traditions. Before the farming economy and cultural tradition from inland Jiaodong (the Dawenkou culture) replaced the coastal foraging economy and its cultural tradition during 6-5500 BP, cultural exchange had already occurred between these coastal populations. For example, around 6000BP, painted designs and vessel forms of the Jiaodong coastal cultural tradition (Baishicun I) (Yantai Museum 2000:29-90) were unearthed in a Mid Xiaozhushan deposit (Liaoning Museum et al.1981).

One of the important cultural interchanges around 5000BP is the reaping knife, which was the major harvesting tool in farming societies in north China since around 7000BP(Figure 3-10). This reaping knife appeared in the Longshan culture in Jiaodong around 5000BP (Beijing University 2000; Yantai Museum 2000). It usually has one or two holes possibly to tie it to person's hand. This particular reaping knife is found on coastal Liaodong around 5000 BP during the Upper Xiaozhushan period.

Painted designs on pottery and vessel forms found in Liaodong around 6000BP, followed by introduction of reaping knife, are very likely to imply that new settlers perhaps immigrated into Liaodong across the Bohai strait from Jiaodong peninsula. They may indicate the first step in farming expansion from Jiaodong to northeast China.

After 5000BP, cultural interactions between Jiaodong and Liaodong are even stronger than the past and this is indicated by the artefacts found in the Upper Xiaozhushan culture. Two types of potteries representing two different cultural traditions, Liaodong and Jiaodong, were discovered in the same layer in the Xiaozhushan site (Liaoning Museum et al.1981). At the same time, during the period of Upper Xiaozhushan and Dazuizi I, around 5-4000BP, millet was very likely to be brought into Liaodong from Jiaodong farmers (Liaoning Museum et al. 1984).

6.5.1.3 Around 3500BP

Around 3500BP, another cultural interaction is indicated by changing cooking ware. occurred. Presumably, one kind of cylindrical vessel was local cooking ware in Liaodong prehistoric societies. About 3500BP, cooking pot "*Yan*" with tripod hollow legs, which was the typical cooking ware in the Yueshi culture of Jiaodong (Beijing University et al. 2000), appeared in Liaodong. This cooking pot is the indicator of continual contact between the Jiaodong farming communities and transitional farmers in their consolidation phase.

Around 3000BP, along with continually imported tripod-cooking ware, a new lunar shape of reaping knife appeared in the Bronze Dagger culture (Yu, Qiong 1990). This new tool and its new technique of harvesting emerging in Liaodong imply close contact between the Jiaodong and Liaodong societies and also imply an increase in farming economy in Liaodong. Similar reaping knives were also discovered in Korea about c.3000BP. After the settlers in Korea adopted this reaping knife, they created some local types (Li, Songlai 1997:63). This adoption of reaping knife is very likely caused by adoption of crop cultivation, including foxtail millet and rice.

6.5.2 Summary

Archaeological discoveries in the Liaodong peninsula have suggested that cultural contact and interactions in northeast China and neighbouring regions in three major periods: around 7-6000BP, 5500 and 3500BP. The contacts and interactions in these periods had different effects on local economies in terms of moving towards a farming economy. In particular the second and third periods had significant contributions to the transition to farming.

In the first period, evidence of contact between hunter/gatherers in the Liao River region and Liaodong peninsula in northeast China and the Korean peninsula is based simply on decoration designs on pottery and geographical connection. This contact may also have resulted in diffusion of broomcorn millet domestication according to the crop recovered in the Xinle site in the Lower Liao River of northeast China. This broomcorn millet domestication found in the Xinle site seemed to have no substantial impact on local economies in neighbouring regions.

However, the contacts between Liaodong and Jiaodong after 6000BP indicated by the Jiaodong traditional painted designs and actual vessel forms appeared in the Liaodong peninsula imply a close relationship between these two regions. This became the prelude of contact around 5500BP. During this time, an important tool, the reaping knife for plant food harvesting was brought into Liaodong very likely by immigration from Jiaodong. During this period, millet cultivation was very likely introduced into

Liaodong across sea from Jiaodong but not from inland northeast China such as the Lower Liao River region.

Another important contact happened during the period around 3500BP when new cooking ware in the form of tripod pottery was brought into Liaodong peninsula perhaps by migrations. Millet might be cultivated as early as 5000BP in this area according to the recovery in South Korea (Crawford & Lee 2003). Rice cultivation became common. Along with reaping knife diffusion into Korea, crops cultivation, both millet and rice, also occurred in the Korean peninsula.

6.6 PATTERN OF THE TRANSITION TO FARMING IN LIAODONG

There are at least three trends of transition patterns based on the cultural systems, Xiaozhushan-Dazuizi, Santang and Houwa-Machengzi. Combining tool analysis and the possibility of plant domestication, the extent of farming is not clear before the 5500BP in the Xiaozhushan-Dazuizi cultural system. It is somewhere around 5% in the availability phase. After about 5500BP, however, the Xiaozhushan-Dazuizi cultural system took a substantial step towards a farming economy. But the other cultural systems, Santang and Houwa-Machengzi, seem to take different directions.

6.6.1 The pattern of Xiaozhushan-Dazuizi

According to the tool complexes of the Xiaozhushan-Dazuizi cultural system, the possible farming percentage in economy in different periods could be described as in Table 6-2 and Figure 6-27. This is the pattern of the transition to farming of the Xiaozhushan-Dazuizi cultural system in the Liaodong peninsula.

This pattern can be understood as deriving from contact between local foragers and neighbouring farmers in the south side of the Bohai strait, the northern coast of Jiaodong, occurring during the Lower Xiaozhushan period around 7000BP. So this period may belong to the late availability phase (Solid line in Figure 6-27) or the early substitution phase (small doted line in Figure 6-27), depending on the two possibilities of farming percentage. If farming percentage was over 5%, transition process is the small doted line in the substitution phase, or in the availability phase if it is less than 5%. The extent of farming possibly started increase before the Mid

Xiaozhushan period around between 6-5000BP. And the substitution phase was entered between Upper Xiaozhushan, around 5500BP, and Dazuizi I around 4500BP. After c.4500BP, the transition process became the last stage of the consolidation phase (Figure 6-27).

The transition process indicated by the pattern of Xiaozhushan-Dazuizi is similar to the ZRC model with three phases. For example, the date of the beginning of the availability phase is unknown because there is no site representing hunting predominant economy as in the first diagram in the baseline (Figure 3-17). But at least, it was not later than 7000BP(Figure 6-27).

There are two possibilities about the beginning of substitution phase. First, the substitution phase may have been very short, only about 1000 years, if the solid line of Figure 6-27 is correct. Second, the substitution phase may be longer than 2500 years if considering the small dotted line. No matter which possibility is correct, a substantial increase of farming did not occur until after 5000BP. Thus in this case I prefer to use the solid line to represent transition pattern. From the beginning of the consolidation phase, farming economy continues to rise rapidly (Figure 6-27).

A short period of substitution and a rapid increase in the farming economy is unlikely to be caused by climate changes. My environmental reconstruction shows the climate after 5500BP became slightly cooler and wetter than in the previous period. Pine – dominated forest should develop compared to the previous well-developed forested situation and present climate and vegetation reference discussed in Chapter 4. Both land and marine resources should be sufficient to provide food for the human populations under this environment. But why did human groups in Liaodong quickly change their traditional way of life and become farmers under such an optimum environment? The possible explanation is new settlers, who emigrated from farming societies of Jiaodong after 5000BP. This assumption is based on some of Jiaodong style materials discovered in Liaodong deposits. It is very likely that farmers in Jiaodong moved to Liaodong and brought their traditional households together with their farming techniques and joined local communities. This farmer emigration was probably the major reason resulting in the farming transition in Liaodong.

6.6.2 The patterns of Santang and Houwa

In the Liaodong peninsula, two cultural systems other than the Xiaozhushan-Dazuizi cultural system developed after the Lower Xiaozhushan period. The first was the Santang cultural system, which emerged around c.6000BP, and was concurrent with the Mid Xiaozhushan culture. Santang has unique artefacts and its economy was dominated by hunting/fishing. The second cultural system was Houwa II, which began around 6500BP during the early Mid Xiaozhushan period.

The Santang cultural system does not appear to have remained on the coast after its early development. Its distribution includes not only the Liaodong coast (the Santang site) but also the hilly land of central Liaodong (the Xishan site) and the Lower Liao River area (the Pianpu site). Moreover, its remains on the coast of Liaodong represent the early stage of this system, such as Santang I, II, III from c.6-5500 BP, a similar period to Mid Xiaozhushan (Zhu, Yonggang 1993). I have used the Santang tradition in Chapter 5 to discuss the transition model in the Lower Liao River area. Data from the Santang system on the coast of Liaodong later than Mid Xiaozhushan is not available. Further analysis is needed for this tradition when the data become available.

Similarly to Santang, the Houwa cultural system, including Houwa II and Machengzi I, seems to begin in the same period of early Mid Xiaozhushan period around 6000BP or even earlier. The origin and descendants of this cultural system are still waiting for further fieldwork to find out. In addition, economies indicated by tool complexes in the two sites, Houwa and Machengzi, are quite different even though they are in the same material cultural system. This might be the result of different environments as discussed earlier.

Figure 6-27 shows a possible variation within an earlier transition towards agriculture (large dotted line) in the Houwa-Machengzi cultural system. This variation imply that some groups might continue their traditional style of economy, such as hunting/gathering and fishing, which might exist parallel with the process of transition to farming in other groups

This variation in the transition pattern in Houwa-Machengzi cultural system is significant in the transition process in the Liaodong peninsula. It indicates that there at least are two different transition processes carried out side by side in Liaodong. Liaodong communities with two different cultural systems entered the availability phase of transition to farming. However, they seemed not to take the same direction in their transition processes. Around 5000BP, the Xiaozhushan-Dazuizi cultural system quickly adopted a farming economy. At the same time, the Houwa-Machengzi cultural system still appreciated hunting/gathering and fishing life style and resisted a farming transition.

6.6.3 Comparison to the ZRC model

Comparing to the ZRC model, the similarities are obvious in the pattern of the Xiaozhushan-Dazuizi cultural system, except for a short time span in the substitution phase in Xiaozhushan-Dazuizi pattern. The Xiaozhushan-Dazuizi pattern is almost a copy of the ZRC model. This implies the reliability of the ZRC model in research of transition to farming in this region.

However, there is also a significant difference due to other patterns existing side by side with the Xiaozhushan-Dazuizi pattern. This difference at least implies that a unilinear model may only illustrate one single process but a multi-linear model is possibly closer to the facts. Particularly in a secondary agricultural area, the strong influence from farming communities and migration of these farmers may form a force pushing hunting/gathering societies towards farming. This is shown by a unilinear model of the transition to farming, such as the ZRC model. But local economic tradition may still remain in the form of some traditional hunter/gatherers if the natural environment can meet the requirements both for farmers and foragers. In this situation a multi-linear model may be necessary to demonstrate the various economies and the variety of processes in the transition to farming.

6.7 CONCLUSION

The transition to farming in Liaodong reveals local character. First, the particular local environment has provided a variety of natural resources, including maritime, freshwater (rivers), forests, grasslands, hilly lands, and plains. This environment is different from the Liao River region. Various economic styles existed in the same time. Under this optimum environment, ancient people were almost free to choose their life styles, traditional hunting, gathering and fishing or adopting a new way, such as agriculture.

Second, three cultural systems are associated with three different transition processes. This implies the close relationship between cultural tradition and economies. The Xiaozhushan-Dazuizi pattern is very similar to the ZRC model, which is likely to represent a transition process caused by the migration of farmers. However, the Houwa-Machengzi pattern may represent local groups which ignored farmer's influence and continued depending on the traditional economy.

Third, the pattern of Santang also provides evidence of a multi-linear process of the transition to farming in the Liaodong peninsula. The traditional economy of Santang was hunting and gathering. If the assumption that Santang communities were migrates from the coast of Jiaodong is correct, the traditional economies, hunting and gathering, of these communities was carried to the new region. But once Santang communities moved inland from the coast, adoption of farming may have occurred due to the different natural conditions and changing economic strategies to meed socio-political needs compared to its early coastal settlement.

Overall, based on the Liaodong patterns, it seems that cultural system and natural resource are very likely to be the major factors in determining whether to adopt agriculture. Farmer migration has become the main stream to complete the transition to farming in the Liaodong peninsula. But in the same times, traditional hunting and gathering economy could exist which perhaps was supported by abundant natural resources, which sufficiently satisfied local communities needs.

CHAPTER 7. CASE STUDY (3) CENTRAL NORTHEAST CHINA

7.1 INTRODUCTION

In this Chapter, I will use my framework again to draw an outline about the process of transition to farming in central northeast China. In the first section, introduction, I will discuss present the natural environment as a reference for the reconstruction of the environment in the past. I will also state some expectations in this case study compared to others and the background of discoveries about plant domestication will be also included. The two regions, the Song-Nen plains and Ji-Chang region, will be discussed separately, the former in section 2 and latter in section 3. In these two sections, I will discuss environmental changes since the Holocene began mainly based on pollen data. The summary of archaeological chronology and analysis of tool complexes as well as some archaeological discoveries other than tool complexes will be in both section 2 and 3 based on current archaeological discoveries in the two regions. The comparison of the patterns of transition to farming in these areas will be in section 4. A short conclusion is in section 5.

7.1.1 Present-day natural environmental features

The geographical position of central northeast China comprises some particular features compared to others. Firstly, the geographical landscape is different from the other areas. Central northeast China is an inland plain: the Song (Songhuajiang River)-Nen (Nenjiang River) plains have an elevation of less than 200 metres. These plains are similar to the Lower Liao River area, but with less rainfall because the latter is relatively near the coast. Secondly, central northeast China is located in a transitional area between two environment zones. Likewise the Upper Liao River area, which is also located in the same transitional area, central northeast China is located between the Mongolian plateau, with over 1000 metres above sea level and dry climate with grassland, desert or semidesert in the northwest (zone 3 in Figure 7-1), and the Changbaishan Mountains usually with less than 1000metres in altitude and with relative humid and forested environment in the southeast (zone 2, 3 in Figure 7-1) (Liu 1988).

In addition, the Song-Nen plains are surrounded by three mountain ranges, Changbaishan in the southeast, Daxinganling in the northwest and Xiaoxinganling in the northeast. The Kerqin desert along the Upper Liao River has made links between the Song-Nen plains and the Upper Liao River difficult, and this situation apparently was even harder in the past. One corridor which should connect these two areas was along the south side and another was on the west side in the foothills of the Daxinganling Ranges (Figure 7-2).

Moreover, the landscape in central northeast China is very different from other areas in northeast China. A small desert named the Song-Nen desert is located in the centre of the plains. This desert was formed since the Holocene began (Ren, Guoyu 1997). Many water pools are distributed along the Songhuajiang and Nenjiang rivers due to the poor drainage system. Modern rainfall in this area is less than 400mm per year and even less in the desert. The plains are covered by some dry arid-loving grasses. Forests develop in the Xiaoxinganling and Changbaishan Ranges, which are located in the east and southeast corner, where the rainfall increases to more than 500mm, in some areas even more than 6-700mm (Chinese Map Press 1998).

Central northeast China is usually divided into two regions in Chinese archaeology. One is the lowland of the Song (Songhuajiang)-Nen (Nenjiang) plains, including the Songhuajiang plain and Nenjiang plain, and another is at the southern end of central northeast China, called Ji (Jilin)-Chang (Changchun) region.

The centre of the Song-Nen plains is based on the area where the Nenjiang River joins into the Songhuajiang River. The entire Song-Nen plains are nearly all less than 200 metres above sea level. The term “Song-Nen plains” in local archaeology usually means only the area of less than 200 metres above sea level. The Ji-Chang region is around southern end of the geographical Song-Nen plains. This region is mostly between 2-500 metres in elevation along the riverbeds and flood plains, but around 1000 metres above sea level on some tops of hills. This area is the transitional area from the lowland, Song-Nen plains to mountains, the Changbaishan Mountain ranges.

The environment of these two regions is slightly different in relation to the precipitation, temperature and vegetation coverage. The modern climate reveals a trend of increasing precipitation and temperature if moving from the Song-Nen plains to the Ji-Chang region. For example, in the Song-Nen plains, the present annual precipitation is less than 400 mm but in the Ji-Chang region is near 500 mm. Also vegetation coverage reveals slight increase of arboreal species, showing grassland combining with a low density of trees in the Ji-Chang region compared to almost absolutely herbs dominant in the Song-Nen plains (Chinese Map Press 1998).

7.1.2 The significance of the transition study in central northeast China

Central northeast China is one of the important areas for my study because this area will show the process of transition to farming occurring from one secondary agricultural areas, the Liao River area to another the Song-Nen plains. In addition, the specific geographical location and natural environment may also show some different results in the process of the transition to farming.

The transition to farming from secondary agricultural areas may reveal some differences compared to the process extending from the primary agricultural area, north China, to the secondary areas, such as the Liao River area and the Jiaodong peninsula.

When the Xinglongwa societies in the Liao River area began to contact the farmers in north China, as previously discussed, the transition process was very likely to remain in the availability phase in terms of the ZRC model. According to archaeological studies, human inhabitants in the Song-Nen plains seemed to be primarily hunter-gatherers without any possibility of being directly in contact with farming societies. This economic style in central northeast China cannot be identified as the availability phase in terms of the ZRC model. However, in my analysis in Chapter 3, the availability phase may also include the situation when there is a small amount of subsistence depending on cultivated plants within hunting, gathering and fishing communities. Plant cultivation in central northeast China could be developed locally or adopted from other hunting and gathering communities, such as the southern neighbour Xinle society in the Lower Liao River region. However, when the farming economy became predominant in the Liao River area around 4000BP, the contact between these two regions would have become direct contact between hunter/gatherers and farmers.

As I discussed above, the unique features in natural environment in central northeast China, the Song-Nen plans, such as geographical location, climate changes and vegetation coverage may also affect the time and way of adopting plant domestication. The different environment conditions also influenced the local societies to set up different economic strategies and subsequently change the direction of transition to farming, which is another expectation in this Chapter.

7.1.3 The background of plant domestication

The first floatation process to have taken place in northeast China is in the Baijinbao site, in the Song-Nen plains, by Gary Crawford. He collected some soil samples from this site when he was visiting there in 1986. The soil samples were sent to Japan for floatation and further analysis. Six seeds were recovered through the flotation and three of them have been identified as domestic crops: common millet (Figure 7-3) (*Panicum miliaceum*) (Appendix 5).

As discussed earlier, using the floatation process in order to intentionally recover botanical remains including plant seeds, either domestic or wild, is not common in Chinese archaeological fieldwork, particularly in northeast China. In the Song-Nen plains, archaeologists did not think that plant domestication occurred in such early period before the recovery of common millet in the Baijinbao site. The Baijinbao culture was around 3000BP and the date of the crop seeds recovered from the Baijinbao site should be similar. This may not be the earliest date of domestication because of the lack of floatation practices in this region.

Other discoveries of domestic crops are from the Xituanshan culture around 3000-2500BP in Ji-Chang region. For example, soybean was found in the Dahaimeng site dated to around 2500BP (Liu, Jingwen 1991:14). Also common millet and foxtail millet were found in the Dahaimeng, Xituanshan (Tong, Zhuchen 1987:40) and Houshishan site (Liu, Jingwen 1991). These discoveries indicate that at least around 3000BP a variety of domestic plants was cultivated in central northeast China. Even though this date would not be the earliest plant domestication in this region, it is the reliable data based on the evidence of domestic seeds. Besides these domestic plants, hemp may also be domesticated since the remains of hemp fabrication were found in the Xituanshan culture, such as in the Xingxingshao and Houshishan sites, but perhaps were not used for food (Liu, Jingwen 1991:15).

An agricultural economy is confirmed for central northeast China around 2000 BP, during Han dynasty based on written records. A group of local communities, which might be in the social status between early state and late chiefdoms, was called *Fuyu* in the south side of the Song-Nen plains. Chinese historical records described how *Fuyu* had developed agriculture with “five cereals” (rice, common millet, foxtail millet, wheat and beans) (Gan & Sun 1984:168). Archaeological discoveries in relation to the *Fuyu* society are assigned to the Laoheshen (Paoziyan) culture (San 1988; Jia, Weiming & Wei, Guozhong 1989). Domestic plants of the “five cereals” should be recovered if the floatation method was used in fieldwork even though no domestic seeds have been found yet during current excavations in *Fuyu* period. However, *Fuyu* society was only located in the south side of the Song-Nen plains and most areas were still occupied by other groups of humans such as the societies represented by the Upper Hanshu culture (Zhang, Zhongpei 1997; Li, Chenqi et al. 1994). No domestic seeds have been discovered in the sites of these traditions during similar excavation methods as in the area of the *Fuyu* society.

7.2 FIRST REGION, SONG-NEN PLAINS

There are four parts involved in this section: environmental reconstruction, archaeological chronology, tool complex analysis and archaeological discoveries other than tools. All these four parts relate to the transition to farming in the Song-Nen plains.

7.2.1 Environmental reconstruction

Environmental reconstruction for the Song-Nen plains is mainly based on the pollen data derived from the Dongwengenshan site (123.29E & 46.27N) (Ye, Qixiao et al. 1991). I have reinterpreted this pollen data in Chapter 4 to argue with the original explanation in the field report (Ye, Qixiaoet al.1991: 189). This site is located in the central Song-Nen plains and the sediments and pollen remains in this site basically reflect environmental changes in the Song-Nen plains through the Holocene.

Based on pollen data derived from various sites and using the interpolation method I have attempted to establish the outline of precipitation and temperature changes through out the Holocene in Chapter 4. The following illustrations are a close look at these changes (Figure 7-4; 7-5).

Referring to these diagrams, around 12000 BP, annual mean temperature was possibly lower than –6º C and rainfall was less than 200 mm. Under these conditions, the climate in Song-Nen plains was very arid, cold and dry. The landscape was a semidesert with a few shrubs (Figure 4-19). Along with the slight increase of temperature and rainfall during the beginning of the Holocene, desert withdrew from most areas and became concentrated in the central plains. Grass covered the areas which was desert in the previous period (Figure 4-20). This condition perhaps continued through the whole Holocene even to the present time (Figure 4-21, 4-22 and 4-23). The only possible change is that very small numbers of trees (*Pinus* etc.) appeared along with the slight increase of rainfall and temperature (Figure 7-4; 7-5).

Based on the sediment data derived from the Dongwengenshan site, four soil deposits separated by three wind-blown sandy layers were revealed in the deposit. Ye, Qixiao et al. (1991:189) have described that the four soil deposits were formed during 8-6000 BP, 5-4000BP, 3300-2500BP and 1500-1000BP respectively, but without explanation how such dates for these soil layers were derived from C14 determination. Four C14 dates are different from these periods, being 7000±100 (cal. BP 7726-7874) in soil layer I, 4400±80 (cal. BP 4858-5051) for layer II, 2900±80 (cal. BP 2945-3082) for layer III and 1400±100 (cal. BP 1233-1409) for layer IV (Ye, Qixiao et al.1991: 188). Based on these four calibrated dates I have changed period for soil layers to close to the C14 dates (Table 1 shaded rows). Even though the laboratory details of these C14 dates are not cited in the report they are the only available dates for these layers.

Combining the information in Table 7-1 and pollen data shown in Figure 4-1, my environmental reconstruction for the Song-Nen plain is as follows. The plains were grassland for most of the Holocene due to the lower rainfall and warm temperature.

High aridity has created desert in the central region of the plains but some areas near Dongwengenshan have developed soil layers through a local relatively humid climate and the slowing down of the strong monsoon from the northwest. There is a thick sand layer, about 3 metres deep, between the first (8000BP) and the second (5000BP) soil deposits, compared less than 1 metre thick in the other sand layers. This thick sand layer possibly indicates a very dry, warm and windy climate during 6-5000BP. This assumption is also reflected by the analysis of temperature and precipitation, as well as the pollen data. Therefore, around 6000BP, the climate in the Song-Nen plains was very warm but aridity was still higher than the previous and later periods. Unlike in the Liaodong peninsula, the "Great Holocene Optimum" was not presented in the mid Holocene of the Song-Nen plains. This situation is similar to the Upper Liao River area.

7.2.2 Summary of archaeological chronology

According to very limited field surveys and excavations, at least six perods have been recognised: Daxingtun before c 10000BP, Xiaolaha I-1 around 6500BP, Xiaolaha I-2 (Angangxi) around 5500BP, Xiaolaha II around 4000BP, Baijinbao around 3000BP and Upper Hanshu around 2000BP (Figure 7-6; Table 7-2). The first period is around 10000BP, which is unlikely to be the earliest human habitation considering the lack of attention to the late Pleistocene within local archaeological practice. The gap of more than 3000 years between the first and second periods is because no data are available yet in this region, except one single burial with no artefacts is dated to 9000BP. There is also one C14 date for the first period.

For the first period, before 10000BP, archaeological discovery is very limited due to the lack of fieldwork. Two sites, the Daxingtun site (Gao 1988; Huang et al. 1984) discovered in the central Song-Nen plains and the Qinghetun site (Yu, Huili 1996) in the Upper Nenjiang River area reveal the general image of early human habitation in this area. One C14 date, 11800±150 (cal. BP 13498-13700) apply to the Daxingtun site. Even though almost all reporters have suggested that the stone artefacts found in the Daxingtun site indicate the beginning of microlithic technology (eg. Yu, Huili 1996; Gao 1988:87; Huang et al. 1984:237), some even saying that micro-blades were found in this site and these might be used for composite tools (Yu, Huili 1996:264), the stone artefacts shown in the illustrations in the report cannot be identified as typical micro-blades. The only exception is one stone core which may be close to a microcore (Huang et al. 1984:237 Figure 3:9). There is no C14 date from the Qinghetun site. But based on the stone tool technology, Yu, Huili (1996) has suggested that Qinghetun may be earlier than Daxingtun because there is no microlithic technology. This speculation remains uncertain without further studies, because the microlithic stone tool technology did not necessarily appear at the same times and some groups may have adopted this technology earlier than others.

There is still a lack of archaeological discoveries for the early Holocene except for one burial found in Qingshantou, which is dated to about 11000BP (Li, Xikun et al. 1984; Jin, Canzhu et al. 1984; He, Ming 1994). This burial has no artefacts associated.

Several fragments of pottery unearthed in the Xiaolaha site are said to date to around 6500BP. These fragments were found in the first horizon of this site. The stratigraphic data shows these fragments are the earliest remains in the deposits of this site (Heilongjiang Kaogusuo et al. 1998; Yu, Huili et al. 1997). Similar pottery fragments are also found in other sites through surface observation. Archaeologists presume these pottery fragments found in the Xiaolaha and other sites represent a archaeological culture. There is no C14 date available for this material. Archaeologists have dated this culture to around 6500BP by comparison with similar ceramic production and decoration in neighbouring areas (Heilongjiang Kaogusuo et al. 1998:98). This culture is called the first group of Xiaolaha Layer I (Xiaolaha I-1), which is the earliest discovery during the Holocene in this region. These fragments revealed simple shapes of pottery, including cylindrical pots with straight walls and small rims. Common decoration on the surface of the pottery is incised marks, which form geometric patterns. No stone tools have been reported. This may be the result of insufficient field discoveries.

The next period is the culture of the second group found in Xiaolaha Layer I (Xiaolaha I-2). This group includes pottery with open mouths and slight bent rims. Decoration with horizontal clay bands, varying between 2-8 lines, appears under the rims of pottery. Triangular stone arrowheads with rounded corners and slight indented base are the typical Song-Nen type of arrowhead (Figure 7-11) (Jia, Weiming 1985a).

This type of arrowhead is also found in the burials of Angangxi that were excavated in 1930 (Liang, Siyong 1959) and burial No.6 in Erkeqian (Tao, Gang & Jia, Weiming 1992; An, Lu & Jia, Weiming 1986). As Chang (1961:59) suggested that the Angangxi culture implicates a hunting, fishing economy and with no sight of agriculture. I have studied stone arrowheads based on discoveries in different traditions in northeast China and suggested that the earliest date of this arrowhead in the Song-Nen plains is likely to be around 5500BP (Jia, Weiming 1985a). The Angangxi burials are assigned to the Xiaolaha I-2 culture around 5500BP (Heilongjiang Kaogusuo et al. 1998; Yu, Huili et al. 1997).

Nevertheless, C14 dates 4000±360 (cal. BP 3957-4874); 3688±104 (cal. BP 3868-4152) derived from the Xiaolaha site show this culture is around 4000BP (Heilongjiang Kaogusuo et al. 1998:98), which is later than I suggested. Based on these C14 dates, Yu has indicated that the tradition of Xiaolaha II is closely related to Xiaolaha I-2, because the C14 date, 3830±340 (cal. 3826-4647) applied to the culture of Xiaolaha II is very similar to the dates 4000±360 (cal. BP 3957-4874) and 3688±104 (cal. BP 3868-4152) of Xiaolaha I-2. He argued that these two cultures shared many similarities in the characters of ceramics, so that the culture of Xiaolaha II should be the descendent of Xiaolaha I-2 (Heilongjiang Kaogusuo et al. 1998:100). However, pottery from these two groups is rather different in their shapes and decoration not to "share many similarities" as Yu described (Heilongjiang Kaogusuo et al. 1998:62-63). Xiaolaha I-2 is mainly decorated but Xiaolaha II is plain surface (Figure 7-6). Therefore, the correct date for Xiaolaha I-2 and its relation to Xiaolaha II is still unclear.

In considering the typological comparison with pottery discovered in neighbouring areas, the Xiaolaha I-2 might be in the similar period of the Pianpu culture (Li, Gongdu & Gao, Meixuan 1998) distributed in the Lower Liao River area and also the culture of Zuojiashan Layer III (Jilin University 1989). Pottery in these three cultures shares some common features indicating the common temporal characters. Even in entire northeast China, pottery has a similar trend in the change of decorations at the same period. For example, around 7000 BP, almost the entire body of vessel, from rim down to bottom is decorated. This decoration area was reduced from the bottom to the rim in later periods. Decorating the whole body of pots was in the tradition of

Lower Xinle (7000BP) (Shenyang Administration 1978) and Zuojiashan Layer I (7000BP) (Jilin University 1989). This decorated area was reduced to upper rim area in the Pianpu (5500BP) (Liaoning Kaogusuo et al. 1992a) and Zuojiashan Layer III (5000BP) (Jilin University 1989). This character also can be found in the pottery of the Xiaolaha I-2 culture. Therefore, the Xiaolaha I-2 culture (Angangxi) is more likely to be in the period around 5000BP or maybe starting as early as 5500BP.

In addition, a common feature of pottery during the Bronze Age, around 4000BP in northeast China, is less decoration, usually with plain surface only, or some exceptions like cord marks, which is seen as part of the normal process of producing pottery rather than intentionally decorating it. Plain surfaces are the major character of ceramic products in the Xiaolaha II culture dated to around 4000BP. Between Xiaolaha I-2 and Xiaolaha II there is a gap of at least around 1500 years. What kind of the material cultures during 1500 years in the Song-Nen plains will rely on future works.

The next period is already discussed above, the beginning of the Bronze Age Xiaolaha II around 4000BP (Heilongjiang Kaogusuo et al.1998; Zhu, Yonggnag 1998b). Plain pottery is predominant in this period and with an obvious pot shape with neck and shoulder compared to cylindrical shape in the previous period. For instance, pottery is usually narrow near the top in order to shape neck and shoulder, and then globular. Adding several clay nipples on the shoulder, which may be used for easier handling with ropes, is the major character of this pottery. A new shape of pottery, tripod "*Li*" emerged in this culture but is only found in small numbers and size (Heilongjiang Kaogusuo et al. 1997a). The variety of bone tools is similar to the previous period, indicating similar economic style. A number of shell tools emerged in this culture suggesting the exploration of fresh water resources other than fish. Fish attractors made of shell show the lure method to catch fish. This method can be traced back several thousand years: ancient Amur people used the same way to attract fish, but the fish attractors were made of stone (Kononenko 2001). Bronze artefacts in this culture are small items only such as buttons and small knives (Heilongjiang Kaogusuo et al. 1998).

The Baijinbao culture around 3000BP represents another period of Bronze Age in this area. The Baijinbao site has been excavated three times since 1970s (Heilongjiang Kaogusuo et al. 1997a; Heilongjiang Kaogudui 1980), but there is no publication of the second excavation. The content of the Baijinbao culture is mainly based on the first and third excavations in the Baijinbao site. Tripod "*Li*" with cord mark became popular and geometric patterns comprised by slim cord impressing on surface of pottery forming unique features on the pottery of the Baijinbao culture. More shell tools, in particular shell sickles were found in this culture, as well as bone tools such as harpoons. House construction is more sophisticated during this period being usually with a large pillar comprised two logs of wood combining with other poles to support the roof. A storage pit is usually found in the corner of a house.

The next period, around 2000BP after Baijinbao, is the Upper Hanshu culture (Xiaolaha III). Archaeologists have suggested that the Upper Hanshu culture is very likely to be the direct descendent of the Baijinbao culture. This is usually based on the typological similarities of artefacts and house remains (Li, Xuelai 1998; Zhu, Yonggang 1998b; Jia, Weiming 1986). Cord mark tripod "*Li*" is still popular but the geometric pattern of decoration seemed have passed its flourishing period in the Baijinbao culture. Bone tools and shell tools have similar shapes compared to the last period but decrease in numbers. Iron artefacts usually in the form of small items such as knives or buttons are found in this culture (Heilongjiang Kaogusuo et al. 1997a). This is the earliest iron discovery in this area (Figure 7-6, Table 7-3).

Archaeological data from the Song-Nen plains shows that three cultures, Xiaolaha II, Baijinbao and Upper Hanshu (Xiaolaha III) very likely comprised one cultural system and is called Xiaolaha-Baijinbao cultural system. This cultural system includes several sites such as Baijinbao, Xiaolaha, Hanshu and Erkeqian.

Some local experts (e.g. in Heilongjiang Kaogusuo) attempt to distinguish the remains of Erkeqian Layer II from the Baijinbao cultural system. The reason for this is that the tripod "*Li*", which is one of major cooking wares in the Baijinbao cultural system, was not found in Erkeqian Layer II during the second excavation in 2001 (Heilongjiang Kaogusuo 2003a). However, in the first excavation in the Erkeqian burials in 1985, there were some fragments of tripod pottery "*Li*" unearthed from burials belonging to Layer II (An, Lu & Jia, Weiming 1986). Similar pottery, which belongs to Erkeqian Layer II, was also found in nearby area such as in Erkeshan when I conducted field survey with several local archaeologists in 1989. Similarly to Erkeqian Layer II, burials found in the Dongshantou, Niuweibagang and Xiaodengke sites have no discoveries of tripod *Li* and are assigned to the Baijinbao cultural system as well (Li, Xuelai 1998; Zhu, Yonggang 1998; Jia, Weiming 1986).

Artefacts that are different between burials and settlement villages even within the same culture, is common in archaeological discoveries in northeast China. For example, in the Xituanshan culture distributed next to the south distribution area of the Baijinbao cultural system, tripod pottery (*Li* or *Ding*) is usually not present in burials compared to settlements (Chen, Yong 1993; Zhu, Yonggang 1991a). A similar situation can also be found in Liaodong. Therefore, the lack of tripod pottery "*Li*" is very likely caused by artifactual differences between burials and settlements. In the same cultural system, the artefacts found in settlement villages are very likely to be abandoned gradually or suddenly left due to fire or other disasters. They should reflect a relatively complete image of the artefact complex used in daily life. However, the artefacts in burials were usually selected by cult, custom or even personal preference as I discussed in relation to the methodology of tool complex analysis in Chapter 3. The final solution for this debate needs further fieldwork such as searching for settlement remains of Erkeqian or the burials of Baijinbao in nearby areas. It is premature to distinguish Erkeqian burials from the Baijinbao cultural system. I have proposed that Erkeqian layer II belongs to the Baijinbao culture in this thesis until further data become available.

In addition, the Baijinbao culture dates to about 3000-2500 BP based on typological studies (Jia, Weiming 1986:15). The date of Erkeqian burials should be around 2500BP in the late stage of the Baijinbao culture (An, Lu & Jia, Weiming 1986; Zhao, Hongguang et al. 1991). Local archaeologists also postulated a similar date for Erkeqian, about 2800-2200BP (Heilongjiang Kaogusuo 2003a). This date is later than Baijinbao and earlier than the Pingyang burials and the Upper Hanshu culture (Heilongjiang Kaogusuo 1990). Local archaeologists suggest that Erkeqian is different from Baijinbao but this difference may due to the different periods within one cultural system. In the current situation, it is better to include Erkeqian II in the Baijinbao culture.

7.2.3 Tool complex analysis

Tool complexes in the Song-Nen plains from around 7000BP to 2000BP, show a trend of change from hunting and fishing tool dominant to gathering tool or the tool for crop cultivation. This trend implies economic style changed from hunting/gathering and fishing to farming along with the development of the Xiaolaha-Baijinbao cultural system.

The tool complex of the early stage, the period of Xiaolaha I-1 around 7000BP, is not available because there is no tool data reported. Archaeological discoveries in this period are only a few fragments of pottery (Heilongjiang Kaogusuo et al. 1998:64). The shape and decoration represented by this pottery are similar to the Zuojiashan Layer I, which was found around 150 kilometres south of the Xiaolaha site. Tool complexes of Zuojiashan Layer I reveal hunting as predominant economic style combined with plant food gathering and a small amount of fishing (Figure 7-7).

In order to make comparison, I use the tool complex of Zuojiashan I as the first period in the Song-Nen plains. Tool complexes in Xiaolaha I-1 may not be the same as Zuojiashan I even though they are in the same period (around 7000 BP) and have similar artefacts and are very close in distribution areas. Xiaolaha I-1 occurs in the centre of the Song-Nen plains at less than 200 metres above sea level, and Zuojiashan I is dispersed in the southern end of the Song-Nen plains, on hilly land on the boundary between plains (Song-Nen) and mountains (Changbaishan), at higher than 300 metres in altitude. In considering the different environments between these two regions, the tool complexes should reveal some differences. I use the tool complex derived from Zuojiashan I to represent the first period in the Song-Nen plains because no tool data are available from Xiaolaha I-1.

Tool complexes from Xiaolaha I-2 (Angangxi), about 5500BP reveal hunting and fishing predominant (Figure 7-7). Gathering and woodcutting are zero which reflects the lack of gathering and woodcutting activities in daily life, even though these activities might still exist at a low level (Heilongjiang Kaogusuo et al. 1998). The environment of this period also reflects a landscape with lack of trees. Referring to the steppe landscape, hunting activities were possibly more related to the small animals. This may also be the reason for the large number of fishing tools, indicating a large amount of subsistence depending on fishing. A high proportion of fish in subsistence has become the unique feature of economic style in early settlement in the Song-Nen plains compared to others. Exploiting freshwater resources, particularly fishing, was the major economy in Xiaolaha I-2 compared to a relatively lower level of exploration of maritime resource in the coastal areas of the Liaodong and Jiaodong peninsulas as discussed in Chapter 6.

Gathering tools increased from zero in previous period to above 20% in the period around 4000BP in Xiaolaha II (Figure 7-8). Woodcutting tools also increased to near 20% compared to zero in the last period. This may relate to the environmental change, lower temperature but more rainfall in this period allowed trees, such as pine, to grow (Figure 7-6). The increase of gathering tools associated with the increase of woodcutting tools may imply the possibility of cultivation activities involving some land clearance. Gathering and cultivation are suggested as the subordinate supplement of food supply since nearly half the tools relate to hunting activities together with more than 10% fishing. This tool complex is similar to the Xishan site of the Santang culture in Liaodong (Figure 5-27), which perhaps was in a similar substitution phase in terms of the ZRC model.

Around 3000BP, based on the discoveries of the Baijinbao site, gathering tools had reached near 70%, and conversely, hunting tools were reduced to less than 20% and fishing tools to only 5%. Woodcutting tools remain around 10%, perhaps indicating less woodcutting activities either for land clearing or housing, craft activities or other purposes (Figure 7-9). This tool complex is very likely to imply that the economy in the Baijinbao culture was predominant by plant subsistence particularly domestic plants such as millet.

Around 2000BP, during the period of Xiaolaha III (Upper Hanshu), tool complexes changed dramatically. Hunting and fishing tools increased to nearly 30% in each category. Also wood cutting tools increased to more than 30% but gathering tools were reduced to less than 15 %. The increase in hunting tools might reflect the development of a herding industry, because in the Pingyang burials of this period, which are probably included in the Upper Hanshu culture, more than one hundred domestic animals, such as dog, horse, cow, pig and sheep (Heilongjiang Kaogusuo 1990:171) were unearthed. These domestic animals indicate the development of a herding economy during this period. This herding economy perhaps already began during the period of the Baijinbao culture. The increase of hunting and fishing tools imply that the economic style in the Song-Nen plains transferred from one dominated by crops cultivation to being mainly dependent on domestic animal herding, perhaps combined with a small amount of hunting and fishing (Figure 7-10). A high level of woodcutting tools perhaps implies the development of variety of activities involved with timber industry in a herding economy.

7.2.4 Archaeological discoveries other than tools

Archaeological discoveries other than tool complexes in the Song-Nen plains reveal the progress of human settlement in adapting to this specific environment. Through adapting to the environment, ancient Song-Nen inhabitants invented or adopted new tools in different periods appropriate to different economic styles. The emergence of settled villages and the change of house construction also imply socio-economic development through the history. Development in ceramic production and new cooking pots adopted from southern counterparts perhaps implies people needed to cook plants in the Song-Nen plains societies.

7.2.4.1 Specific tool development

Based on archaeological discoveries, some specific tools emerged in different periods indicating the progressive process in technology and strategy involved in economic activities. If the invention of arrowheads suggests bow hunting, which is the progress of hunting technology, sinkers together with fish attractors should indicate strategically intensive net fishing activities. Also if reaping knives indicate plant food gathering, sickles should designate effective harvesting technology, which is usually related to plant food farming activities.

The discoveries of artefacts including micro-blades, arrowheads, and stone sinkers in the Xiaolaha I-2 (Angangxi) reflect an economy dominated by hunting combining with fishing around 6000BP in the Song-Nen plains. Presumably, the economic style in the early period, such as in the beginning of the Holocene in this region was somewhat similar to Xiaolaha I-2, even though the data for this period is not available. I suggest this because of the specific faunal and floral environment which developed. During the early Holocene, modern small animals living in the temperate steppe quickly replaced large mammoths and woolly rhinoceros. Changing from large to small animal hunting, which was forced by environmental change, was another option for food procurement and frequent small animal hunting should also stimulate people to invent effective tools, such as arrowheads used with bows to shoot small targets in Xiaolaha I-2 (Figure 7-11).

Exploiting freshwater resources including fishing would have happened very early in the Holocene, but might not become the major subsistence then since the tradition of large animal hunting, which provided sufficient food might not be changed rapidly. So a fishing industry might start as early as before the Holocene but not play an important role in food procurement until the late stage of the early Holocene.

Several fish figurines were found in Xiaolaha II (Figure 7-12), and the report presumes that they were used as lures to attract fish into traps or nets. Similar items are found in many places in east Siberia (Michael 1958:19, 46, 55, 56) and on the coast of the Japan Sea in Primorye region of Russian Far East (Kononenko 2001). Several ethnic groups of Eskimos living in the Arctic Circle and other Tungus group still use fish figurines as sinkers or lures (Michael 1958:56). Therefore, the development of fishing tools like bone harpoons, stone sinkers and fishing net together with fish figurines (Figure 7-12) imply improved strategic fishing technologies.

Intensive bow hunting and strategic net fishing illustrate that prehistoric human groups were well adapted the environment of the Song-Nen plains around 7-6000BP and this environment included a variety of small animals living in steppe with open-woodland and many water ponds and rivers providing fish and other freshwater resources. In addition, the dry and hot climate around 6000BP would have resulted a decrease of terrestrial resources and intensified exploitation of freshwater resources, such as fishing and shellfish collecting.

Apart from hunting and fishing tools, current discoveries document reaping knives in the Song-Nen plains around 4000BP in the tradition of Xiaolaha II. These reaping knives found in Xiaolaha II were made of shell with two holes (Figure 7-13).

As an effective tool of harvesting plant food, there is a historical trajectory to the reaping knife dispersal into northeast China. Reaping knives appeared in the Liao River area, such as the stone reaping knife found in the Xishuiquan site of the Hongshan culture, dated to around 5500 BP. This stone-reaping knife is suggested to derive originally from north China around 6000BP, such as in the Banpo culture (Figure 3-10) from which it diffused to northeast China later (Yu, Qiong 1990). Some reaping knives found in northeast China have a specific name, called "semilunar-shape stone knife" in northeast Asian archaeology, because the shape of this reaping knife is similar to the new moon. The reaping knife found in Xiaolaha II is very likely to represent the influence from the Liao River area, even though it is made of shell not stone. The shell material for this reaping knife may reflect people adapting to environments with a lack of stone materials but with abundant freshwater resources including shell, when they adopted reaping knife harvesting techniques in the Song-Nen plains.

Around 3000BP, in the Baijinbao culture, the sickle appeared in the Song-Nen plains and, similar to the reaping knife, this sickle is also made of shell not stone as in other regions (Figure 7-14). The sickle may be seen as an advanced type of reaping knife. A handle replacing the two holes used for tying to the hand has made this tool more efficient in plant food harvesting. Sickles found in excavations are usually without handles because wood is difficult to preserve from deterioration in normal natural conditions. Associated with these shell sickles, common millet was recovered from the Baijinbao site. This implies that millet cultivation had probably become the main economic activity in the Baijinbao culture.

7.2.4.2 Improvement of house construction

The differences in house construction found in the Xiaolaha-Baijinbao cultural system from around 4000BP to 2000BP shows great elaboration. These changes may relate to the needs of storing plant food particularly for domestic crops.

The earliest house construction found in the Song-Nen plains is in Xiaolaha II around 4500 BP. This house is usually a small square pit with a hearth in the middle and a shallow storage pit in the corner (H9 in Figure 7-15) (Heilongjiang Kaogusuo et al. 1998). In this period, houses are usually 4 X 4 metres. This house may not represent the earliest dwelling in this area, due to the lack of information in early period, such as in Xiaolaha I-1 around 6500BP and Angangxi around 5500BP.

House structure had improved in the Baijinbao culture around 3000BP. The shape of the house changed from square to rectangular. For example a house found in the Baijinbao site contained three large postholes in three corners inside and a rectangular posthole for two large posts near the fourth corner. This rectangular posthole was apparently used to support the fourth corner of the house. This was used because in the fourth corner, a large deep pit for storage, around two metres in diameter and more than two metres deep was built (Figure 7-16). This house was 35 square metres, more than double in Xiaolaha II.

House construction changed again in the Xiaolaha III culture (Upper Hanshu) around 2000BP. It was still rectangular in shape, almost the same as in Baijinbao. The entrance is similar to Baijinbao but storage pit previously inside the house had disappeared and the size has increased to 72 square metres, again more than double that in the Baijinbao period (Figure 7-16). The disappearance of pit storage inside the house implies that some changes occurred in economic styles, making unnecessary such a deep pit as in Baijinbao. This change was likely to be the herding economy taking over the dominant position from the farming economy in previous period.

In conclusion, successive changes in house structure within the same cultural system but in different periods in the Song-Nen plains may imply that economic development allowed building larger houses in order to satisfy the requirements of social change, such as for extended family or communal purpose. This possibly implicates a development of social complexity in this region.

7.2.4.3 Changing cooking ware

Presumably, before Xiaolaha I-2 around 5500BP, pottery used for cooking in the Song-Nen plains was a normal ceramic pot with flat bottom. In order to make fire underneath this type of cooking pot, people used small pit hearth combined with some stands such as rocks (Figure 7-18 left). This might be the local cooking tradition during this period.

Around 4500BP, during the Xiaolaha II, small size tripod pottery *Li*, 12cm in diameter and 16cm high, was found in the Baijinbao site. Some fragments possibly from a larger tripod "*Li*" were also unearthed (Heilongjiang Kaogusuo et al. 1997a). As an effective cooking pot, *Li* is used broadly in farming societies in north and northeast China. The small one found in Baijinbao seems not for cooking because of the size but of the others, the larger one should be used as new cooking ware, even though it perhaps was not common during this period. So the cooking pot in Xiaolaha II should mainly use cylindrical pot supported by three rocks for stands (Figure 7-18 left), and a small number of new cooking pot tripod "*Li*" was also imported.

Tripod pottery *Li* used commonly as cooking ware in this area very likely began in the Baijinbao period, around 3000BP. Associated with this new cooking ware *Li*, numbers of ceramic stands were unearthed. Qiao (1986) has studied these stands and suggested that they were used for supporting tripod *Li* above a fire (Figure 7-18 middle), because there is usually a small hole on the top of each stand (Heilongjiang Kaogudui 1980). Using stands for cooking ware *Li* is unnecessary because it already has three feet for standing above a fire. However, in Xiaolaha III (Upper Hanshu) around 2000 BP, unnecessary stands seemed persistently to be used since numbers are found in the remains of Xiaolaha III (Heilongjiang Kaogusuo et al. 1997). The legs of the tripod pottery *Li* were reduced in this period. Apparently, during Xiaolaha III, people reduced the length of legs on cooking ware *Li* instead of simply discarding unnecessary stands, because almost all tripod *Li* found in Xiaolaha III have three legs shorter than in previous period (Figure 7-18 right).

This process of tripod pottery *Li* adoption implies that millet produced by the farming economy in the Song-Nen plains might use the same cooking ware as used in millet farming societies but traditional cooking methods using three stands has been preserved and oddly combined with the tripod pottery *Li*. Therefore, changing to a new way of life may also keeping traditional ways of food procurement as well.

7.3 SECOND REGION, JI-CHANG REGION

As I described in the beginning of this Chapter, the second region in central northeast China, the Ji-Chang region is located in the southern end of the Song-Nen plains. Around this southern end of the plains, elevation increases to around more than 300 metres and some areas even higher than 500 metres compared to below 200 metres above sea level in the Song-Nen plains. This sloping hilly region is the transitional zone from the Song-Nen plains to the Changbaishan mountain ranges. This region should show some differences compared to the Song-Nen plains in relation to environments, cultural traditions and the process of transition to farming.

7.3.1 Environmental reconstruction

Reconstructing the environment for the Ji-Chang region is mainly based on the pollen data from the Guangming (Qiu et al. 1981) and Xiaoquanyan boreholes (Zhou, Kunshu et al. 1984a:37) (Figure 7-19). The Guangming borehole, located in the centre of the Ji-Chang region, contains data only from the mid to the late Holocene. The data for the early Holocene is derived from the Xiaoquanyan borehole, which is located around 70 kilometres west of Guangming, almost out of the Ji-Chang region.

Because these two data sets were from different areas some differences should appear in the environmental reconstruction. The pollen data from Xiaoquanyan shows grassland dominant after the beginning of the Mid Holocene compared to forest during the mid Holocene and opened woodland-grassland during the late Holocene in Guangming (Figure 7-19).

Data derived from Xiaoquanyan has shown that arboreal pollen was higher, around 20% compared to less than 5% in the central Song-Nen plains during the early

Holocene (Figure 7-19). But arboreal pollen is suddenly reduced to less than 5%, then kept stable in the mid Holocene before a slight increase but still less than 10% in the late Holocene in the Xiaoquanyan site. The herb pollen was nearly 25% during the early Holocene, slightly higher than the arboreal, but increased up to more than 70% in the mid Holocene and continued to increase to more than 80% during the late Holocene in Xiaoquanyan. The pollen data in Xiaoquanyan are similar to Dongwengenshan, central Song-Nen plains where the arboreal pollen was less than 5% during the early Holocene but increased to around 10% during the late Holocene.

However, the pollen data derived from Guangming in the centre of the Ji-Chang region should be more significant than Xiaoquanyan located in the further south in relation to the environmental reconstruction. Pollen data reveals grassland with a low density of trees in the west, particularly during the early Holocene. Trees grew during the mid Holocene in Ji-Chang region and forest covered most hilly slopes. But the numbers of tree were reduced and opened woodland became dominant in mountain slopes during the late Holocene.

Rainfall and temperature, analysed according to the synthetic studies described in Chapter 4, changed in a similar pattern in both the Song-Nen plains and Ji-Chang region through the Holocene (Figure 7-4; 7-5). Temperature slightly dropped to 2ºC after the highest record of 5ºC in annual mean temperature during the mid Holocene. Rainfall increased during the mid Holocene, then reduced about 4000BP from 500mm to 450mm around 2000 BP, which was at the same level around 6000BP. There was more rainfall in the Ji-Chang region than in the Song-Nen plains throughout the Holocene (Figure 4-21). This rainfall increase is indicated by higher arboreal pollen in the Guangming borehole compared to Xiaoquanyan and Dongwengenshan. Because of the increase in rainfall, trees should also increase in the Ji-Chang region particularly during the late Holocene. However, tree pollen seems to decline according to the pollen data (Figure 7-19 right). This may be similar to the Liao River area and caused by farming activities.

7.3.2 Summary of archaeological chronology

Five periods are identified from the Upper Pleistocene to around 2000BP in the Ji-Chang region. The representative discovery for the first period is the Zhoujiayoufang site, dated to 26000 BP (Sun et al. 1981). Zuojiashan layer I, II and III should represent the second, around 7000BP, third around 6000 and fourth period around 5000 BP (Jilin University 1989). The Xituanshan culture is in the fifth period around 3000BP (Zhu, Yonggang 1991a; Chen, Yong 1993; Chinese Academy Dongbei Team 1964).

The first period represented by the Zhoujiayoufang site contains some extinct faunal remains and stone artefacts. This site was discovered in Zhoujiayoufang, Jilin Yushu. Faunal remains in this site reveal typical Upper Pleistocene complexes particularly the woolly rhinoceros (*Coelodonta antiquitatis*) and mammoth (*Mammuthus primigenius*). Small stone and bone tools were unearthed during the excavation. C14 dates of a tree fossil discovered in the same layer with artefacts indicate these remains are around 26000BP (Sun et al. 1981:286). I have to use the data from Daxingtun, which was found in Song-Nen plains to instead of Zhoujiayoufang in the Ji-Chang region because the date of Zhoujiayoufang is too early (Figure 7-20).

There are no discoveries after Zhoujiayoufang until around 7000BP with the Zuojiashan I culture. This is followed by Zuojiashan II around 6000BP and Zuojiashan III around 5000 BP (Jilin University 1989). The cultural traditions represented by the artefacts found in these three layers seem to belong to the same cultural system. Each culture in this system includes several sites. For example, Zuojiashan I includes the artefacts found in the Yuanbaogou site (Jilin Kaogusuo 1989). The date of the Yuanbaogou remains is similar to Zuojiashan I according to the relative dating method. The Lower and Upper remain found in the Xiduanliangshan site are ascribed to Zuojiashan II and III respectively (Miyamoto Kazuo 宫本一夫 1993).

Zuojiashan Layer I includes the Zuojiashan site, as well as the Yaojingzi and Yuanbaogou sites. This culture contains pottery, stone and bone tools, and house remains. Cylindrical vessels decorated with incised zigzag design are common pottery.

The patterns of decoration on pottery reflect the interrelation between the Ji-Chang region and its neighbouring areas around 7000BP. For example, zigzag design was found in the Xinglongwa (Figure 5-31), Lower Xinle (Figure 5-15) and Lower Xiaozhushan (Figure 6-11). However, this design has not been found in the Song-Nen plains (Figure 7-7). This is possibly due to the limits of fieldwork, but it might indicate the relatively distant relationship between these two sub-regions in central northeast China around 7000BP.

The third period, around 6000BP is represented by the artefacts found in Zuojiashan II and Lower Xiduanliangshan (Jilin Kaogusuo 1991a). These artefacts include vessels similarly to the Zuojiashan I. There was no substantial change in pottery complexes compared to the period of Zuojiashan I (Chen, Yong 1990).

The fourth period around 5000BP, represented by the remains found in Zuojiashan III, includes the Upper remains in the Xiduanliangshan site (Jilin Kaogusuo 1991a). Some changes occurred in this period compared to Zuojiashan II. For instance, the decorated area on cylindrical pots was reduced from almost full body to the upper half or even only a small area near the rim. A new pot form with an oblique mouth appeared in this period, implying a specific activity related to this particular pot (Figure 7-20).

Based on some differences on pottery design, Jin, Xudong (1992) attempts to separate Xiduanliangshan from Zuojiashan II and III and put them into different cultural systems. His attempt is valuable in relation to understanding the specific character of each site for future typological and chronological studies. But these differences may be just the same culture distributed in different environmental areas. For instance, the Zuojiashan site is located in the flood plains compared to mountainous slopes of the Xiduanliangshan site. Therefore, in this thesis I still position the Xiduanliangshan site within the Zuojiashan cultural system. They may belong to different *Variant* if future discoveries make them more clearly separate.

There is no excavation report about human inhabitation around 4000BP in this area. This does not mean that there is no human occupation during this period but only some random discoveries of artefacts may belong to this period. For example, based on pottery fragments, local archaeologists have ascribed the Upper Yaohongzuizi remains to the Xituanshan culture and presumed that the date of Upper Yaohongzuizi is about 3500-3000BP (Jilin Kaogusuo et al. 2003). At the same time, they have also noted the difference between the Upper Yaohongzuizi remains and the Xituanshan culture, such as the polished stone tool hoe with a specific shape which is not presented in the Xituanshan culture (Jilin Kaogusuo et al. 2003:30). In addition, house construction in the Upper Yaohongzuizi site is also different from Xituanshan. For example, house constructions in Xituanshan are usually of rectangular or circular pit form, sometimes using rocks to pile walls, eg. in the Changsheshan site (Jilin Wenwudui 1980). But house in Upper Yaohongzuizi is a pentagon of pit with no walls (Jilin Kaogusuo et al. 2003). So the Upper Yaohongzuizi remains are very likely to be a different cultural system to the Xituanshan.

Based on the comparison of artefacts around 4000 BP found in neighbouring areas, I suggest the date of Upper Yaohongzuizi perhaps is around 4-3500BP, which is earlier than local archaeologists assigned. Therefore, Upper Yaohongzuizi may represent this period around 4000BP. Referring to the limited discoveries of artefacts, however, it is still too early to conclude that the remains of Upper Yaohongzuizi represent a new cultural system around 4000BP in the Ji-Chang region. In this thesis I put the remains of Upper Yaohongzuizi into the Xituanshan culture until further discoveries are made.

During the fifth period around 3000BP, this area was occupied by the Xituanshan culture. The Xituanshan cultural system might come from Liaodong hilly land, for example the Machengzi culture. Xituanshan societies began to settle in this area very likely around 3000 BP. Pottery found in the Xituanshan culture has plain surfaces with no decoration. The range includes pots with narrow necks and globular shape bodies with two handles. Tripod pottery *Li*, *Ding* and goblets shape pottery *Dou* also appeared in this period. Bronze items including sickles, knives and axes are usually found in piled rock burials. These items become the evidence to assign Xituanshan to the Bronze Age in this area (Figure .7-20).

7.3.3 Tool complexes in Ji-Chang region

Within the same culture, tool complexes derived from different levels, or from different sites in Ji-Chang region show some similarities in earlier period, but appear some differences in the later period. Based on a series of changes in tool complexes from around 7000BP to 2000BP, hunting and fishing tools decreased and gathering (some farming) and woodcutting tools increased, which implies that the economic style had changed from hunting and fishing predominant to combining with a certain proportion of farming.

The similarity between tool complexes is in the earlier period within the culture of Zuojiashan I around 7000BP. For instance, the culture of Zuojiashan I includes three sites: Zuojiashan layer I, Yaojingzi (Jilin Kaogusuo et al. 1992a) and Yuanbaogou (Jilin Kaogusuo 1989). The tool complex in each site is very similar (Figure 7-21). These tool complexes indicate that hunting was the major economic activity supplemented by fishing and gathering. I use the mean percentage to represent the tool complex in this period.

However from the period of Zuojiashan II (c.6000BP) tool complexes appear to be different between different sites even though they are in the same culture. For instance during the period of Zuojiashan II and III, tool complexes in the Lower (Figure 7-22) and Upper (Figure 7-23) Xiduanliangshan, nearly 200 kilometres south of the Zuojiashan site were different to the Zuojiashan site even if within the same culture. For instance, gathering tools are higher nearly 50% in Lower Xiduanliangshan compared to only 20% in the same culture of Zuojiashan II. Woodcutting tools are around 11% in Lower Xiduanliangshan compared to 40% in Zuojiashan II. The differences in the tool complexes in the same culture between these two sites, Zuojiashan and Xiduanliangshan, may indicate different adaptations of the economies to different environments.

Different tool complexes within the same culture also can be seen in the Xituanshan culture, for instance between the Houshishan and Changsheshan sites. The number of hunting, fishing and gathering tools is almost the same, around 30% in the Houshishan layer I, with woodcutting tools being only 10%. But in Layer II of Houshishan, the number of hunting and fishing tools is reduced slightly and woodcutting tools doubles compared to Layer I (Figure 7-24 top). The mean number of tools, such as hunting with more than 20% and nearly 30% of fishing and gathering, indicates a similar level of categories of economic activities in Houshishan societies (Figure 7-24, bottom).

However, tool complexes in the Changsheshan site suggest a predominantly hunting economy even though it belongs to the Xituanshan culture as well. For example, the number of hunting tools is more than 40% and there are around 30% of fishing tools. Gathering tools are less than15% (Figure 7-25).

Another example showing a different tool complex within the same culture is the Huangyuquan site of Xituanshan culture. Tool complexes in this site suggest a predominantly fishing economy, as fishing tools are 60% compared to less than 10% in both hunting and gathering (cultivating) (Figure 7-26).

However, in the Yaohongzuizi site, which was assigned to be the Xituanshan culture by local archaeologists, the tool complex suggests a farming economy because nearly half of tool number is for gathering (cultivating) compared to less than 20% hunting plus fishing (Figure 7-27). This tool complex, with its implication of farming economy and the date around 4000BP, which is relatively earlier than the period of the Xituanshan culture, may indicate the Yaohongzuizi remains do not belong to the Xituanshan culture, as I discussed earlier.

7.3.4 Archaeological discoveries other than tool complexes

Four major archaeological discoveries other than tool complexes, namely faunal remains, bronze sickles, stone reaping knives and tripod pottery *Li*, *Ding,* in Ji-Chang region characteristically reflect the economic style and tool making technology as well as cooking ware in relation to farming activities. Sickles and reaping knives were found in the Xituanshan culture representing the gathering or harvesting technique in daily life. Tripods *Li* and *Ding* are specific cooking pots adopted from agricultural counterparts in neighbouring areas. Also several sites contain faunal data such as Yaojingzi and Zuojiashan.

7.3.4.1 Faunal evidence

Faunal evidence found in Zuojiashan shows that wild animal bones are predominant, around 60-70% in all three layers (Figure 7-28). Domestic animal bones are only around 10% in all faunal discoveries. Fish bones are only around 1%, which may not accurately reflect the actual situation because fish bone is too fragile to preserve and too small to be recovered. So the actual number for fish bones may be higher than in the report. Relatively, the number of shellfish is higher than fish with nearly 10 %. Animal bone discoveries in the Yuanbaogou site have a similar pattern and percentage in each category as Zuojiashan except that fish number more than 10 % (Figure 7-29).

However, I am sceptical about some identification. For instance, pigs found in this site are identified as both domestic and wild but there is no explanation of how to distinguish these two groups. In fact, acceptable methods for animal identification, in particular for domestic pigs, has not been established in archaeological research in northeast China. Even though domestic pigs are likely to present in the Zuojiashan remains, without a clearly define scientific explanation the number of domestic animal will be less accurate. Thus, the percentage of wild animals may be higher than the current number.

The patterns of animal bones in Zuojiashan and Yuanbaogou imply that meat subsistence perhaps comes from around 70% wild animal hunting, around 10% from other categories, such as domestic animal herding, shellfish collecting and fishing. These patterns of animal bones give a similar economic picture to tool complexes in each site. For instance, in Zuojiashan, tool complexes suggest that animal hunting is the major food supply with a minimum number of more than 45% in three layers compared to less than 10% fishing tools. No fish bones were recorded in Zuojiashan layer II; coincidentally neither were fishing tools. This suggests tool analysis is reliable method for establishing economic styles in archaeological studies.

7.3.4.2 Reaping knife and bronze sickle

Similarly to grindstone, reaping knife has been seen as an agricultural indicator in local archaeological practice (Liu, Jingwen 1991), even though this practice is far less reliable without domestic plant studies or residue analysis. The reaping knife is indeed an important indicator for a gathering or harvesting economy in relation to plant food collecting. The earliest date of reaping knives in this region is about 3000 BP in the Xingxingshao burials of the Xituanshan culture. This is 2000 years later than in Liaodong and nearly 3000 years later than in the Liao River region (Yu, Qiong 1990).

Reaping knives are not only made of stone. In the Baijinbao site in the Song-Nen plain, this tool is usually made of shell or bone instead of stone (Heilongjiang Kaogudui 1980). This shell knife usually is not reported as a standard reaping knife, as it is not made of stone, which Chinese archaeological documents use as a criterion. In the Ji-Chang region, only stone reaping knives are reported.

Another tool with a bone handle fitted with a series of flakes in order to form a cutting edge may also be considered as a reaping knife. The flakes for constructing the cutting edge are usually produced from microcores, such as a wedged core. This composite tool is always ascribed to hunting activities such as cutting animal meat and skin in local archaeological reports. It is very likely this tool was used as a reaping knife for collecting plant food in the early period in central northeast China including the Song-Nen and Ji-Chang region before the stone reaping knife appeared. Shell and bone reaping knives and composite reaping knives are found in Yuanbaogou (Jilin Kaogusuo 1989) and Yaojingzi (Jilin Kaogusuo et al. 1992a). So, the date for using reaping knives to collect plant food seems to be as early as 6000BP.

As described above, the change from shell, bone and composite reaping knives to stone reaping knives occurred around 3000BP in the Xituanshan culture (Figure 7-30). The shape of the reaping knife is also different from previous periods. The maximum length of stone reaping knives found in Xituanshan is more than 39cm (Tong, Zhuchen 1987:93) compared to 17cm for shell reaping knife in Baijinbao (Heilongjiang Kaogudui 1980:316) and 10.7cm in Yaojingzi (Jilin Kaogusuo 1992a:682). At the same time, bronze sickles emerged in the Xituanshan culture indicating that intensive harvesting tools were required by the farming economy (Jilin Kaogusuo et al. 2003:342; Liu, Jingwen 1991:15).

7.3.4.3 Oblique-mouth pot

A pot with an oblique mouth was found in Zuojiashan III (Figure 7-31 Right). This specific pot has been found in several places belonging to different cultural systems. For instance, the earliest discovery of this unique pot form is in the Xinle site (Figure 7-31 Left) more than 200 kilometres south of Zuojiashan and dated to around 7000BP(Shenyang Administration 1978) in the Lower Liao River area. A later discovery than this is in the Hongshan culture (Figure 7-31 Middle) around 6000BP (Chinese Academy IMT 1982). This discovery is more than 350 kilometres west of Zuojiashan. The discovery in the Zuojiashan III is around 5000BP and a similar oblique pot is also found in the Tongren culture around 1700 BP in the Sanjiang plain (Zhao, Hongguang et al. 1991:55), more than 500 kilometres northeast of the Zuojiashan site. These discoveries of oblique mouth pots imply an indigenous custom widely using this particular pot for some special purposes in northeast China.

This unique shape of pot found in Zuojiashan III is likely to be adopted from the Liao River area, indicating the close relation between Zuojiashan III in the Ji-Chang region and Xinle in the Liao River regions. The earliest domestic crops in northeast China have been found in the Xinle culture. The close relationship between Xinle and Zuojiashan indicates cultural exchanges occurred between Xinle and Zuojiashan not only as shown in the oblique mouth pot but also cylindrical pots decorated with similar incised and impressed patterns. Thus, domestic crops are very likely also to be introduced into Zuojiashan.

7.3.4.4 New cooking ware

Around 4-3500BP, some new cooking wares emerged in both the Song-Nen plains and Ji-Chang region, such as tripod pottery *Ding*, *Li* and steaming cooking ware *Zeng*. Tripod pottery *Li* first emerged in Xiaolaha II (c. 4000BP) and became the major cooking ware in the Baijinbao tradition (c.3000BP) in the Song-Nen plains. *Li*, *Ding* and *Zeng* emerged in the Xituanshan culture around 3000BP (Figure 7-32) but appeared in Upper Yaohongzuizi perhaps be as early as 4000BP. So the date of tripod pottery emerging in the Ji-Chang region is the same as in the Song-Nen plains. These cooking wares were originally produced in north China and adopted by the Lower Xiajiadian and Gaotaishan cultures in northeast China after c.4000BP in the Liao river area, and also adopted by the Yinjiacun culture around 3500BP in the Liaodong peninsula. In Liao River area, these cooking wares emerged at the time when the consolidation began in terms of the ZRC model. Therefore, these cooking wares should be important for indicating the transition to farming in the Song Nen plains and Ji-Chang region.

The adoption of tripod pottery *Li* and *Ding*, in the Xituanshan culture in the Ji-Chang region, is different from the Baijinbao culture in the Song-Nen plains. Simply reproducing these cooking wares in local modification is the major adoption method in the Xituanshan culture compared to sophisticated shapes and unnecessary stands for tripods in the Baijinbao culture. This simple local adoption has resulted in these cooking wares becoming new local traditional ceramic products distinguished from other cultures. For example, the tripod *Li*, the major cooking ware, is thinner and plain on the surface in the Xituanshan culture compared to fatter and cord impressed marks all over its body in the Baijinbao culture. Despite the differences in the tripods between these two cultures, the major purpose of adopting them is probably the same, normally to cook particular foods from domestic plants such as millet.

Steaming cooking ware *Zeng* was not found in Baijinbao but discovered in the Xituanshan culture (Figure 7-33 Right). Similarly to the tripods, *Zeng* found in Xituanshan is also plain on surface, and with a single hole in the middle of base in order to let steam enter from boiling water in a pot underneath.

Plain surfaced pottery *Zeng*, tripod *Li* and *Ding* comprise the cooking ware complex in the Xituanshan culture. Using this cooking complex, fish, meat from hunting and fishing, and plant food collected either from domestic or wild sources would be easily cooked compared to the single cylinder cooking ware in the previous period such as in the Zuojiashan III.

7.4 THE PATTERN OF TOOL COMPLEXES IN CENTRAL NORTHEAST CHINA

In this section, I will discuss the contrast in tool complexes between two regions, the Son-Nen plains and the Ji-Chang region in central northeast China. I will also analyse tool complexes as responding to environmental changes in this area and make comparison to the process of the transition to farming in the Yellow River area.

7.4.1. Contrast between two regions

The patterns reflected in the tool complexes are different between the Song-Nen plains and Ji-Chang region. First, tool complexes show basically successive changes in the Song-Nen plains in contrast to intermittent changes in the Ji-Chang region. For example, the number of hunting tools in the Song-Nen plains changed from higher, around 50-70% during 6-5000 BP to lower, about 40% in c.4000BP, then below 30% after c.3000BP. Also the number of gathering tools remained relatively stable till a dramatic increase during 3000 BP. In contrast, the number of hunting tools in the Ji-Chang region fluctuated from more than 60% around 7000BP to around 40% in about 6000BP, then up to more than 50% c.5000BP (Figure 7-33).

The second difference between these two areas is the similarity within the same cultural system and tool complexes in the Song-Nen plains compared to the variety of tool complexes even within the same culture and the same period in the Ji-Chang region. For instance, within the Xiaolaha II culture, there is great similarity between different sites such as Baijinbao and Xiaolaha, and as well as in the late period, the Upper Hanshu culture between the Baijinbao and Xiaolaha sites. The similar features in different sites within cultural system are very likely the result of tool complexes in responding to similar environmental condition in different areas in the Song-Nen plains. However, in the same culture, such as in Zuojiashan I in the Ji-Chang region, tool complexes between different sites, Zuojiashan and Xiduanliangshan, reveal different patterns, for example a higher proportion of hunting tools, more than 40%, in Zuojiashan but a higher percentage of gathering tool, around 50% in Xiduanliangshan.

In the Xituanshan culture, tool complexes reveal even greater variety than in Zuojiashan. For instance, tool complexes in the Houshishan site tend to have similar numbers in each category, around 20-30% in hunting, fishing and gathering. But in the Huangyuquan site, fishing is predominant with 60% compared to less than 10% in both hunting and gathering (Figure 7-33).

Moreover, the economic styles implied by tool complexes are relatively clearer in the Song-Nen plains than in the Ji-Chang region. For example, a hunting and fishing economy was predominant around 6-5000BP in the Song-Nen plains and changed to a mostly gathering or crop cultivating economy after c.4000BP. This change reached the highest level around 3000BP before it changed again around 2000BP. The change about 2000BP may be the result of an increase in herding, which has led to the decrease of farming activities (Figure 7-34).

In the Ji-Chang region, the economic styles reflected by tool complexes are not as clear as in the Song-Nen plains particularly after c.6000BP. For instance, a hunting economy was predominant around 6000BP based on the tool complexes of Zuojiashan. But the tool complexes of the Xiduanliangshan site show hunting becomes secondary compared to the higher level of gathering. A gathering economy was continually dominant through c5-4000BP and also around 3000BP if the economic styles are based on the tool complexes from Yaohongzuizi and even Houshishan (Figure 7-35). However, the economy implied by the tool complexes in Changsheshan reveals hunting dominate, while fishing seems the major economy in Huangyuquan (Figure 7-35).

7.4.2. The relation between tool complexes and environmental changes

In the Song-Nen plains climate was relative stable after the dramatic increase both in temperature and rainfall during the early Holocene. Archaeological data about tool complexes are not available for this period, so there is no comparison with environment. The data I collected for this thesis comes only from around 7000BP and later. Therefore, analysis comparing tool complexes with environmental changes starts from this time.

Tool complexes in the Song-Nen plains seem not to directly respond to the environmental changes. For example, around 6-5000 BP, climate was possibly dry and warm, which is indicated by the sand deposit and pollen data in the Dongwengenshan site (Table 7-1, Figure 4-1). Associated with this dry condition, hunting and fishing tools dominated in the tool complex (Figure 7-34). But around 4-3300BP, the temperature rose and the environment became dry again (Table 7-1,

Figure 4-1), while the economy indicated by the tool complexes became predominantly gathering or crop cultivation. Therefore, a dramatic environmental change may not necessarily lead to agricultural transition.

Environmental conditions are relatively stable since c.6000BP in the Song-Nen plains, and almost all the plains share similar environmental resources. The change in economies in this area particularly after the mid Holocene around 4000BP in starting crop cultivation is not related to environmental conditions but possibly related to the social and economic needs within society, or the competition with neighbouring areas, especially the needs in the social and political activities (Figure 7-36).

In the Ji-Chang region, overall the levels of temperature and rainfall are higher than in the Song-Nen plains throughout the Holocene. The higher temperature during the mid Holocene perhaps caused a slight change in the environment by decreasing trees and increasing grassland (Figure 7-19). Responding to this environment, during 7-5000BP, the economics was dominated by hunting. Gathering was secondary to fishing (Figure 7-37). The hunting economy as indicated by tool complexes decreased sharply around 4000BP. No environmental reason can be connected to this decrease. The reason for it may be the cultural interaction that competition between farmer and local hunting/gathering societies has led to adoption of plant cultivation and decrease of hunting activities. A farming economy indicated by the variety of discoveries of crops associated with new cooking wares, *Li*, *Ding* and *Zeng*, probably became the major economy in some groups within the Xituanshan culture such as Yaohongzuizi (Figure 7-35). However, in other groups, food procurement may have continued to be dominated by hunting, such as in Changsheshan, or by fishing as in Huangyuquan, or by combining three economy together, hunting, fishing and farming, e.g. in Houshishan. This situation cannot be explained by environmental changes. It is very likely to be determined by different choices in each group and on the availability of local natural resources. Here the internal factors, such as the motivation of socio-political needs determined the orientation of transition to farming.

During the late Holocene, rainfall increased and temperature decreased slightly but tree pollen unexpectedly decreased from 55% to 35% (Figure 7-19). This may be connected to around 20% woodcutting tools in all sites of the Xituanshan culture.

Cutting trees down for land clearance in farming activities may also occur during Xituanshan culture particularly the high level of wood cutting tools around 4000BP, which is similar to the Liaodong peninsula (Figure 7-35, 7-38).

In summary, the changes in economic styles from foraging to farming in central northeast China, including the Song-Nen plains and Ji-Chang regions, are perhaps not the direct result of environmental changes. It is more likely to be mainly influenced by farmer counterparts in the south during the period 4-3000 BP. Particularly in the Song-Nen plains, around 3000BP, a farming economy became predominant. But in the Ji-Chang region, this influence seems weaker, because till around 3000BP, some groups in this region still kept hunting and fishing rather than farming among the same culture such as in Xituanshan.

7.4.3 Comparison to the models of the Yellow River area

There are three differences in the patterns of transition to farming between central northeast China and the Yellow River area: the dates of starting the availability phase, the time span of the substitution phase and changing from farming to herding after the consolidation phase in the Song-Nen plains.

As a primary agricultural area, the date that the availability phase started is quite early; it is possible before 9000BP in the Yellow River area. If consider Xianrendong site in south China as the baseline described, this date may start as early as 11000BP. But in the Song-Nen plains and Ji-Chang region, this date is around 5500BP, based on the possibility of contact between hunter/gatherers in central northeast China and farmers in the Liao River area. This date is around 3500 years later than in the Yellow River area (Figure 7-38).

The second difference is the time span in the substitution phase. For instance, in the Yellow River area, it was around 2500 years before the consolidation phase began. But this time span in the Song-Nen plains is shorter, only about 1000 years. The substitution phase is longer being more than 3000 years in the Ji-Chang region and consolidation phase did not occur until this area was controlled by the Han dynasty around 2000BP. After the Han Empire extended its political power into this area, farming economy was pushed to increase by several factors, such as political enforcement, immigration of farmers and adoption by local residents.

7.5 CONCLUSION

Unlike the transition pattern in the Liao River area where social political motivation combined with environmental changes may play an important role in the transition to farming, in central northeast China, environmental changes seem not as important as the cultural interaction with farming societies. The interaction indicated by changing cooking ware and using reaping knives and sickles in both the Song-Nen plains and Ji-Chang region were associated with crop cultivation as indicated by domestic seed recoveries, while the environment was relatively stable. This feature may imply that cultural interactions are more important than environmental changes in relation to the process of changing traditional economic forms. However, changing the conventional way of food procurement from hunting/gathering to farming is determined by people's choice. As discussed in Chapter 5, the motivation of social political needs Would have to make the final decision to whether to adopt agriculture, pastoralist or continuing hunting and gathering.

Also, farming in central northeast China even entered the consolidation phase during the process of transition to farming in the Son-Nen plains, but never became as dominant economy as in the Yellow River area. This feature is similar to the Liao River area and the Liaodong peninsula. However, in the Ji-Chang region, the consolidation phase, with more than 50% of farming in the economy, was apparently not achieved until very late, after 2000BP.

The process of the transition to farming sometimes turns to proportionally more herding rather than predominantly farming, as in the Song-Nen plains. This may be the result of both changing environment and cultural tradition. Sometimes this process may also reverse to hunting/gathering before entering to the consolidation phase as in the transition process in the Ji-Chang region. In this case, the availability of local environmental resources may play an important role, as abundant natural resources such as animals, fish, shellfish and other freshwater resources, also nuts, fruits and other wild plant resources in the mountain bush, might weaken the competition from farming economy and slow down the process of transition to farming.

CHAPTER 8. CASE STUDY (4): CHANGBAISHAN MOUNTAINS

8.1 INTRODUCTION

In this Chapter, I will use the data derived from archaeological studies in northern Changbaishan Ranges, mainly in northeast China, to analyse the process of the transition to farming. This area in my study is the first region entirely covered by mountains. Therefore, I expect to have some different results from others because of this specific environment. In Section 1, introduction, I will briefly describe the geological location, physical features and present natural environment, as well as the background of domestic plant discoveries in this region. Environmental reconstruction for this region will be in Section 2, and followed by the chronological summary of archaeological studies in Section 3. Section 4 discusses tool complexes and in section 5, I will discuss some archaeological discoveries other than tool complexes. The pattern of transition to farming in north Changbaishan Range will be generated in Section 6 and conclusion will be in Section 7.

8.1.1 Present environmental description

The northern area of Changbaishan Ranges included in my study is mainly located in the southeast corner of northeast China and northeast corner of Korea, and also the southern corner of Primorye in the Russian Far East (Figure 8-1).

Both physical features and geographical location are different from other regions within my case studies. The highest mountain area is in the northeast corner of Korea usually around 1000-2000 metres above sea level. The southern Primorye in the Russian Far East is a lower mountainous area of around 500-1000 metres above sea level. The entire study region in Changbaishan Ranges is higher in the south and lower in the north and is around 600 kilometres long and 300 kilometres wide. The Song-Nen plains are to its west and Japan Sea to the east. The Liaodong peninsula is to the southwest and the Sanjiang plain at the north connects to the Amur region of the Russian Far East.

There are several drainage systems, which might be used for ancient transportation connecting different groups in this mountainous area (Figure 8-2). These rivers form many valleys becoming important agricultural resources both in the past and today. The Mudanjiang River is the longest one beginning from middle of this area and runs north, joining to the Songhuajiang River. Mulinghe is the second large river, running to the northeast into the Wusulijiang River. Both Wusulijiang and Mudanjiang belong to the Heilongjiang (Amur) River system. The Tumenjiang River starts from Baitoushan and runs east into the Japan Sea becoming the boundary of China and North Korea. The Suifenhe River is a shorter one and runs into the Japan Sea as well. Rice, millets and soybean are the major crops in these valleys and all these rivers provide abundant freshwater resources such as fish.

The vegetation coverage and climate are different from other regions. Temperate forest is well developed on the mountain slopes compared to the grassland found in most areas of previous case studies. Conifer mixed with deciduous forest covers all mountains. *Pinus* is the major tree, forming the forest in the mountains below 1500 metres above sea level. In a few areas over 1500 metres above sea level *Betula* forest develops. Mean temperature is about 4ºC and annual rainfall is around 500 mm, compared to less than 400mm in the Song-Nen plains and Upper Liao River regions. Nearly 70% of the rainfall is in the summer. The river valleys are usually less than 500metres above sea level and some of them have developed flood plains covered by grass. Besides a variety of crop agriculture in this region, wet rice is the major agricultural product, usually cultivated by the Korean minority of China particularly in the south Changbaishan area. Industries based on the forest, such as timber, tree planting and some economic plantations of mushrooms and other edible fungi, and herb medicine like ginsengs also play important roles in the local economy.

Volcanic activities are an environmentally specific aspect in this area. Two groups of volcanoes, the Baitoushan and Jingbohu, are located in this region and they have been active intermittently during the Holocene. The Baitoushan volcanoes are located in the highest area of the Changbaishan Range, at about 2700 metres above sea level at the boundary between China and North Korea (Figure 8-3). The last eruption was in 1900AD and the eruptions around 1000-1400BP were the most severe volcanic activities in the Holocene. During these eruptions, the lava and erupted rocks and dust covered an area with a diameter of around 60 kilometres (Xu, Dongman et al. 1993:88).

Baitoushan volcanic activities should have impacted on the environment and human occupation in this region, but so far no archaeological record is related to them. Several eruptions of the Baitoushan volcanoes have generated obsidian layers. Obsidian was one of the popular raw materials for making stone tools in prehistory in the Changbaishan region. The earliest obsidian artefacts were found around 70 kilometres northwest of Baitoushan with an estimated date of earlier than 10000BP (Zhou, Changqing & Du, Xuejing 2003). This date is based on stratigraphic and faunal data. If this date is correct, some obsidian layers are of Pleistocene age. Exploitation of obsidian was one of the positive outcomes of the volcanic activities. The negative results, affecting human life, may appear in archaeological deposits, which need more research.

The Jingbohu volcanos are located in the Upper Mudanjiang River area around 200 kilometres northeast of Baitoushan. These volcanos were formed during the Pleistocene and lava overflow from volcanic eruptions built an embankment across the Mudanjiang River forming a lake called the Jingbohu Lake. Zhang, Zhaocong et al. (2000) have observed several craters in the Jingbohu area. Based on the C14 dates and stratigraphic data in volcanic layers, they found these volcanos, at least, erupted three times after the mid Holocene. Based on his calibrated C14 dates Zhang et al. pointed out the first two were around 3500BP and 2400BP (Table 1). The last eruption has been estimated to be around 1000-2000BP (Zhang, Zhaocong et al. 2000:282).

However, the C14 dates provided in Zhang's research did not explain how to obtain the calibrated dates in relation to the volcanic gas effect, and did not give the distance between sampling location and sources such as volcanic crater (Zhang, Zhaocong et al. 2000:281). This distance is significant for volcanic effect on C14 dating. If the sample location is more than 200m away from effect sources the effect on C14 dating is very limited (Brun et al. 1980). Whereas if the sample location is near the effect source the error of C14 date will vary between 400 to 1500 years. In addition, Zhang's calibrated dates are more than 1000 years different with original dates (Table 8-1). So the correct dates for these three times eruption are still not clear.

These eruptions in Jingbohu volcanos, as the Baitoushan volcanoes, should also have had an impact on local environments and human societies. The impact should also be revealed in archaeological remains and should be emphasised in further fieldwork.

8.1.2 Background of domestic plant discoveries

The number of discoveries of domestic plants is limited. A small number of domestic plants have been found occasionally during excavations. Much information, including domestic plants has not been actively collected. Similar archaeological practices can be found in North Korea as well. In the Primorye area of the Russian Far East, archaeologists have studied domestic remains by flotation methods for more than fifteen years but the results of this research have rarely been published in English. In South Korea, this situation has been improved in recent years. In this part, I will discuss the discoveries of domestic plants in the Changbaishan areas mainly including the area in China and in North Korea according to the Chinese literatures. Also, based on English documents, I will discuss the discoveries of domestic plants in the neighbouring areas including Primorye and South Korea.

8.1.2.1 Domestic plants discovered from the Changbaishan region

There are several domestic plant discoveries in the Changbaishan area. In the Dongkang site (129.23E, 44.13N) archaeologists discovered some carbonised seeds inside a vessel during excavation. Later, these seeds were identified as common millet and foxtail millet. The conservative carbon date from these seeds is 1695±85 BP (Heilongjiang Museum 1975) and around 2100BP after the calibration for fractionation effect from the millet carbon[*] (Jia 1985b; Lin 1985). Another discovery is from my own fieldwork in 2001 (Appendix 6). During this flotation, five seeds were recovered in soil samples taken from the section in the Qiaohexi site of the Tuanjie culture. These five seeds include two wheat (*Triticum*) (Figure 8-4: 1,5), one broomcorn millet (*Panicum miliaceum*) (Figure 8-4:3), one hemp (*Cannabis sativa*) (Figure 8-4:2), and one unknown (Figure 8-4:4). Based on ceramic typological comparison, the pottery fragments found in Qiaohexi (20 kilometres west of the

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[*] In 1970s, C14 date published by archaeological institute of Chinese Academy was not calibrated with fractionation effects.

Tuanjie site) are similar to those of Tuanjie (131.11E, 43.95N). The Tuanjie culture is dated to around 1900-2400BP, so the date of these seeds should be similar.

Domestic plants are also found in northern end of Changbaishan. For instance, some carbonised seeds were found in a house in the Guntuling site (131.12E, 46.75N). These seeds are identified as domestic hemp (*Cannabis sativa*). C14 dating on charcoal found in the same house suggests that the date of these seeds is possibly around 2000 BP (Heilongjiang Kaogusuo 1997).

In southern part of Changbaishan ranges, the northeast corner of North Korea, domestic plants were found in the Odong (129.55E, 42.36N) and Hogokdong (129.28E, 42.37N) sites along the banks of Tumenjiang River (Figure 8-5). Soybean was found in the Odong site dated to around 3500BP (Li, Yunduo 1983:98). Broomcorn millet was found in the remains of four houses in the Hogokdong site, some inside vessels and some on the surface of the floor (Li, Yunduo 1983:98). Archaeologists also found sorghum inside a storage pot unearthed in House No15 during the excavation of Hogokdong (Li, Yunduo 1983:98). The date of these domestic plants found in the Hogokdong site is estimated as around 3000BP (Li, Yunduo 1983:98).

8.1.2.2 Domestic plants recovered from neighbouring areas

Apart from northeast China, in the neighbouring areas of Changbaishan, Korea and the Primorye area of the Russian Far East, are also found some remains of domestic plants. Geographically, the mountainous areas along the east coast of the Korean peninsula are the southern expansion of Changbaishan Ranges, usually around 1000 metres above sea level. The Primorye area of the Russian Far East is next to the northeast end of Changbaishan and is a coastal flood plain some 200-400 metres above sea level. The discoveries of domestic plants in these areas are important references for the study of the transition to farming in the Changbaishan area (Figure 8-5, 8-6).

One of the recoveries of domestic plants is in the Krounovka 1 site (Figure 8-5) during excavations of 2002 and 2003 (Vostretsov et al. 2003). By the floatation process, archaeologists have found broomcorn millet and foxtail millet as well as some seeds from wild plants in the remains of house 4 (Figure 8-7). The C14 date suggests that these plant remains may be as early as 4600BP (Vostretsov et al.2003:374). Some fragments of shell from wild nut, such as walnut and oak nut were also found in this house.

On the west coast of North Korea, foxtail millet and domestic bean (small red bean) were found inside a vessel in the remains of House No39 during the excavation of the Soktalli site (125.42E, 38.59N). The Soktalli site is dated to about 3000BP (Li 1983:98). Also rice, foxtail millet, barley and sorghum were found in the Hunamni site (Figure 8-5, 8-6) dated to around 3000BP (Nelson 1995:144).

Overall, the dates of domestic crops are around 4600BP to 2000BP with the oldest date from the Primorye and youngest from the Changbaishan area in northeast China. These results are mainly based on occasional discoveries and the dates may be modified with further research.

Further south, in the coastal area near the Korea Strait of the Korean peninsula, Crawford and Lee (2003) have studied crop remains in several sites by floatation and AMS direct dating methods. In their studies, broomcorn millet and foxtail millet are dated to middle Chulmun, around 5400BP. This suggests that scientific recovery methods such as floatation, pollen and phytolith analysis, and applying AMS directly to the seeds will rewrite the date and context of crop complexes. For example, if broomcorn millet and foxtail millet found in Korean peninsula and the Primorye area of Russia are originally come from northeast China, the date of these crops should not be later than 5400BP in North Korea and 4600BP in the east Changbaishan area.

8.2 ENVIRONMENTAL RECONSTRUCTION

There are seven pollen data sets used in this thesis for environmental reconstruction in the Changbaishan areas. One is in Gushantun, southern Changbaishan (Liu, Jinling 1989:504) and the others are in the north Changbaishan along the Mudanjiang and Mulinghe Rivers (Xiao, Jiayi & Sun, Shiying 1987). The environmental reconstruction for this area also needs to be compared with the results from the synthetic studies in Chapter 4 about overall temperature and precipitation changes in northeast China throughout the Holocene, e.g. Figure 4-19, 4-20 and 4-21.

8.2.1 Environment reflected by Pollen data

Most pollen data reveal a forest dominated environment through the Holocene in the Changbaishan region. For example, the pollen data derived from Gushantun shows arboreal pollen is more than 40% in most periods of the Holocene (Figure 8-8).

The pollen profiles the Mudanjiang River area show little change between arboreal and non-arboreal pollen, both around 40-50% during the mid Holocene (Figure 8-9). Vegetation implied by this pollen data is likely to be forest. Around 2000 BP, arboreal pollen reduced to around 30%, which is about half the non-arboreal pollen. Vegetation coverage indicated by this pollen profile is more likely to be grassland with low density of trees.

This change seems more obvious in sites further north such as Hongqiaowuozi, the Mulinghe River area (Figure 8-10). From 5000 to 4000 BP, arboreal pollen (tree) decreased to less than 30 %, but non-arboreal pollen (herb and fern) increased, such as herbs from 30% around 5000BP to 45% in 4000BP. Then arboreal pollen became dominant again after 3000BP, with nearly 60% in about 1000BP and nearly 80 % in the present.

8.2.2 Environment indicated by temperature and rainfall

Based on the synthetic analysis described in Chapter 4 (Table 4-3, Figure 4-16, 4-17, 4-18), both mean temperature and annual rainfall have increased since the end of the Pleistocene. Annual mean temperature increased after the Holocene began and reached 5ºC around 6000BP after 2ºC decrease around 8500BP. It decreased again, to about 1ºC in mean temperature around 4000BP then returned to 3ºC in the present (Figure 8-11 left). Annual rainfall increased sharply, from 300mm around 12000BP to 500mm after 10000BP. It became stable with 500mm around 9-7000BP then increased again to 750mm, similar to the present level, after about 2000BP (Figure 8-11 right).

The environment reflected by temperature and rainfall changes is similar to the local pollen data. Woodland is the major vegetation coverage though the entire Holocene. During the early and mid Holocene, broadleaved deciduous trees, such as birch were predominant (Liu, Jinling1989; Xiao, Jiayi & Sun, Shiying 1987). This forest changed to needle-leaved evergreen, such as pine, *Abies* and *Picea* which were dominant after the mid Holocene, around 3000BP.

However, pollen data has shown some differences compared to temperature and rainfall. In the Gushantun pollen data (Figure 8-8), arboreal pollen reduces sharply during the last millennium. In Hailang, this pollen decreased around 4000BP (Figure 8-9) and around 2000BP in the Hongqiaowuozi pollen data (Figure 8-10). The arboreal pollen decrease in Gushantun may indicate human activities, possibly farming activities during the last 1000 years. But the examples of Hailang and Hongqiaowuozi are difficult to ascribe to human disturbance, because the arboreal pollen increased again after a decrease. These circumstances need further discussion after the analysis of tool complexes.

8.3 SUMMARY OF THE ARCHAEOLOGICAL CHRONOLOGY

This summary of chronology starts from c.7000BP because no data earlier than this is available in this region. Several discoveries in Changchun (Changchun Institute et al. 2003) may date to around 10000BP but no excavation or scientific dating has been carried out.

There were two major cultural systems before c.4000BP in Changbaishan region. One is the Sopohang system named after discoveries in the Sopohang site (Nelson 1995:60) near the estuary of Tumenjiang River, in the northeast corner of North Korean. This area is in the south of Changbaishan ranges and this cultural system may be distributed over the southern Changbaishan area. Another cultural system is the Zhenxing named after excavation of the Zhenxing site (Heilongjiang Kaogusuo et al. 2001) located in the bank of Lower Mudanjiang River (Figure 8-12).

These two cultural systems separated between 7000-5000BP. The Sopohang cultural system was mainly discovered in the Tumenjiang River area. The early pottery around

7000BP is cylindrical, usually decorated with incised patterns near the mouth. This type of pot is found in every culture in different periods within this system (Li,Yunduo 1983:26). Around 7000-5000BP these pots have different decoration, such as impressed geometric patterns (Heilongjiang Kaogusuo et al. 2001) compared to the incised decoration in the Sopohang system. The Zhenxing system is also called the Xinkailiu system further north, such as in the Sanjiang plain of China and in the Amur River area in Russia. The remains found in the Zhenxing site are poor, so it is difficult to generalise the features of this system. A similar cultural system has been found in the Boisman sites (Boisman 1 and Boisman 2) (Feng 2003) located on the coast near the Japan Sea, at the east edge of the Changbaishan ranges. The Boisman site is located less than 100 kilometres north of the Sopohang site, about 200 kilometres south of the Zhenxing site. A large number of artefacts were found in the Boisman site including pottery, stone and bone tools, and these artefacts belong to several cultural traditions within the Zhenxing (Boisman) cultural system. In northeast China this system is distributed in the north of the Changbaishan ranges but its centre is in further north.

The Sopohang system extended northwards and pushed the Zhenxing system towards the north around 4000BP based on typological studies. The Zhenxing system was almost pushed out from the north Changbaishan area around 4000BP. Around this period (4000BP), the cultural tradition represents the Sopohang cultural system is called the Lower Yinggeling in China, Zaisanovka in Russia. The Lower Yinggeling (Zaisanovka) culture occupied almost the entire area of the Changbaishan Ranges around 4000BP. The Zhenxing (Boisman) system still appeared in the further north, the Sanjiang plains and Amur River areas after c. 4000BP.

After a short period of cultural unification within Sopohang cultural system, the Lower Yinggeling or Zaisanovka culture was replaced by two major cultures around 3500BP. One is called Upper Yinggeling (called Xingcheng in Jilin province), mainly distributed in the south of Changbaishan along the Upper Mudanjiang and Tumen Rivers areas. Another is called the Shihuichang culture, distributed mainly in the north Changbaishan along the Lower Mudanjiang, Mulinghe and Suifenhe areas. These two cultures are likely to be generated from the Lower Yinggeling (Zaisanovka) culture. In other word they still belong to the Sopohang cultural system.

Pottery is similar between these two cultures, such as cylindrical pot with opened mouth and thick rims. The difference between them is the decorations on pottery. Decorations on pottery in the Upper Yinggeling culture are rare compared to a variety of decoration such as incised net or spiral patterns in the Shihuichang culture. C14 dates for both the Upper Yinggeling (Xingcheng) and Shihuichang are around 4000-3000BP (Feng 2003), indicating the successive connection with the Lower Yinggeling culture. Based on the discovery in the Upper Yinggeling site archaeologist postulated that hunting and gathering may still the major economy in this period but with sedentary life style (Wa 1992).

Around 3000BP, two cultures, Qiaonan and Liutingdong appeared in this region. The Qiaonan culture was distributed in the northern and the Liutingdong in the southern Changbaishan area. Pottery found in the Qiaonan culture is usually a globular body decorated with horizontal lines on surface of pots compared to the pottery found in the Liutingdong culture with relatively straight body and plain surface, sometimes with two nipples on the shoulders. The Liutingdong culture was probably developed from the Upper Yinggeling culture and belongs to Sopohang cultural system.

In next period around 2000BP, the Tuanjie culture and Dongkang *Variant*, appeared in Changbaishan Ranges. The Guntuling culture is also found in the northern Changbaishan area but its centre of distribution is in further north and belongs to anther cultural system. Pottery in most of these cultures is similar, which implies unification within the Sopohang cultural system. For example, decoration on pottery almost disappeared in all cultures and a variety of handles, such as knobs, rings, nipples and hornlike handles, which were usually on the shoulders of pots, appeared on pottery in almost every culture. Specific steaming cooking ware "*Zeng*" associated with "*Dou*", a pottery with goblet shape but with a taller stand and of larger size, appeared in the cultures distributed in the south Changbaishan region, such as Tuanjie, Dongkang. Both "*Zeng*" and "*Dou*" are adopted from southern northeast China and they continued to be used in the later period, such as in the Dongxing culture around 1800BP in the north Changbaishan region (Figure 8-12).

Dating to around 1800BP, an iron plough was discovered in the Baoan fortress in the northern end of Changbaishan. Even though this plough is still an individual discovery this indicates that plough cultivation may have been adopted in the entire Changbaishan area (Heilongjiang Kaogusuo 2003b:31).

8.4 TOOL COMPLEXES

Analysing tool complexes in this region should track the two cultural systems, Zhenxing-Boisman and Sopohang, particularly in the earlier periods. But tool data in the earlier period of the Sopohang cultural system around 7-5000BP is difficult to access. So the data for analysing tool complexes of this earlier periods is based on the Zhenxing-Boisman cultural system. After about 4500BP, this cultural system withdrew from Changbaishan region but remained in regions further north such as in Amur (Heilongjiang) River area, where tool data is difficult to access and is also beyond my major research area. Therefore, after about 4500BP, tool complexes in Changbaishan region are represented by the Sopohang cultural system. Tool data in the two cultural systems comprise the whole process of historical change in tool complexes.

Based on these two cultural systems, in this section, I will discuss some features illustrated by these tool complexes, and also discuss the economic styles they indicated. The changes of these economic styles in relation to the process of agricultural transition will be emphasised in this discussion.

8.4.1 Two features in tool complexes

Tool complexes in the Changbaishan Mountains areas reveal two characters. One is that within the same culture, tool complexes tend to be different between burials and settlement villages, as well as between different environments such as forested inland and coast. Another is that the tool complexes in this region basically follow the trend of a large number of hunting tools in the early period reducing through time, while gathering tools increase from a very small amount early on, to a higher level in the later period.

8.4.1.1 Different tool complexes within the same culture

Similarly to other areas, within the same culture in the Changbaishan region, tool complexes derived from different burial sites tend to be similar. But tool complexes between burials and settlement villages are very different. For example, in two burial sites, Xinxingdong and Jincheng within the Liutingdong culture around 2500BP, tool complexes are similar (Figure 8-15). But these tool complexes of burials are different from the Xinguang settlement site of the Liutingdong culture (Figure 8-16).

This difference in tool complexes between settlements and burials is unlikely to be caused by different economic styles adapting to local environments, because artefacts found in burials usually reflect specific burial customs, which is strongly influenced by cult and even individual preference. The similarity in tool complexes between the two burial sites might suggest a unifying cult or custom within the same culture rather than individual preference. They are unlikely to indicate an artefact complex from daily life compared to settlement sites as I discussed in early Chapters. Thus, I use the tools found in settlement sites to represent tool complexes in each culture.

Apart from the difference in tool complexes between burials and settlement, tool complexes also show different patterns between different environments such as forested inland and coast within the same culture. This difference appeared in the Lower Yinggeling (Zaisanovka) culture between the Boisman and Jingu sites.

Tool complexes in the Lower Yinggeling (Zaisanovka) culture derived from the coastal Boisman site (Figure-8-17) are different from the inland Jingu site (Figure 8-18), even though they are within the same culture. The number of hunting tools in the Jingu site is 25%, compared to nearly 50% in the Boisman site. A large number of gathering tools, nearly 50%, associated with more than 25% woodcutting tools in the Jingu site compared to less than 20% gathering and less than 4% of woodcutting in Boisman. There are no fishing tools in the Jingu site (Figure 8-18) compared to nearly 30% of fishing tools in Boisman (Figure 8-17). This difference in tool complexes between different sites in the same culture may also indicate human groups adapting to different local environments, as Boisman is a coastal site but Jingu is located in the forested mountain. Similar circumstances have been discussed in earlier Chapters.

Tool complexes have changed from hunting and fishing dominance in the early period to a balance between hunting and fishing, and gathering (or cultivating) in the late period, particularly within one cultural system. I am going to discuss tool complexes in two cultural systems separately. Because tool data is not available for the early traditions of Sopohang system as I stated earlier, they are absent in this thesis.

8.4.1.2 The trend in changing tool complexes

The trend of change in tool complexes in both cultural systems is that hunting tools predominate in the earlier stage and reduce later, and gathering tools increase through time. The early stage in the Zhenxing (Boisman) system around 7000BP is represented by the Zhenxing-I-A culture. But tool numbers are too small to be useful in this site, with 20 hunting tools only (Figure 8-19).

The Xinkailiu site belongs to Zhenxing I-A site, so I can use the tool data derived from the Xinkailiu site to represent tool complex in this culture (Heilongjiang Kaogusuo et al. 1996). Tool complexes in the Xinkailiu site reveal hunting dominant and associated with more than 10% fishing and less than 2% gathering tools (Figure 8-20).

In the next period around 6000BP, the Zhenxing (Boisman) cultural system is represented by the Yabuli culture found in the northern Changbaishan region. The tool complex of the Yabuli culture indicates hunting tools still predominant but slightly decrease from nearly 70% in the last period to just above 60%. Gathering tools increased sharply from nearly zero to nearly 30%. No fishing tools were found in this site (Figure 8-21).

Around 5000BP, the Zhenxing (Boisman) system is represented by the upper levels of the Boisman site. The tool complex in this period reveals a decrease in hunting tools to near 50%. Fishing tools are the second most important with nearly one third of the total, and gathering tools are less than 20%. The number of woodcutting tools is very small with less than 5% (Figure 8-22).

After c. 5000BP, the Zhenxing (Boisman) system was replaced by the Sopohang system (called Lower Yinggeling in China or Zaisanovka in Russia). Around 4000BP, the Zhenxing (Boisman) system almost completely moved away from the

Changbaishan region and occupied in further north. From around c.4000BP, tool complexes presented here belong to the Sopohang cultural system.

One of the earliest cultures of the Sopohang system distributed in northern Changbaishan area around 4000BP is the Lower Yinggeling (Zaisanovka) culture. The tool complex of this culture is based on the discoveries in the Boisman site (Figure 8-17) and Jingu site (Figure 8-18) because they are different as I discussed earlier. Tool complex of the Zaisanovka culture derived from the Boisman site is similar to the Boisman culture. Hunting tools are dominant with more than half the total and fishing tools are also considerable, nearly 40%, but gathering tools are only 5% and woodcutting tools are less 3% (Figure 8-17).

Around 3500BP, the Shihuichang culture appeared. This culture is very likely to be the descendent of the Lower Yinggeling (Zaisanovka) culture since there is a close relationship between the artefacts found in both cultures. They both belong to the Sophang cultural system. The number of tools found in the Shihuichang site is only seven including five woodcutting and two gathering tools. This small number of tools cannot be used for illustrating the tool complex.

Around 3000BP, the Upper Yinggeling (Xingcheng) culture is found in most areas of the southern Changbaishan region. The tool complex of this culture is represented by the tool discoveries in the Xingcheng site. In this tool complex, hunting tools comprise less than 40 %, and gathering and woodcutting increased dramatically compared to the tool complex in the Zaisanovka culture. Fishing tools also were reduced from nearly 40% in the Zaisanovka to less than 5% in the Upper Yinggeling culture (Figure 8-23).

In another site Nanshan, which also belongs to the Upper Yinggeling culture dated to around 3000BP, the tool complex illustrates a different image (Figure 8-24). Hunting tools predominate, with nearly 70%, and there are no fishing tools present. Gathering tools in this complex are more than 20% and associated with more than 10% woodcutting tools.

From 3000 to 2000BP, several cultures and subgroups, such as Liutingdong, Tuanjie, Dongkang, Guntuling and Qiaonan were distributed from south to north in the Changbaishan region. Tool complexes between these cultures or subgroups are different. For example, the tool complex in the Liutingdong culture distributed in the south of Changbaishan shows that the number of gathering tools is more than 45%, slightly higher than hunting tools. No fishing tools are present in this tool complex (Figure 8-25).

The tool complex in the Tuanjie culture reveals that gathering tools dominate, with around 45%, combined with more than 20% fishing and around 35% of woodcutting tools. No hunting tools are present in this tool complex (Figure 8-26).

In the Dongkang culture, which is called Dongkang variant in some Chinese documents, the four categories of tools occur in different percentages in the Shihuichang and Dongxing site. The differences in tool complexes of the Dongkang culture between these two sites are that gathering tools associated with similar level of woodcutting tools predominant in the Shihuichang site but hunting is the leading category around 40% in the Dongxing site (Figure 8-27).

The tool complex in the Guntuling culture has more than 50% of gathering tools combined with around 40% of hunting tools. No fishing tools are present in this culture (Figure 8-28).

The Qiaonan culture is distributed in the northern end of the Changbaishan area. The tool complex in this culture is dominated by nearly 75% hunting tools. Gathering, woodcutting and fishing tools in this culture are around or less 10% (Figure 8-29).

Around 1800BP, the Dongxing culture developed in the north of the Changbaishan area. Tool complexes in different sites within this culture are various. For example, tool complexes are very similar between the Zhenxing and Dongxing sites, but very different from the Hekou site. Hunting tools are more than 40% in both the Zhenxing and Dongxing sites but not in the Hekou site. In the Hekou site, gathering tools, with more than 60 %, becomes dominant (Figure 8-30).

8.4.2 Economic styles indicated by tool complexes

It is possible that from the beginning of the Holocene till about 5000BP, including the Zhenxing I-A, Yabuli, and the late Boisman culture between c.7000 to c.5000BP, hunting and fishing were predominant (Figure 8-31). The economy had a dramatic change around 4000BP in the Lower Yinggeling (Zaisanovka) culture. A gathering economy was predominant for the first time in the Changbaishan area. This change was associated with the millet found in the Krounovka site (Vostretsov et al.2003). The recoveries in the Lower Yinggeling (Zaisanovka) culture indicate the adoption of cultivation combined with other plant food gathering, such as walnuts, pine nuts, hazel nuts and also some wild fruits or edible root in this area (Vostretsov et al.2003) became dominant in the Lower Yinggeling (Zaisanovka) culture. However, some sites, like the Boisman site, seem to continue the early economic style of Zhenxing-Boisman culture system during the Lower Yinggeling (Zaisanovka) period probably because of their coastal basis (Figure 8-31)

Economic styles around 3000BP in the Changbaishan region tend to be various with the trend of increase in gathering (cultivating) and decrease in hunting and fishing (e.g. top diagrams in Figure 8-32). From the Upper Yinggeling tradition around 3000BP to the Liutingdong in 2000BP and Dongxing in 1800BP, a gathering economy indicated by gathering tools increased to more than 70% and both hunting and fishing decreased to less than 15%. Also in the same times, some hunting and fishing economies were still predominant in some sites such as the Nanshan site in the Upper Yinggeling culture around 3000BP, the Qiaonan site about 2000BP and the Zhenxing and Dongxing sites in the Dongxing culture. The continuity of hunting and fishing economy may be the result of local cultural tradition supported by abundant wild resources (Figure 8-32).

Based on the tool complexes in Figure 8-29 and 8-30, the percentage of plant cultivation in economy in each period may be estimated (as Table 8-2). For example, in the Zhenxing I-A culture, the percentage of cultivation in economy is very likely to be less than 1.5 % based on the tool complex in the Xinkailiu site. There, the 1.5% of gathering tools is likely to be mainly used in wild plant collection rather than in crop cultivation because the remains of domestic plants have not been recovered in this site

(Table 3-1). Therefore, the percentage of cultivation was probably very small, no more than 0.5%. Based on tool complexes and the discoveries of domestic crops the percentage of cultivation in the total economy in each period has been estimated in Table 8-2. In addition, after 4000BP, tool complexes appeared different proportions even within the same culture. The percentage of cultivation in total subsistence economy in the same culture also revealed different numbers in different sites. In order to compare each other, in Table 8-2, I also put the percentage of cultivation from different sites (Table 8-2).

8.5 ARCHAEOLOGICAL DISCOVERIES OTHER THAN TOOL COMPLEXES

Archaeological discoveries in relation to the study of transition to farming in the Changbaishan region include several aspects: possible trade of Jade objects and obsidian raw materials, the dispersal of reaping knives and specific pottery "*Dou*" and steaming cooking pot "*Zeng*".

8.5.1 Trade of Jade objects

Jade objects are widely found in the north Changbaishan region around 6-5000BP (Feng 2003; Yu 1992) such as in the Yabuli culture (Heilongjiang Kaogusuo 1988b). Some jade objects found in the Yabuli site are similar shape to the same items found in the Hongshan culture in the Liao River area. The location of the quarry for these jade materials has not been systematically looked for and this should be done in future research. Jade material in the Hongshan culture is usually assigned to the quarry in Xiuyan, Liaoning, northeast China. However, only a small amount of jade objects can be assigned to the Xiuyan jade and for most jade objects found in the Hongshan culture it is not clear where they come from. Moreover, no jade quarry has been found in the Changbaishan region. Therefore, jade objects found in this area may come from the Liao River areas through the Song-Nen plains by ancient trading (Sun et al. 1997). However, this assumption needs to be clarified in future gemmological study based on jade discoveries in northeast China. This trading might not be directly with the societies of the Liao River area because the hunting and fishing communities in the Song-Nen plains located between the Changbaishan and Liao River area. This trade network must have brought some new technologies and information into the

Changbaishan areas. This indirect contact may lead the Yabuli culture to be able to enter the availability phase in the transition to farming.

8.5.2 Obsidian trading

Obsidian artefacts including mainly arrowheads are found all over the Changbaishan region around 4000-3000 BP and became one of the major characters of Lower Yinggeling (Zaisanovka) and Upper Yinggeling (Xingcheng) cultures. In the Lower Yinggeling (Zaisanovka) culture around 4000BP, only a few sites contain small amounts of obsidian artefacts. But in the Upper Yinggeling (Xingcheng) culture, almost every site contains obsidian artefacts including the Sopohang and Odong sites located in the northeast corner of Korea (Li, Yunduo 1983:70), as well as the Zaisanovka site in the Primorye region of Russian Far East (Jilin Kaogusuo et al. 1998; Yanbian Museum 1991; Heilongjiang Kaogudui 1981).

For many years, Chinese archaeologists speculated that obsidian material was obtained from local quarries, particularly in the Yinggeling site located near the Jingbohu volcanoes (Heilongjiang Kaogusuo 1981). But geological studies in this region show the eruptions of Jingbohu volcanoes have not produced any obsidian (Zhang, Zhaocong et al. 2000). Therefore, these obsidian artefacts found in the Yinggeling site were not made of local obsidian.

Geological studies in the volcanic region around the Baitoushan Mountains located near the boundary between China and North Korea show obsidian in this area was formed by volcanic eruptions around 900 years ago (Jin, Bolu et al. 1994; Xu,Dongman et al. 1993). This obsidian resource was formed several thousand years after the Lower and Upper Yinggeling cultures and cannot be used for making their artefacts. One large obsidian core was found in the deposit earlier than about 10000 BP at about 100 kilometres south of the Baitoushan area (Zhou, C. & Du, X. 2003). If the date of obsidian core is correct and is local in origin, a quarry should exist earlier than 10000 BP and may occur in the deposit formed by early eruptions.

Despite the location of any obsidian quarry remaining unclear, the evidence of using this material to make artefacts in the Lower and Upper Yinggeling cultures indicates that the obsidian is very likely to come from one place, perhaps in the Baitoushan area, distributed to others through trading. But this trading seems to be restricted among different groups within the Lower and Upper Yinggeling societies because obsidian artefacts are rarely found in other cultures, e.g. in Zuojiashan III (Jilin University 1989) and Xiduanliangshan II (Jilin Kaogusuo 1991a).

Keeping obsidian trading within the Lower and Upper Yinggeling societies indicates the close relationship in sharing material resources and technology between different groups. Within this close relationship, plant cultivation should also be adopted by different groups in the Lower and Upper Yinggeling societies since domestic millet were recovered in the Krounovka site of the Lower Yinggeling culture. However, some groups located in mountainous areas, such as in the Yinggeling site, do not seem to have accepted crop cultivation because no domestic seeds were recovered from the deposits of these cultures (Jia, Weiming et al. 2003; Appendix 6).

8.5.3 The dispersal of reaping knives

Reaping knives appeared in the Dongkang, Tuanjie cultures in the Changbaishan region around 2000BP (Yu, Qiong 1990). As discussed in earlier Chapters, reaping knives appeared in the Yellow River area of northern China no later than 8000BP, such as in the Cishan culture (Hebei Administration et al. 1981). This form of reaping knife was adopted by the Hongshan culture around 5500BP in the Liao river area and in the Upper Xiaozhushan culture around 5000BP in the Liaodong peninsula of northeast China. In the Song-Nen plains and Ji-Chang region, this date is about 3000BP. The date of this reaping knife in the Changbaishan region around 2000BP is not the latest dispersal because in Korea, this reaping knife was used until around 1800BP and it developed a triangular shape (Li, Songlai 1997:62-63), which may be the result of resharpening and reusing (Nelson 1993:123-126). This dispersal of reaping knife indicates the adoption of reaping knife harvesting technique in northeast China and Korea.

8.5.4 Adoption of specific pots “*Dou*” and “*Zeng*”

Goblet shape pots “*Dou*” and steaming cooking pot “*Zeng*” are not traditional ceramic products in northeast China. They were adopted from the Yellow River area of north

China about 5-4500BP. As the traditional ceramic products of farming communities in central China, *Dou* and *Zeng* appeared earlier than 6000BP. This tradition of ceramic products along with the steaming cooking technique, which might be particularly used for plant foods, was gradually dispersed into northeast China around 5-4500BP in the Liao River areas and the Liaodong peninsula. A farming economy may accompany this dispersal (Table 8-2). This tradition of ceramic products finally arrived in the Changbaishan region around 2500BP in the Tuanjie, Dongkang cultures. This probably also indicates the adoption of farming economy.

8.6 COMPARISON WITH THE YELLOW RIVER AREA

In order to compare with the transition process in the Yellow River area, I need to discuss the date of each phase in the Changbaishan region in relation to the ZRC model. Because the economic styles in the Changbaishan region are various through time, such as major hunting or fishing, gathering dominant, or combined with hunting/fishing and gathering, or farming dominant, sometimes several economic styles existed in the same time and the same culture. I have selected some economic styles indicated by the tool complexes to describe a relative complete transition process. For example, in the Dongxing culture, the economic style indicated by tool complexes shows two different types, a farming economy signified by the Hekou site and a fishing economy represented by the Zhenxing and Dongxing sites. In the transition process, only the farming economy of the Hekou site is included. The fishing economy in the Zhenxing and Dongxing sites represents the local traditional economy resisting involvement in the farming transition process. This fishing economy is not included in the transition process to farming economy. Therefore, in the discussion about the three phases of transition to farming I include only the tool complexes comprising the farming transition process. Other economies will be discussed later.

8.6.1 The dates of the three phases in the Changbaishan areas

The process of the transition to farming in the Changbaishan mountainous areas seems to begin from around 5000BP and this assumption is based on two aspects. The first aspect is that contact with farmers has occurred around 5000 BP based on jade trading. There is no evidence indicating that the direct contact between local populations and farming societies has occurred before c.5000BP. The second aspect is that a farming economy or crop cultivation, either adopted from farmers or developed locally, is very likely below 5% in all food industries according to the analysis of tool complexes and domestic plants (Table 8-2). The absence of domestic plants and large amount of hunting and fishing tools imply that plant cultivation possibly did not exit before c.5000BP. It is unlikely that crop cultivation was developed or adopted before this period.

Further, despite some characters of artefacts, like pottery shapes and decorations in the Zhenxing I-A culture, showing some common features in broad areas of northeast Asia, contact between the local population and farming societies could only start from around 5000BP or at least not earlier than about 6000BP according to the specific Jade objects found in the Yabuli culture. According to the tool complexes in this period, gathering tools are insignificant, less than 4% as in the Xinkailiu site (Figure 8-29 top left). Therefore, the beginning of the availability phase, at the earliest is from c.6000BP and more likely around 5000BP.

A farming economy increase over 5% in the Changbaishan region very likely occurred between 5-4000 BP represented by the Late Boisman and Lower Yinggeling (Zaisanovka) cultures. In comparing the two diagrams of tools complexes in the late Boisman (Boisman site) and Lower Yinggeling (Jingu site), gathering tool increased from around 20% in the Boisman site to near 50% in the Jingu site. At the same time not only did hunting tools decrease but also crop remains were recovered from this period in the Krounovka site. Therefore, it is reasonable to assume that the substitution phase in terms of the ZRC model of the transition to farming began around 5-4000BP.

The transition process entering the consolidation phase of the ZRC model was probably around 2000-1800BP, represented by the Guntuling (Guntuling site) and Dongxing (Hekou site) culture. The tool complex in the Guntuling culture indicates that farming economy is likely to reach 50% and became over 50% in the Hekou site.

8.6.2 Comparison between the Changbaishan and Yellow River areas

In comparing the transition process in the Changbaishan and Yellow River areas, the two patterns have similar trends if we ignore some economic styles which were not part of the transition process in the Changbaishan region. Both patterns have a similar rate of increase in a farming economy. For example, the transition process in the mainstream in the Changbaishan region began around 6-5000BP in its availability phase till around 4000BP when the substitution phase started. The substitution phase finished around 2000BP and began the consolidation phase (Figure 8-33). This trend is very similar to the Yellow River areas.

However, there are some differences between these two transition patterns. One of differences is the relatively short period in the availability phase in the Changbaishan region. For instance, the availability phase seems to be only 1000 years compared to nearly 3000 years in the Yellow River areas. Another difference is that the farming economy in the Changbaishan region has not reached as high level as in the Yellow River area. The highest level of farming economy is around 60% in the Changbaishan region compared to 90% in the Yellow River areas.

In addition, varieties of economic styles exist at the same time as the process of economic transition to farming. In these economic styles, a farming economy or the cultivation proportion in their economies usually remains lower than 5% till around 1800BP or even later.

8.7 CONCLUSION

The transition to farming in the Changbaishan region reveals some specific features. First, the transition to farming is unlikely to have been caused by environmental change because the changes of environmental condition are less dramatic than in other regions. Adoption of a farming economy in Changbaishan region is very likely the result of cultural influence and immigration by farmers. For instance, the cultivation economy perhaps began around 5-4000BP. As a prelude of this change, cultural contact has already occurred, for example the jade objects from indirectly trading with farming societies around 6000BP. A farming economy reaching 50% of the economy around 2000BP is difficult to ascribe to environmental conditions, because there was unlikely to have been any dramatic environmental alterations which could push human inhabitants into changing their traditional way of food procurement. Conversely, cultural interaction represented by a specific type of reaping knife and pottery *Dou* and *Zeng* indicate adoption of the life style of farming communities. Local community have to change their economic strategy to compete with the expansion of Han Empire to adopt agricultural economy.

In addition, there are some events recorded in Chinese ancient scripts, such as the Han Empire extending its political power into the Changbaishan area through political diplomacy or army deployment (Jia, Weiming 1981). This expansion of political power from farming societies should also push a farming economy into this region.

However, the competition between local societies may become important factor leading to the final agricultural transition. Around 1800BP, a large number of wall fortresses were built in this area, indicating the development of social complexity and the competition between local groups.

Second, political and cultural interaction sometimes might not able to change the traditional way of food procurement. For instance, the process of transition to farming only occurred in some groups even within the same cultural system. Some groups might retain their traditional ways of food procurement. Retention of their traditional economies for a long time is indicated in the tool complexes of the Nanshan site around 3000BP, the Qiaonan site around 2000BP, also the Zhenxing and Dongxing sites around 1800BP. This can be seen in some modern ethnic groups. They may continue a predominantly hunting or fishing economy without farming or with only small amount of farming and herding until the present, such as Heze and Erwenke minorities in present northeast China. Even though the political and cultural interaction and competition within local groups or with Han Empire, these local societies choose different economic strategies and continue to adopt local environment with various ways of food procurement, which they think, is the most effective way of economy to meet the socio-political needs in their societies.

CHAPTER 9. OVERVIEW OF THE TRANSITION TO FARMING IN NORTHEAST CHINA

9.1 INTRODUCTION

As I assumed at the beginning of this thesis, northeast China is suitable for applying the ZRC model in researching the transition from foraging to farming. Four areas, the Liao River areas, Liaodong peninsula, central northeast China and Changbaishan, have been studied based on current archaeological discoveries. According to the results of case studies in these areas, it is possible to analyse the patterns of the transition to farming in northeast China. This analysis is in section 2 of this Chapter, and followed by the spatial observation about the ZRC model applied in northeast China in section 3. In section 4, I am going to discuss the relationship between plant cultivation and environment, and the relationship between plant cultivation and technology in section 5. These discussions are related to the basic conditions for a farming economy, such as ecology, technology and motivation addressed in Chapter 2. Some cultural influences in relation to the transition to farming will be discussed in section 6. The analysis of some elements in relation to farming transition in northeast China will be in section 7 and the model of transition to farming will be discussed in section 8. Discussing process and explanation of transition to farming will be in section 9 followed by conclusion in section 10.

As I discussed in Chapter 2, the ZRC model is the one to be chosen for testing in researching the transition to farming in northeast China. The ZRC model is divided into three phases, availability, substitution and consolidation, based on the proportion of farming in entire economy. The availability phase is the period that crop cultivation, either adopted from farmers or developed independently, is less about 5%, and some contacts with farmers may have occurred. The substitution phase is when farming has reached the level of higher than 5% but less than 50% in the entire economy. Once farming achieves more than 50% in the entire economy, the transition process enters the consolidation phase. This three-phase model of the transition process from hunting and gathering to farming has been shown to appear in northeast China through the case studies and with some supplements due to the differences between model and data.

9.2 SYNTHETIC ANALYSIS OF TRANSITION PATTERNS IN NORTHEAST CHINA

There at least are six areas, the Upper and Lower Liao River, Liaodong, Song-Nen plains, Ji-Chang and Changbaishan, that reveal a variety of transition process in northeast China (Figure 9-1). Based on the shape of each diagram, these patterns can be divided into three groups. The first group includes the Xiaozhushan-Dazuizi, and Changbaishan mainstream. The second group contains the Song-Nen plains, Upper Liao River and Ji-Chang areas. Houwa in Liaodong and other sites in the Changbaishan areas comprise the third group.

9.2.1 The ideal group

The patterns in the first group are very similar to the pattern in the Yellow River area (Figure 9-1), which show a consistent increase of farming economy. The difference between the pattern in the Yellow River and this group is that the dates and time spans vary in each phase of the ZRC model. For example, the time span in the substitution phase is almost 4500 years compared to around 2000 years in the Yellow River area. But the trends through three phases to a complete transition process are the same. These patterns of transitions to farming represent a relatively ideal form, as Zvelebil (1998:12) described his "availability model" (the ZRC model) I also name these patterns "**the ideal group**" (Figure 9-2).

9.2.2 The reverse group

The second, "**reverse group**", represent a process reversed after experimenting an increase of farming economies. For instance, in both the patterns of the Upper Liao river area and Song-Nen plains, the farming economy decreased after the transition process entered the consolidation phase. Presumably, after reversing the process of a transition to farming, an economy should remain in a combination of hunting/gathering, farming and herding, sometimes including fishing. The percentage between farming and other economic forms may be similar and stable. However, the pattern in the Ji-Chang areas sharply decreased and remained in the substitution phase before reaching the consolidation phase (Figure 9-3). This reverse may relate to an increase of herding economy in some cases. But there is no evidence indicating an increase in herding economy in the Ji-Chang area. Therefore the possibility that farming economy reverses towards hunting and wild food gathering still exists.

The result of this reverse process may include three different situations. The first, when the reversal leads to the farming economy being less important than hunting or fishing, is seen in the others in the Ji-Chang region (Figure 9-3). The reverse group changes to a resistant group which will be discussed later. Second, a reduction in the farming economy is the result of an increase of herding, the economic style changes to semi-farming and semi-herding such as in the Upper Liao River region and Song-Nen plains (Figure 9-3), or perhaps herding predominates. The third, if a farming economy reverses to a percentage similar to hunting or fishing, then the economic style becomes semi-hunting or semi-fishing and semi-farming, or just one third in farming, fishing and hunting. This combination of multi-economic styles such as in the Ji-Chang region (Figure 9-3) may exist for a quite long period in northeast China.

9.2.3 resistance group

The third group contains the patterns with a stable low level of farming economy, usually less than 15% in my study areas. For example, the pattern in the Houwa system reveals a very slow increase in the farming economy, less than 10% in 4000 years. The pattern derived from other sites than the sites in the major transitional process in the Changbaishan area also shows that a farming economy remains lower than 5% before 2000BP. This group perhaps indicate a resistance to a farming transition from a traditional hunting gathering economy. So I call this group the "**resistance group**" (Figure 9-4).

9.3 SPATIAL OBSERVATION OF TRANSITION PROCESS IN NORTHEAST CHINA

I have argued in Chapter 3 that the ZRC model not only represents the three temporal stages but also corresponds to a spatial meaning. This argument has been supported by the case studies in northeast China. Based on the case studies in each area, I have illustrated the spatial process of the transition to farming from around the seventh millennium to the second millennium BP. In order to emphasise the transition process from hunting/gathering to farming, I summarise the mainstream of the economic transition to farming only.

Around 7000BP, the process of the transition to farming in southern northeast China, such as the Liao River regions and the Liaodong peninsula, but perhaps including the Jiaodong peninsula, began its first stage, the availability phase. At the same time, the farming transition in northern China, the mid Yellow River areas, was in the substitution phase. The remaining areas of northeast China, such as the Song-Nen plains and Changbaishan area had less chance to contact farmers in northern China directly and remained traditional hunting/gathering economies (Figure 9-5).

During 6-5000BP, the farming transition in the mid Yellow River area of northern China moved into the consolidation phase and the areas in southern northeast China and the Jiaodong peninsula, into the substitution phase. The Song-Nen plains and the southwest Changbaishan area including the northwest corner of the Korean peninsula started on the availability phase (Figure 9-6).

During fourth millennium BP, southern northeast China, the Liao River areas and Liaodong peninsula and northern China including the Jiaodong peninsula finalised the transition to farming, so that all areas were in the consolidation phase. The Song-Nen plains and southwest part of Changbaishan area entered substitution phase. Most Changbaishan areas and the Korean peninsula entered the availability phase (Figure 9-7).

Around the third millennium BP, the areas of transition in the consolidation phase were both central and southern Northeast China. The Changbaishan areas and Korean peninsula, as well as some areas in the Primorye region of Russian Far East, changed from the availability to the substitution phase (Figure 9-8). These areas entered the consolidation phase in about 2000BP (Figure 9-9).

After about 2000BP, the northerly areas of northeast China was very likely to be in a long running process of transition to farming, some groups with consolidation but others with availability phase keeping hunting, gathering and fishing for a long time.

9.4 THE RELATIONSHIPS BETWEEN PLANT CULTIVATION AND THE ENVIRONMENT

It is difficult to draw a conclusion about what is the relationship between the results of transition process and the factors that cause or at least influence economic changes. It is unlikely that only one factor could account for the transition. Apart from internal factor of social motivations, based on the environmental reconstruction and case studies in northeast China, it is very possible to search for some traces, which may indicate the external reasons for the transition to farming. In this section, I am going to analyse major dramatic environment changes and the periods that the level of temperature and precipitation met the basic needs of plant cultivation in northeast China.

9.4.1 Dramatic environmental changes

There were two periods of dramatic environmental changes in northeast China, the beginning of the early Holocene around 10000BP and the mid Holocene around 6000BP.

At the beginning of the early Holocene, around 12-8000BP, temperature and rainfall increased sharply. The areas affected by this change included the entire northeast China. For example, annual mean temperature increased from -6ºC in c.12000BP to 3ºC around 8000BP, around 9ºC increase, and precipitation from less than 200mm in c.12000BP to around 400mm about 8000BP in the Song-Nen plains. As the result of this change, the Pleistocene fauna in northeast China was completely replaced by modern animals and the vegetation also changed accordingly. Some deserts in the northwest, such as the Liao River areas and Song-Nen plains shrank in size and most areas were covered by grass. In the Liaodong peninsular and Changbaishan areas, vegetation coverage changed towards open woodland and forest. Although the Liao River areas and Song-Nen plains were only covered by grassland and deserts, the increase of temperature and precipitation probably also produced some woodland along mountain slopes.

Another dramatic environmental change in this period was the rise in sea level causing huge land loss, of about 9.44×10^5 square kilometres in the early Holocene.

This may have had three possible impacts. Firstly, this land loss made Liaodong and Korea two separate peninsulas. Secondly, maritime resources became available on the coasts in these two peninsulas in contrast to the inland resources in earlier period. Thirdly, human and fauna inhabitants in the lost land were forced to move inland, into northeast China.

The second period of dramatic environmental change in northeast China was during the mid Holocene around c.7000 to 5000BP. In this period, environmental changes mainly included a high level fluctuation of temperature in the mid Holocene. This fluctuation contained a sharp increase temperature at first, usually about 6ºC, e.g. from annual mean temperature 2ºC around 7000BP to 8ºC in c.6000BP in the Liao River area, then 3-4ºC decrease after c.6000BP. This temperature fluctuation has led to this period becoming the warmest climate in the Holocene in northeast China. The possible results of this environmental change was high evaporation causing a very dry climate in the areas with lower level rainfall, such as in the Upper Liao River and Song-Nen plains.

9.4.2 The time when climate is suitable for cultivation

Tracing the time when the climate was suitable for crop cultivation in northeast China is based on two aspects. The first is to select a crop and find its basic climate requirements. I have selected millet because this crop flourishes under extreme conditions, such as dry and cold. The second aspect is the climate data indicating the transition from the end of Pleistocene, the extreme cold and dry to the relative warmer and humid climate during the early Holocene.

The climate required for growing millet is limited to areas where annual precipitation is more than 300mm and mean temperature above 0ºC. Such a climate usually provides adequate conditions for millet growing within around three months frost-free period (Shen 1951:207; Harlan 1992:205). For example, in present-day northeast China, millet is cultivated in areas not over 50ºN latitude. The climate in the area over 50ºN latitude in northeast China is very cold with below 0ºC mean temperature and annual rainfall less 300mm (Chinese map press1998:120). The frost-free period in the areas over 50ºN latitude is shorter than three months (Chinese map press 1998:120), which is over the limit for millet growing.

It was extreme cold and dry during the end of Pleistocene, around 18000-12000BP throughout northeast China, and even in the Liaodong area, which was the warmest, millet would not grow (Figure 4-17, 4-18, 4-19). Presumably, under such extreme cold and dry climate, the frost-free period should be similar to or even colder than the present area over 50ºN Latitude, such as in the northern Daxinganling region in northeast China, where frost-free period is less than three months. Rainfall in Korea may have been more than 300mm but the temperature was lower than 0ºC, and very likely a similar climate, humid and cold occurred in the Bohai and Huanghai plains. The frost-free period in Korea and the Bohai and Huanghai plains was very likely less than three months. Therefore, around 18000-12000BP, millet, one of the plants with poorest climate requirement could not have been grown successfully. This situation was not changed until after 12000BP.

Around 10000BP, the rainfall increased to more than 300mm over almost the entire area of northeast China. Temperature also increased and in the Liaodong and Lower Liao River areas in the south, the Sanjiang plain in the east, mean temperature reached above 0ºC for the first time since the Holocene began. In these three areas, as well as the Korean peninsula, the frost-free period extended longer than three months. The period around 10000BP is when the climate in northeast China began to be appropriate for millet growing. The temperature continued to increase and around 8000BP, most areas in northeast China, including the Song-Nen plains and Changbaishan area met the basic climatic requirement for millet growing. The Daxinganling area in northern northeast China remained an exception.

In summary, there were two dates when climate met the basic requirement for growing millet in different areas in northeast China. The first date is about 10000BP, and during this period, three areas: the Liaodong, Lower Liao River areas and Sanjiang plain became suitable for millet growing. The second date is 8000BP and the remaining areas in northeast China, except Daxinganling, were appropriate for millet growing.

9.5 THE RELATIONSHIP BETWEEN PLANT CULTIVATION AND TECHNOLOGY

Technological improvements in relation to plant cultivation in northeast China includes three major periods, initial cultivation, reaping knife adoption and plough cultivation.

9.5.1 The technology of initial planting

Presumably, the technology of initial farming should be the very beginning of cultivation techniques with simple tools such as wooden or stone digging tool. The knowledge of planting is very cursory, perhaps only knowing the process of picking up the mature seeds and burying them in the soil in the right season as indicated by the cold and warm cycles of a year. The knowledge and techniques of initial planting may develop locally for the primary agricultural area. For example in the early stage of the Xianrendong site (Zhang 2000), around 14-10000BP, a human group started cultivating rice (Table 3-6). But it may be also adopted from farmers in the secondary agricultural areas such as in most circumstances in northeast China.

In northeast China, the initial planting period begins before c.7000BP if we consider the millet remains discovered in the Xinglonggou (Chinese Academy IMT 2004) and Xinle site (Shenyang Administration 1985) in the Lower Liao River region. However, this date may not be the earliest if we consider the climate availability for millet cultivation in this region. As I discussed in the last section the climate suitable for millet cultivation is very likely to be as early as 10000 BP. Human groups could cultivate millet then but we cannot assume this occurred without the presence of millet remains.

The initial period of cultivation tends to be different in different regions. For example, in the Upper Liao River region this date should be earlier than 8000BP. In the Lower Liao River region, this date seems to be earlier than 7000BP. This date in the Ji-Chang region may be as early as in the Lower Liao River region because the very close cultural connection between these two regions in that time. However, early cultivation in the Song-Nen plains might be as late as c. 5000BP. The tool complex around 6000BP in the Song-Nen plains comprised hunting and fishing tools only which indicates a relatively late date for early cultivation. Around 4000BP, the tool complex in this region contains more than 20% of gathering tools associated with similar number of woodcutting tools and the farmer's cooking pot "*Li*" was adopted. In addition, around 4000BP, the reaping knife appeared (Figure 7-13, 7-14) indicating the techniques of cultivation belonging to the next higher level, which is far more than initial cultivation and will be discussed later. Therefore, the initial cultivation period in the Song-Nen plains is likely to be between 6000 and 4000BP.

9.5.2 The technology of harvesting using a reaping knife or sickle

After the initial cultivation techniques and knowledge, a major technical improvement in relation to plant cultivation in northeast China, which can be identified through conventional archaeological methods, is the invention or adoption of the reaping knife. So I call this period reaping knife harvesting period. In northeast China, the reaping sickle is rare and is some times associated with reaping knife. Sickles should be later than reaping knife in north China which was the origin place for both reaping knife and sickle. For example, the stone reaping knife found in Cishan site is dated about 8000 BP in north China (Hebei Administration et al. 1981) and this date may be pushed even earlier if considering the shell reaping knife, dated to about 10000BP, found in the Xianrendong site in the Yangtze River area (Jiangxi Administration 1963; Zhang 2000). The earliest stone sickle was found in the Peiligang site with the date about 8000BP (Chinese Academy Henan Team 1995). But it was in different situation that reaping knife and sickle appearance in northeast China because when the reaping knife was first being used in northeast China, sickles had been used in north China for more than 3000 years. We may question why local populations in northeast China did not adopt the sickle, which was already available in north China, instead of reaping knife. The reasons for this may be the difficulty of making a sickle in terms of time, labour and skill, or that the reaping knife was sufficient for a relatively small amount of harvest, or both. However, it is unlikely that harvesting using the reaping knife or sickle was developed locally when considering the dates and shapes of the reaping knives found in northeast China (Table 9-1). Reaping knives in northeast China seem to be adopted from north China not only because the dates of the earliest discovery is more than three thousand years later than in north China, but also the earliest shape in northeast China was similar to that in north China (Yu, Qiong 1990). This reaping knife replace the “microblades-reaping ” knife, which was invented around 8000BP in northeast China. The earliest date of reaping knives in northeast China is around 5000-5500 BP both in the Liao River regions and the Liaodong peninsula. Together with reaping harvesting techniques, reaping knives took about 3000 years to be adopted by prehistoric societies in northeast China, at first in the southwest, then towards to the northeast (Table 9-1).

Similarly to the initial cultivation periods, reaping knife adoption in northeast China happened at different times in different regions, earlier in the southwest and later in the northeast. There are three waves of reaping knife expansion into northeast China. The first wave was around 5000BP in both the Liaodong peninsula and the Liao River regions as I discussed above. The second was around 3000BP, when the reaping knife accompanied by reaping harvesting techniques extended into the Song-Nen plains, Ji-Chang regions and northwest corner of Korean peninsula (Table 9-1). The third was after 2500BP and this expansion has reached the Changbaishan areas including the northeast corner of Korean peninsula, eastern mountainous areas of northeast China and Primorye region of Russian Far East, and as well as Japan in the remains of early Yayoi culture (Aikens et al. 1996, 1982:201) (Table 9-1).

As an indicator of intensive plant food harvesting, the reaping knife is usually seen as one of the important tools used for crop cultivation in Chinese archaeology. But without the evidence of domestic seeds, this assumption remains unclear. The adoption of reaping as a harvesting technique indicated by the discoveries of reaping knives perhaps suggests the acceptance of crop cultivation and farming economy because the date of the oldest reaping knives is similar to the date that tool complexes suggest a farming economy appeared. For example, in the Liao River area, despite domestic plants being found as early as about 7000BP in the Xinle site (Shenyang Administration et al. 1985), a farming economy is unlikely to begin before the Hongshan culture around 5500BP. This is also the date of the earliest reaping knife discovery in the Hongshan culture around 5500BP. The numbers then were small, but knives became popular in the Lower Xiajiadian culture, the period when farming economy was predominant (Table 9-1).

9.5.3 The plough farming technology

Plough farming technology means that the plough, as a new tool in crop cultivation, brought a new era in the transition to farming. This new era of farming not only meant the new tools in soil preparation but also indicates that the size of crop fields and the proportion of farming economy have substantially increased. Ploughs are usually made of iron and making iron plough requires specific craftpersons and certain time. So the plough farming indicates the relatively high level economy and should produce more surplus than previous techniques.

Adopting plough-farming technology in northeast China occurred around 2000BP, during Han Dynasty including the region controlled by Han Empire, such as the southwest of northeast China and also some regions held by local tribes like the Ji-Chang and northern Changbaishan regions. Dating to around 1800BP, an iron plough was discovered in the Baoan fortress in the northern end of Changbaishan. This indicates that in the entire Changbaishan area, plough cultivation was possible and might have been adopted. However, this plough is still an individual discovery (Heilongjiang Kaogusuo 2003b:31).

9.6 SOME CULTURAL INTERACTIONS RELATED TO THE FARMING TRANSITION

Through the case studies in northeast China, three major indicators of cultural interactions from north China in relation to the farming transition were discussed in earlier Chapters, including painting design on ceramic products, adoption of cooking ware, *Zeng, Li, Yan* and *Ding,* and specific pottery *Dou* dispersal.

Painting designs on ceramic products, particularly on the surface of pottery was one of the traditions of both north and northeast China. The first painting designs appeared in the Upper Liao River area before 6000BP and in the Liaodong peninsula around 5500BP. These two traditions of painting design were the result of cultural interaction with the two regions of north China. The painting design in the Liaodong peninsula connected to the Jiaodong peninsula and in the Upper Liao River region, painting design related to northern Hebei (see Chapter 5 and 6).

Around 4000BP, local societies developed their own painting techniques. For example, various colour-painting designs on pottery were found in Dadianzi burials of the Xiajiadian culture dated to about 4000BP (Chinese Academy IMT 1996a). Also, various local designs of colour painted pottery were found in Dazuizi burials dated around 4000BP in the Liaodong peninsula (Dalian Kaogusuo 2000). These colour-painting designs may be seen as the continuation of the first wave of cultural interaction of colour-painting design connecting to north China.

Colour-painting design developed again around 2000BP but in a region further northeast. Red colour painting appeared in the Upper Hanshu culture and the Qinghua site (Heilongjiang Kaogusuo 1988a) about 2000BP in the Son-Nen plains. Colour painting appeared in the Tuanjie culture around 2500BP in the Changbaishan region, but was never common there.

Tripod cooking wares in northeast China, such as *Zeng, Li, Yan* and *Ding*, were first adopted from north China around 5-4500BP in the Liaodong peninsula and Liao River regions (see Chapter 5). These cooking wares continued to disperse into central northeast China around 3500BP (see Chapter 7). After around 1800BP, all these cooking wares gradually disappeared in northeast China.

Another specific pottery *Dou* was adopted in the Liaodong peninsula and Liao River regions around 5000-4500BP, and around 3000BP it appeared in the Ji-Chang region. It became popular in the Changbaishan area around 2500BP (Table 9-1).

9.7 COMPARISON BETWEEN TRANSITION PATTERNS AND OTHER ELEMENTS

In this section I am going to combine all external factors that I have discussed above to analyse the process of the transition to farming in each area. These factors include two dramatic environmental changes, the time that climate began to be appropriate for millet growing. Some internal factors such as the major technological improvement in plant food cultivating and processing such as reaping harvesting, plough farming and tripod cooking, and some cultural interactions are included

9.7.1 The southwest areas

The southwest areas include the Liao River area (Upper and Lower) and Liaodong peninsula. I combine these three regions together because they are directly connected with north China either through terrestrial or marine routes.

I have discussed how sea level increased and the possibility of a concentration of population during the early Holocene. The areas influenced by this event included the southwest areas of northeast China. This dramatic environmental change made the climate in the Lower Liao River and Liaodong peninsula suitable for millet growing (Figure 9-10). However, the farming economy did not increase until after around 8000BP, when the climate was suitable for millet growing not only in the Liaodong peninsula and Lower Liao River region but also in the Upper Liao River and almost entire northeast China. Therefore, the first dramatic environmental changes during the early Holocene did not make any substantial change in the local economy in relation to hunting/gathering and farming, even though, presumably there were increase food demand due to new migration from Bohai plain. The theory of population pressure leading to agricultural transition may not appropriate to this area.

The second dramatic environmental change during the mid Holocene around 6000BP, when it became dry and hot in the Liao River regions particularly in the Upper Liao River region, coincidently happened at the same time as a sharp increase in farming in the Upper Liao River region. Also colour painting techniques on ceramic products and reaping harvesting tools and skills were introduced into this region during this period (Figure 9-10). However, these factors seem not to affect populations in the Lower Liao River region and Liaodong peninsula where the farming economy was relatively stable before around 5500BP.

Around 5-4500BP, farming economy substantially increased in all regions in the southwest areas accompanied by the appearance of tripod cooking wares, which were the major cooking tools of farmers in north China. In three regions in the southwest area, the farming transition entered the consolidation phase in this period. However, at the same time, some human groups in the Liaodong peninsula continue hunting/gathering and fishing with a low level of farming, such as the Houwa culture, until it was finally replaced by plough farming economy as a result of farmer immigration from north China under the political power of the Han Empire around 2000BP(Figure 9-10).

9.7.2 The central area

The central area includes the Song-Nen plains and Ji-Chang regions. In this area the farming transition began around 7000BP, so the first dramatic environmental change during the early Holocene did not affect the economies (Figure 9-11). The economy began to change after the second environmental change during the mid Holocene. For example, a farming economy increased in the Ji-Chang region around 5000BP then remained stable. The farming economy increased sharply between 4-3000BP in the Song-Nen plains, when tripod-cooking wares were adopted from the south area. However, some populations still maintained low level of farming economy and continued to reduce it, such as in the Ji-Chang region (Figure 9-11).

9.7.3 The Changbaishan area

The two periods of dramatic environmental changes, the early Holocene and mid Holocene did not affect the Changbaishan area. Local human groups relied on subsistence mainly from hunting, fishing and gathering rather than cultivating. Archaeological data has shown that crop cultivation was not present in the Changbaishan area until around 4000BP. After that, the farming economy slowly increased between 4-3000BP. A sharp increase of farming economy between 3-2000BP associated with the adoption of cooking ware *Zeng* and specific pot *Dou* as well as the reaping knife from farming societies in the southwest area. In the same time, some groups remained in a low level farming economy and subsistence mainly relied on hunting, fishing and gathering until very late (Figure 9-12)

9.7.4 Summary

Based on the comparison of transition patterns and other factors, the southwest area was more affected by the two occurrences of dramatic environmental changes. The second change in particular with its dry and hot climate, might have been one of the major external factors to push the prehistoric societies in the Upper Liao River region into more reliance on crop cultivation. Similarly to the southwest area, in both the central and Changbaishan areas, the farming economy increased sharply accompanied with new cooking wares.

9.8 THE MODEL OF TRANSITION TO FARMING IN NORTHEAST CHINA

As I discussed earlier in this Chapter, transition patterns from each case study are attributed to one of three groups: the **ideal**, **reverse** and **resistant** groups. There is also a sub-group called "combination economy" within the reverse group. These three groups and the sub group of transition patterns indicate how complex was the situation in the transition process. Prehistoric societies selected the way they thought was the right way to survive. A farming economy was not the only way to survive for them. When some groups were undergoing the transition process and finally became farmers, other groups may go along with them and some may not. Some groups also returned to hunting/gathering in the middle of transition process.

To abstract a model of the transition to farming in northeast China I have to represent all three groups. The first "ideal" group is similar to the ZRC model which goes through three phases to complete transition procedure (Figure 9-13 and 14). This part of the transition model has been discussed most in the ZRC model. In a reverse pattern, the farming economy decreases after a period of increase, either after reaching the consolidation phase or not. This decrease may lead to economy returning to its original hunting, fishing and gathering, or shifting to animal herding (Figure 9-13, 9-14). However, in the resistant pattern, hunting or fishing and gathering as the traditional ways of food procurement are always in a predominant position and these prehistoric societies are resistant to all aspects of farming (Figure 9-13,9-14). Therefore, a relatively complete model of the transition to farming in northeast China includes three different trends (See Figure 9-14) and may be called the **three trends model,** which is based on archaeological data in northeast China and generated from the ZRC model.

9.9 RETHINKING TRANSITION PROCESSES AND EXPLANATIONS

In beginning of this thesis, I have discussed some theories about the transition process and explanations in relation to the farming transition in prehistory. After a series of case studies based on data from northeast China, in this section, I will summarise the processes and explanations of the transition to farming in northeast China and compare it to some other processes and explanations.

9.9.1 Processes of transition to farming in northeast China

The process of transition to farming is usually described as a rising proportion of subsistence depending on cultivated plant or domestic crops while the proportion of hunting, gathering and fishing is decreasing (Smith 2001). When the proportion of subsistence depending on cultivated plants or domestic crops reaches a certain level, hunter/gatherers finally become to farmers. This proportion should be over 50% in the ZRC model. Smith (2001) has argued that artificially making a standard proportion the definition of farmer makes it easier to neglect the “middle ground” situation between hunter/gathers and farmers during the transition process. But how to distinguish farmers from hunters by referring to the proportion of farming in the economy is particularly difficult when the transition process is in the “middle ground”. However, even in Smith’s “conceptual-developmental map” (Smith 2001:15), he has to use proportions to indicate the beginning of agriculture in the transition process. For example, two stages of transition process were illustrated in his diagram. Food procurement (hunting-gathering and fishing) is the first stage, and second stage is called food production. In the second stage of food production two sub stages, “low level food production” and agriculture were divided. There were no economic proportions involved in the stage “food procurement” and the first substage “low level food production”. But in the substage “agriculture”, the starting level of proportion related to farming or herding economies, which were defined as “contribution of domesticates to annual caloric budget” by Smith is around 30% (2001:15). In his illustration, the middle ground in the transition process includes the period of the beginning of low-level food production containing both wild plant and domestic food cultivation to the beginning of agriculture with the farming economy being less than 30%.

It is understandable that there is usually a “middle ground” in the transition process. The substitution phase actually is a “middle ground” in the ZRC model. The difference between the ZRC and Smith’s models is the standardised proportion for defining an agricultural society. This proportion will differ according to different scholars. However, both these models have described the transition process as a single line, which begins with hunting, gathering and fishing dominant, moves to low level food production including plant cultivation or wild animal herding, and then living stock (Smith 2001). However, in the case studies in northeast China, the transition to farming reveals it as a multi-linear process, as described above.

In summary, in the process of the transition to farming in northeast China, as the three groups of transition patterns indicate, there were three different processes, the ideal, reverse and resistant occurring in parallel. They might influence each other or cross overlap each other during the transition history. This multi-dimensional patterns accompanied and influenced each other constructing a dynamic process of transition to farming in northeast China.

9.9.2 Tentative explanations

As I discussed in the Chapter 3, the conditions required by the transition to farming based on society level may comprise ecology, technology and motivation. They are also can be divided into two groups: internal and external. Internal factor includes two categories. One is the availability of technology such as knowledge and skill of plant identification, seasonal growing and harvesting, and another is motivation to adopt or develop plant cultivation, crop domestication and a farming economy, such as increasing food demand either caused by population increase or wild food supply decrease, or even political and cultural intensification. External factor means the availability of an appropriate environment particularly for plant cultivation including rainfall, temperature, flora and fauna (Table 2-1). In this part, I am going to analysis these factors in relation to the explanation of the transition to farming in northeast China.

9.9.2.1 Ecology

There are two different ecological changes in northeast China. One is environmental change towards one generally appropriate for plant cultivation, such as sufficient rainfall and temperature in flood plains or the slopes of mountains. This change happened about 10000BP in the Liaodong and Lower Liao River regions, and by around 8000BP this environmental condition was available in most regions of northeast China. Another is environmental change towards an extreme level. This extreme environment usually makes survival of plants or animals difficult. During the Holocene period, around 6000BP, temperature increase caused some regions experience this extreme condition, such as in the Upper Liao River region and Song-Nen plains.

In northeast China, certainly, the transition would not have happened without appropriate ecological conditions which occurred around 10000BP. This is the first time that environment changed to be suitable for plant cultivation since around 70000BP in northeast China (Wang, Jingtai et al. 1980). This environmental change around 10000BP may lead to occasionally initial plantation but was unlikely to be seen as a cause of economic transition to farming in northeast China. Referring to the tool complexes analysis, economic styles around 10000BP were predominately hunting/gathering and fishing in all areas in northeast China (Figure 9-1).

Another ecological change is to extreme conditions, such as hot and dry during 6000BP in both the Upper Liao River region and Song-Nen plains. This dry and hot climate in the Upper Liao River region perhaps accelerated the transition process since the level of farming economy increased dramatically around this period. The climate change would have forced the Hongshan societies to increase food production from domestication as indicated in Figure 9-10, to meet the increase food demand from social and political activities.

This dry and hot climate might accelerate farming economy because the knowledge and technique for crop cultivation have been developed prior to the climate changes. Before the climate change to extreme around 6000BP in the Upper Liao River area, there was a better environment with warm and relatively humid climate around 7500BP, which was appropriated for millet cultivation. It is very likely that human societies, such as Xinglongwa and Zhaobaogou, developed millet plantation and cultivation techniques and knowledge during this better environmental condition. But the question is whether this climate change finally led to agricultural transition. Otherwise, it could not result in occurrence of the transition to farming. For example, this dry and hot climate seemed not to lead to any changes in economic forms in the Song-Nen plains. The possible reason may have to be the internal factors such as undeveloped farming knowledge or not necessarily to adopt farming economy due to the less development of social complexity. The fishing economy in the Song-Nen plains was nearly 30% compared to non-fishing tools in the Upper Liao River area. This difference of fishing and non-fishing between these two regions appeared throughout history. In the Song-Nen plains, fishing together with other freshwater resources such as shellfish collecting was the traditional economy in local societies and this economic strategiy controlled by the elites in the community possibly allowed them to survive successfully during the extreme hot and dry climate.

In summary, ecological environment, particularly warm and humid environment, is the basic condition necessarily for farming economy exists. Extreme conditions such as hot and dry may slow or accelerate the speed of the transition process. But this circumstance will occur only when transition to agriculture become the social and political needs through the development of social complexity.

9.9.2.2 Technology

There are three types of technological developments in relation to farming transition: initial cultivation, reaping knife harvesting and plough farming. The development of reaping knife harvesting and plough farming was more likely caused by cultural intensification and political power expansion resulting in the spread of farming technology. Therefore, I will discuss these two developments of farming technology in next part.

The technology of initial plant cultivation likely happened around 9-8000BP in the south area of northeast China. The farming economy should have rapidly increased if technology of initial plant cultivation was the dominant reason for making a farming transition happen. But this was not what happened. Initial plant cultivation continued for a long period before the farming economy substantially increased. For example, this period is around 2-3000 years in most regions in northeast China and the Liaodong and Upper Liao River regions, and around 4000 years in the Lower Liao River region (Figure 9-10, 9-11, 9-12). Thus, the technology of plant cultivation is not the dominant reason causing a farming transition to happen.

9.9.2.3 Motivation

Motivation means the intention of prehistoric society to transfer its economy to a farming base. This motivation is why prehistoric societies chose farming economy instead of or as a supplement to their traditional subsistence. There is no doubt that, as prerequisites, appropriate conditions of ecology and technology in relation to crop cultivation should occur earlier than the motivation for transition to farming. Presumably, prehistoric human societies would not change their traditional way of food procurement if there were no threat to it.

What conditions could have sufficient power to force human societies to change their tradition to farming economy? The first condition is usually ascribed to natural environment. But the case studies in northeast China show that in most regions dramatic environmental changes did not achieve any response in relation to the changes of economic reforms. The only exception is the Upper Liao River region. In this region, natural environmental changes around 6000BP had the effect of accelerating an increase in the farming economy. The Upper Liao River region is located in the transition zone from arid or semi-arid to forested area. Therefore, this region is the driest region in northeast China. Environmental changes around 6000BP were characterised by the highest temperatures and higher evaporation since the Holocene began. These changes would have intensified the dry conditions that already existed in this region. It is very likely that this dry condition might reduce food surplus that was necessary for support excessive needs in social and political activities such as ritual ceremonies and monumental constructions in the Hongshan societies. This excessive need was required by the competition of power between the chiefdoms. The development of social complexity in Hongshan societies required sustainable subsistence economy and millet cultivation would have been the best option for supplement diets compared to all other crops, because it can grow in very dry conditions such as semi-arid areas. Nevertheless, as Li, Xinwei (2003:227) pointed out that Hongshan elites were unable to manage the changeable economy, overemphasised ritual and ideological power rather than maintain all power sources to manage efficient economic reform. Hongshan social structure possibly was clasped and transition to agriculture might also reverse after the Hongshan period.

9.9.2.4 Summary

Ecology and technology are the preconditions of a farming economy. Ecological changes could result in the transition proceeding only when these changes are sufficient to cause a shortage of food surplus, which could sufficiently threaten the excessive needs in social and political activities. The attraction of political power behind these social activities would have to be the internal reason for the transition to farming in some regions in northeast China. Without motivation of agricultural transition, which is decided by social and political needs and development of social complexity, transition to farming would never happened in northeast China. The resistant group of transition patterns is an example of how some societies still depend on traditional food procurement even though pushed by environmental changes, cultural and political influences. If the environment is able to provide traditional food resources sufficiently, if these resources are sufficiently support the excessive social and political needs, these resistance groups would remain in the traditional hunting and gathering economy for a very long period.

9.10 CONCLUSION

In comparing to the ZRC model, the patterns of the transition to farming in northeast China reveal three different groups. The ideal group is very similar to the ZRC model and the three-phase process of transition can also found in a spatial approach based on the ideal group. The reverse and resistance groups have widened our view of the transition process and provided details which was described briefly by Zvelebil and Rowley-Conwy in the ZRC model. Multiple dimensions of the transition process are the character of the transition to farming in northeast China. The **three trends model** of the transition to farming in northeast China is the abstract form of the transition process and the social and political needs by the regional communities behind these trends may be responsible for the each direction of transition to farming out of the environmental reasons. It may also represent a farming transition procedure elsewhere.

CHAPTER 10. CONCLUSION

Northeast China is one of the suitable areas to testing the applicability of the ZRC model of transition to farming in prehistoric archaeology. Through the reconstruction of past environments and reinterpretation of current archaeological discoveries in northeast China, this thesis has attempted to apply the ZRC model to this area. The tool complexes analysis used in this thesis and economic style indicated by these tool complexes have made this application become practicable. This tool complexes analysis has a significant meaning in economic studies, particularly in archaeological discoveries in view of the lack of faunal remains in northeast China. The case studies in northeast China have shown the basic reliability of the ZRC model. I am going to summarise the ZRC and "**three trends**" models as well as other models in relation to the transition to farming in section 1. Section 2 is the summary of the relationship between environments and economic styles based on northeast China. Section 3 is further discussion of early plantation, cultivation and agriculture. The comparison of transition process between primary and secondary agricultural area will be in Section 4. A short assessment about tool complex analysis as used in this thesis will be in section 5. Some suggestions for further study in relation to transition to farming will be addressed in section 6.

10.1 ABOUT THE TRANSITION MODELS

In Chapter 2, I have discussed several models about transition to farming, such as "wave of advance" (Ammerman et al. 1971), three stages (Imitation, slash and burn and "Si" tilling) (Chen 1989) and the ZRC model (Zvelebil & Rowley-Conwy 1984). The "wave of advance" model is a assumption about diffusion of agriculture from original centre radiating to periphery regions. This assumption seems not to be proved by the data in northeast China because the date of agriculture in each region shows an uneven diffusion of farming economy and dispersal of farming economy is determined by many aspects including environmental changes, cultural influences and motivation of human societies. The three stages model proposed by Chen, Wenhua (1989) is too ambiguous because the tools used in this model are identified by simple eyeballing rather than by scientific methods such as usewear analysis. The ZRC model has become the experimental model in this thesis after several supplements such as the redefinition of the availability phase. After several case studies in northeast China, the ZRC model has been confirmed in northeast China by the actual archaeological data.

Firstly, the ZRC model of transition to farming basically represent the transition processes in northeast China because the major theory of this model is based on gradual increase of farming economy, which is a type of normal transition procedure for most natural or social phenomena. The model of transition to farming in northeast China appears to have multiple dimensions as was also discussed by Zvelebil (1998:12). Three groups: the ideal, reverse and resistance of transition to farming in northeast China suggest that the direction of transition to farming in different human groups is multi-dimensional, coexisting in the same time, same region, same environment and same archaeological culture (Zvelebil 1998:14).

Secondly, almost all theoretical models describing transition processes are based on their own definition of herding or agricultural societies. For example, in the ZRC model the percentage around 50% of subsistence depending on plant cultivation is the threshold for being an agricultural society (Zvelebil 1998). Using tool complex analysis, this percentage can be defined from archaeological data such as in this thesis. However, some definitions seem impossible to be applied in prehistoric economy. Smith (2001:12, Figure 7), for instance, has suggested that an "agricultural" society should begin from 30% and be defined when over 50% in the contribution of domesticates to an annual caloric budget. But in archaeological studies, it is difficult to calculate a caloric budget because what can be used for retrieving information for the past societies is only the archaeological remains, such as stone tools, potsherds and other debris. People may easily calculate a caloric budget from present ethnic groups based on their anthropological and economic data (e.g. Ellen 1988), but not for prehistoric societies based only on archaeological artefacts.

Using some new technologies, such as the methods for recovery of botanical remains archaeologists are able to determine the approximate percentage of subsistence from archaeological fieldwork, such as Zvelebil (1998) using fauna evidence in the southern part of the Baltic basin and in the study in the Hokkaido island in Japan by Crawford (1995). But, it is almost impossible to implement such experiments in every site and every layer in each site as I argued in Chapter 3. Without analysis of botanical remains, it is difficult to establish a connection between the percentages of farming economy and archaeological data if research mainly based on conservative archaeological documents from the past, and some current fieldwork as well, for instance in northeast China. In considering this situation, providing a method for effectively measuring the percentage of subsistence from conservative archaeological data, such as artefacts, is crucial in this thesis.

Thirdly, the percentages marked for three phases in the ZRC model are variable in the actual situation; as Zvelebil (1998:11) suggested, that this model is a heuristic device. For example, in northeast China, the substitution phase starts with different percentage of domesticates in the entire economy. The consolidation phase is referring to a “full dependence on agriculture”(Zvelebil 1998:11). In the ZRC model this percentage is around 50%, but in northeast China it rarely reaches 50% in many areas.

In order to exemplify the difference between the availability and substitution phase, and for this difference to be exemplified by archaeological data, it is necessary to summarise the definition of these two phases in the ZRC model. The first stage, availability, means that the contact between forager and farmer has been established, and through this contact the exchange of materials and information amongst foragers and farmers has occurred (Zvelebil 1986:12). During this contact, the foragers still predominantly rely on a foraging economy. Alternatively, a hunting and gathering society has developed techniques and knowledge about plant domestication according to my modification in Chapter 4. The second, substitution phase, is the period of when farmers move into the territory of foragers, or when the foragers adopt farming without giving up foraging. Apparently, competition between farmers and foragers has occurred. Also, the increasing farming economy inside the forager society competes with traditional foraging (Zvelebil and Rowley-Conwy 1984:105-106).

Between these two phases, the availability phase seems easier to identify than the substitution phase by archaeological data, because straightforward results by archaeological studies usually relate to cultural contact and exchange, which are the important indications of the availability phase in the ZRC model. The first indication of the substitution phase is about “farmer move into the territory of foragers (Zvelebil and Rowley-Conwy (1984:105)”. In this case, archaeological data should be able to provide necessary evidence to refer this movement. Sometimes, the substitution phase may occur without external farmer colonization. In this situation, the second indication, “the increase of farming economy (Zvelebil and Rowley-Conwy (1984:105)”, of the substitution phase becomes significant. Presumably, this increase of farming economy should be constant over a long period in order to reach the level of consolidation phase and to complete the transition process.

Referring to the case studies in northeast China, there is a turning point that farming economy from a low level of plant cultivation (the availability phase) in a quite long period changes to a continual increase (the substitution phase). This turning point is the indication of the beginning of the substitution phase. For example, this turning point was around 7000BP in the Upper Liao River region and around 5500BP in the Lowe Liao River region and Liaodong peninsula (Figure 9-10). It was around 6000BP in the Ji-Chang region and around 4500BP in the Song-Nen plains (Figure 9-11), and 3500BP in the Changbaishan region (Figure 9-12). A consistent increase in the farming economy should be the indicator of the beginning of the substitution phase in each region and a social and political motivation may be behind this consistence of increase in farming economy.

However, if following these dates to determine the beginning of the substitution phase, the actual percentage of farming economy in the beginning of the substitution phase can be expected to vary in different regions as I discussed earlier. For example, this percentage is around 5% in the Upper Liao River and Ji-Chang regions, less than 5% in the Song-Nen plains and Changbaishan mountains, more than 10% in the Lower Liao River region (Figure 9-10, 11, 12).

Moreover, the percentage of farming economy in the beginning of the consolidation phase is around 50% in the ZRC model, which should mean that a farming society should have more than 50% of subsistence depending on farming economy. Therefore, when the proportion of subsistence depending on cultivated plant or domestic crops reaches certain level (around 50% in the ZRC model), as result of this rising proportion, hunter/gatherers finally become farmers. As I stated in Chapter 9, Smith

(2001) has argued that to artificially make a standardised proportion to define farmer it is usually easier to neglect the “middle ground” situation between hunter/gatherers and farmers during the transition process even though in Smith’s diagram “conceptual-developmental map” (Smith 2001:15), farmer has been defined as “contribution of domesticates to annual caloric budget” is around 30% to 50% (2001:15). Therefore, in this case, there is no precise proportion of farming economy to define farmer societies. Also, as the ZRC model is a heuristic device (Zvelebil 1998), this percentage is arbitrary number and should not be seen as a fixed standard.

As I argued in Chapter 9, it is understandable that there usually should be the “middle ground” in many cases of the transition process. The substitution phase in the ZRC model actually is one of the examples describing the “middle ground”. The difference between the ZRC and Smith’s model is the proportion used for determining an agricultural society. This proportion will differ according to different scholars. If we consider three economic categories, such as hunting or herding, fishing, and gathering or farming, the definition of farmer as mainly depending on a farming economy should mean that society has more than 1/3 of farming economy (including herding) compared to other 2/3 shared by hunting and fishing. But if a society has no fishing, the definition of farmer should mean that a farming economy is more than 50% within these two major economic categories. Again, there is no fixed number of economic categories in societies and, there is no precise percentage of farming economy to define farming society. If also considering seasonal changes that people change their economic due to the seasonal changes in the natural resources availability, the percentage of farming economy used to define farming society will become extreme difficult. The transition to farming is a dynamic process, in a regional scale, the direction of transition (ideal, reverse and resistance) finally will determine whether this process is complete, whether hunter/gatherers have become farmers, or remain still in the middle of transition in the middle ground or the substitution phase.

The “middle ground” in the process of transition to farming may be indicated by some societies with similar percentages in each economic category. This similar percentage may be relatively stable depending on social and environmental background. The percentage of farming economy may slightly swing in a small amount between each category due to the specific environment between good and bad seasons. This economy may be called “semi-farming and semi-hunting” (fishing or herding) in social economic terms. For example, in northeast China, some groups belonging to the reverse category in transition process remain in a similar economic situation with a combination of several economic types and they are in the middle ground of transition to farming.

In summary, the difference between the availability and substitution phase is not necessarily divided by the percentage of a farming economy. The beginning of the substitution phase may be in different percentages of the farming economy, between less 5% to more than 10% according to the different dynamic situations. The indication of the beginning of the substitution phase based on the case studies in northeast China is that farming economy begins to consistently increase. Also the percentage of farming economy to define “farmer” may vary depending on different economic styles and some societies may remain in a combination of various economic types and all these types may have similar percentage. These societies may stop in the middle ground of transition to farming for a long time depending their social and political needs.

10.2 ENVIRONMENTS AND ECONOMIES

Economy implied by tool complexes in northeast China reveal three different relations between environments and archaeological cultures. First, multiple economies sometimes coexist within the same archaeological culture. Second, multiple economies may coexist under the same environmental conditions. Third, tree clearance is very likely in relation to agriculture rather than other behaviours.

10.2.1 Different economies within the same culture

A single archaeological culture is usually seen as a set of sharing common features in most components such as settlement patterns, pottery designs, stone tool technologies, burial custom and the way of food procurement. However, from the analysis of tool complexes in northeast China, ancient societies might have a similar material culture such as in pottery design, stone tool technology, but with different way of food procurement or depending on different food types (Zvelebil 1998:14). Such aspects found in the Ji-Chang region have been discussed in Chapter 8. Within the Xituanshan culture, food procurement appeared different, mainly fishing, or hunting, or farming. Another example is in the Liaodong peninsula, within the same archaeological culture, Machengzi I, economic styles appear different between people living in forested mountain slopes in the Machengzi site and coastal environment in the Houwa site. Machengzi is dominated by hunting but Houwa by fishing. This phenomenon implicates the capability of human societies to adopt different environment. The social and political networks and economic strategies both managed by the leaderships in the communities may be behind this adoption.

10.2.2 Different economies in the same environment

Generally, if the environmental conditions were similar, economies would be thought similar as well. But the actual case studies in northeast China has found that different economic styles coexist under similar environmental conditions. For example in the Liaodong peninsular, two different economies, hunting predominant in Santang, gathering combined with hunting and shellfish collecting in Mid Xiaozhushan appeared in the same time and the same coastal environments (see Chapter 6), which may indicate the difference in their social and political needs under the similar environment.

10.2.3 Possible tree clearance

Tree clearance is very likely caused by human activities for agricultural purposes. Tree clearance in relation to agriculture is usually thought as slash and burn farming practice. This farming practice in human prehistoric agriculture has been repeated in many articles in Chinese documents. But, the connection between this speculation and archaeological evidence has not established, particularly the large amount charcoal caused by slash and burn has not been found in archaeological deposits. This requirement has been argued by Rowley-Conwy (1981). However, the charcoal caused by slash and burn might not be found in a residential site because farming fields may be separated from housing village. Most excavations were carried out in village sites, and no agricultural fields have been discovered and excavated in northeast China. So the assumption of slash and burn farming still remain uncertain. Future research in this subject should focus on discoveries in cultivation fields near the village sites to find whether charcoal is present.

10.3 EARLY PLANTATION, CULTIVATION AND AGRICULTURE

In relation to the transition to farming Price et al. (1995) have distinguished the terms domestication and cultivation. As they describe, the origin of agriculture, domestication and cultivation are the two inevitable procedures with a long period of gradual process. Unintentional planting and intentional planting (cultivation) are the differentiation between domestication and cultivation. Domestication might be occasionally result of individual interest, but cultivation would be purposely accomplished with the technology of field preparation, "sowing, harvesting and storing seeds" for the coming season (Price et al. 1995:6).

Through the studies in transition to farming in northeast China I find it is also important to recognise the relationship and difference between early plantation, cultivation and agriculture. In the transition from hunting and gathering to farming involves three different situations: early plantation, including unintentionally and intentionally planting wild plant; cultivation (intentional and with domestic plant) and agriculture, they are related with each other. Early plantation is a process of wild species planting. I use the "early plantation" to emphasise the process of planting wild species in the early stage of transition to farming. Cultivation is a specific process of plantation. Once the early plantation evolves consciously selecting seed, storing it for the coming season and this consciously selecting plantation has led to a biological change in the selected plant, this plantation becomes cultivation. From early plantation to cultivation is a period of domestication. Agriculture is an economic activity involving a relatively large amount of cultivation in domestic crops usually for the purpose of food procurement. In the research of prehistoric economy, these three terms should be clarified.

10.3.1 Early plantation

Presumably, early plantation may start as early as in the Upper Pleistocene. It is difficult to trace the beginning of early plantation in archaeological record. But it is very likely that intentional plantation for food was possibly associated with wild seed gathering and processing. Tools used for wild seed collecting and processing usually are the reaping knife, grinding stone and top stone and these tools can be preserved in the archaeological record. In northeast China, grinding stones, top stones and some microblades stone tools which can be used as a reaping knife are found associated with domestic seeds, such as in the Zhaobaogou and Xinle sites described in Chapter 5. It is very likely that one of the examples of early plantation is the Xiachuan site, since grinding stones were unearthed dated to around 20000BP. Around Xiachuan period, human groups might plant wild species such as the wild ancestor of foxtail millet, harvest and process its seed for food (Shi, Xingbang 2000).

Early plantation is an important period gradually developed in the transition from hunting and gathering to farming even though some early plantation might not be purposely for food production. Early plantation is the prelude to domestication, or initial domestication. Once this plantation becomes an intentional and conscious behaviour, which involves seed selection and preserving, the content of this plantation becomes the process of domestication (Watson 1995:33).

Every human group could develop this plantation and turn this plantation into domestication. But which plant becomes domestic will depend on which wild species was available in local environment. In northeast China, this early plantation could involve the wild ancestor of broomcorn and possibly foxtail millet, soybean and other local species (Shelach 1999:380). This period should be earlier than 8000BP because after that domestic seed emerged in northeast China (Shenyang Administration et al. 1985). This early plantation and late cultivation for local domestic crops could develop local agriculture and northeast China could become a primary agricultural area. However, this process was disturbed by the full development of agricultural economy from north China when agricultural economy intruded into northeast China along with the strong political cultural influence. Through this influence, local domestication might be easily absorbed in to the full development of agriculture.

10.3.2 Cultivation

Following the first sage, early plantation, is the second stage cultivation. The cultivation is a process of plantation with consciously selecting, storing seed. By constantly selecting seeds for planting in next season, cultivation has necessarily led to some biological alternatives occur in the plant. So cultivation is the late period of domestication and continues to make biological changes to plants to complete the domestication process in human prehistory.

Because cultivation is the late period of domestication, presumably, during this period domestic plants have dramatic changes in biological features, such as enlarging seed size, reducing growing and maturing time, increasing capability to survive in extreme climate. Rice with two species: *O. japonica* (*jing* in ancient Chinese) and *O. indica* (x*ian* in ancient Chinese), for example, are very likely domesticated from the same wild ancestor. During early plantation and cultivation they are separated, one *Indica* growing in warm climate as wild ancestor but another *O. japonica* extended into north region of China, where the wild ancestor cannot survive. Cultivation in northeast China was disturbed and absorbed by the expansion of well developed agriculture from north China.

10.3.3 Agriculture

Agriculture is a developed stage of cultivation in a large amount and maintained by social organization in society (Price et al. 1995:6). Early plantation and cultivation cannot be seen as an agricultural economy. In archaeological discoveries, a few domestic seeds may only suggest small amount of cultivation. This small amount of cultivation may serve as subordinate food addition to major food resources such as fish, animal meat in hunting and gathering society.

Besides the large amount of domestic plant cultivation and social organizational maintaining, agriculture usually not only involves a single crop. Referring to the need of food supply and different local farming conditions, a variety of crops is involved in an agricultural economy. In the secondary agricultural region, among these crops, some may come from previous farming societies in adjacent areas, and some may continue to be developed from local domestic plants. In northeast China, for example, broomcorn and foxtail millet and soybean might continue to become more important while the same crops and rice farming extended into this region.

10.4 TRANSITION PROCESS BETWEEN PRIMARY AND SECONDARY AREAS

There is a difference in the process of transition from hunting and gathering to agriculture in the primary and secondary agricultural areas. This research has found in the primary agricultural area, such as in north China, this process is charactered with a natural, gradual and more internal process agricultural area whereas this process is charactered as a deliberate, sudden and more intrusive process interaction combined with internal process in the secondary agricultural area, such as in northeast China. In addition, there are perhaps fewer differences in economies once agricultural transition has reached the consolidation phase in the primary agricultural areas. On contrary, economic types are usually various and these different economies sometimes coexisted in the same period, same area, same environment and within the same culture in the secondary agricultural area. This may be caused by the different level in the development of social complexity, which appeared variety of social and political needs.

10.4.1 The process of transition in the primary agricultural area

Through the baseline study for my tool complex analysis in Chapter 3, agricultural development in a primary region is likely to be a natural, gradual and more internal process if considering the beginning of this process from plantation of wild species. For example, in the Diaotonghuan and Xianrendong sites, wild rice increased in the period of between 17000 to 14000BP. And then domestic rice appeared around 14000 to 10000BP (Zhang, Chi 2000). It is very likely that around 17000 BP, early plantation of wild rice occurred and this plantation was for the purpose of food supply. This plantation continued for at least 3000 years until domestic rice appeared. This plantation lasted for 3000 years or even more than 3000 years because the beginning of early plantation could be earlier than 17000BP. This first stage of transition to agriculture was natural and gradual. Similarly, the second stage of cultivation starts from 14000BP but the full developed rice agriculture was around 8-9000BP such as in the Jiahu period (Henan Wenyansuo 1999). In this case, the availability phase starts around 14000BP and the substitution phase did not happen until 9000BP. It took around 5000 years to develop agriculture from domestic rice cultivation, and more than 8000 years from wild rice plantation to rice agriculture. The time span of this

8000 years also covers the first two phases of availability and substitution in the ZRC model of transition from hunting and gathering to agriculture.

The transition to agriculture in a primary area is also an internal process through interaction between social and political needs of societies and environmental availability because the development of plantation, cultivation and agriculture basically associates with the improvement of planting, domesticating, harvesting, processing and storing technology and knowledge and community needs inside society. For instance, from Xianrendong to Jiahu, agricultural development seems not the effect from other society. Through repeatedly planting wild rice, the Xianrendong societies accumulated the knowledge of plant growth, climate, seasons, developed planting, harvesting and storing techniques. This development is more like internal rather than adopting from others because there was no other farming community before the Xianrendong societies. The transition to rice agriculture is very likely to be the result of interaction between social needs of Xianrendong society and local environment. Local resources have provided wild species for rice plantation and domestication.

10.4.2 The process of transition to agriculture in secondary area

The transition to agriculture in the secondary area, such as in northeast China, is unlikely to be a natural process. In the case studies of northeast China, this process occurs relatively faster and shorter than the primary area, particularly in the substitution phase. For example in northeast China, the process of transition to agriculture usually is less than 2000 years. In the example of the Liaodong Xiaozhushan-Dazuizi pattern in Chapter 6, from the beginning of agricultural adoption around 5500BP to full developed agricultural society (the consolidation phase) around 5000BP, only took 500 years (the substitution phase).

Apart from internal social needs (Lei, Xinwei 2003), the reason for this transition process being faster and shorter is possible the strong cultural, political and economic interaction from farming societies particularly in the late period around 3-2000BP. Transition to agriculture in this period is the one of the results of interaction between farming and foraging, or between two farming societies. Within this transition process, the interaction between foraging human groups and their local environments is subordinate compared to the interaction. Around 2-3000BP, in northeast China, this process is charactered by strong social and political needs combined with interregional interactions, and sometimes even military occupation or invasion, from north China. These interactions and occupation or invasion are associated with farming economies.

10.5 ABOUT TOOL COMPLEX ANALYSIS

The method of tool complex analysis used in the case studies in northeast China is useful and practicable. In northeast China, not many faunal or floral data are available. The only one can be used for demonstration is found in the Zuojiashan sites in the Ji-Chang region. Faunal data in this site shows around 70% wild animals and less than 2% fishing. These percentages have been reflected in the tool complex with more than 60% of hunting tools and around 4% fishing tools (Figure 7-28). Similar result is also found in the Yuanbaogou site (Figure 7-29). This similarity in faunal data and tool complex has met the basic enquiry in the study of economic style, which means that the pattern of tool complex used in this thesis should approximately reflect economic style in prehistoric societies. From this point, the method of tool complex analysis is reliable.

Generally, a reliable tool complex analysis should result from a reliable tool function category and this category should be based on usewear and residue analysis. But residue analysis is basically absent in northeast China. I have used the indirect reference from Jomon tool categories because residue analysis has been carried out in Jomon research where there are also botanic remains recoveries as I discussed in Chapter 3. The residue and botanic analysis should make the tool category more reliable than that currently using eyeballing identification in most research in northeast China. However, in order to achieve reliable result from tool complex analysis, direct residue analysis is required.

Tool complex analysis provided in this thesis reveals its advantages. First, this method has led to the traditional archaeological data becoming useful and playing an important role in economic investigation. Particularly in Chinese documents, artefacts, including tools are usually recorded relatively completely. This record contains complex descriptions about shape and size. All these data have provided important data for tool categorizing and complex analysis. Even though without direct reference of residue analysis, tool complex analysis can be used if with the reference from nearby region, such in Jomon archaeology in Japan.

Second, tool complex analysis has provided an effective and practicable method for the study of prehistoric economic style even sometimes without the direct reference of botanic remains. Using tool complex analysis, archaeological data (particularly the artefacts usually found by naked eye) can be transferred into a numeric table of economic data. This economic data makes the study of prehistoric economy become possible. The study of prehistoric economy may not only include research of transition to farming but also include other studies involving economic investigation. However, tool complex analysis combining with the investigation of botanic and faunal remains is a better method in prehistoric economic study.

Moreover, the method of tool complex analysis used in this thesis demonstrates the effective way of tracing prehistoric economic information from common archaeological data. As discussed earlier, the study in prehistoric economy is usually based on faunal and floral remains preserved in deposit, artefacts and human body. To acquire this information requires relatively high technology, expensive equipment and slow process. Some scholars attempt to establish prehistoric economic models by analysing the economic system of modern ethnic groups. But sometimes the basic parameters for measuring economic style are impracticable. For instance, Smith (2001) and Ellen (1988) used caloric budgets to indicate the proportion of food depending on domesticates. This parameter of caloric budgets is not very difficult to collect from modern ethnic groups because they are living societies. However, it seems impossible to acquire such caloric budgets from societies which have disappeared for thousands of years. For such prehistoric societies, to acquire economic information from debris, such as deposit layers, fragment of ceramics and burials, tool complex analysis is one alternative from faunal and floral analysis. Combining floral and faunal with tool complex analysis will result in economic analysis being fairly accurate. I am expecting that this method can be applied to other regions in the world, to analyse the prehistoric economy and to be tested through the analysis.

10.6 SUGGESTIONS

This thesis has studied the transition to farming in northeast China. Based on the economic patterns derived from the tool complexes of archaeological data, this study has argued that the ZRC model is applicable in northeast China, and also generated the three trends model as a supplement to it. As a new method, tool complex analysis should be tested in living foraging communities and some ethnic groups remaining in middle ground of transition to farming from anthropological data. Moreover, since this thesis is basically restricted to grain agriculture, a study focusing on livestock, domestic animals may be needed in future. Furthermore, this thesis is focusing on a large scale of transition process and mainly relying on cultural base. Some horizons and traditions are still not well defined in local archaeology. So future studies may focus on the transition process occurring in each horizon and tradition in a small region. In addition, future study may also need to focus on individual species such as millet or rice, to trace its process of domestication, cultivation and adoption. Or a study focuses on specific species of domestic animal, to find the process of domestication, adoption and diffusion in northeast China.

10.6.1 The study in present ethnic group using tool complex analysis

The method of tool complex analysis provided in this thesis should also be tested by the evidence from ethnography. Tools used by present ethnic groups, particularly the people remaining in hunting and gathering, low levels of food production and traditional ways of agriculture, can be identified and categorised into different groups, such as hunting, fishing, gathering and woodcutting used in this thesis. This identification can be based on the actual usage in daily life in these groups and should also be compared to the results of microscopic usewear analysis.

Based on these results of tool identification and a database of toll complexes and economic style can be established. Then comparing this economic style to the actual economic style in daily life will generate a result indicating the validity of the tool complex analysis used in my thesis in archaeological study. In relation to my research area the living hunting and gathering groups should be chosen from the indigenous people living in or near northeast Asia. There are many hunting, fishing, herding and gathering ethnic groups in northeast Asia and nearby area, and more than four different ethnic groups depending on hunting and gathering, herding, fishing economy in northeast China alone. I expect this study of present ethnic groups will make tool complex analysis more reliable to retrieve economic information from archaeological data.

10.6.2 The study on transition to animal farming

The availability of data in Chinese documents, which usually provide no descriptions about faunal remains in excavation reports, leads to this thesis being restricted to the farming economy mainly with grains. This has limited the research coverage. Chinese archaeologists, particularly the local scholars, do not usually collect faunal data during excavations. Some faunal remains such as animal bones which were fortunately collected from field sometimes have been abandoned due to the difficulty of preserving or lack of funding to process examination. So the accumulation of faunal and floral remains should be emphasised during fieldwork in northeast China. A future study in the transition to animal farming based on this faunal data would be an expansion of this thesis.

As a part of research into the transition to farming, animal herding is important. It is a supplement of studying crop farming. In this future research, several subjects will also be generated, such as the relationship between farming based on grains and farming based on domestic animals, and the reflection to a variety of environmental conditions and cultural or political influences. The reason and process of separation in economic styles between crop farming for farmers and animal herding for pastoralists are significant objects in the study on the transition to farming in northeast China, as well as other parts of the world.

10.6.3 The study based on a cultural system or one culture

In this thesis, I am intentionally studying the transition process in several complete cultural systems. Some relatively complete cultural systems such as the Xinglongwa-Hongshan system in the Upper Liao River, Xiaozhushan-Dazuizi in the Liaodong peninsula, Xiaolaha-Baijinbao in the Song-Nen plains and Sopohang in the Changbaishan region, are all assumed to be complete. But each of these cultural systems is not complete, and still in the situation of definition waiting for new data to fill the gaps. For example, from the Xiaoheyan culture in the Upper Liao River region, cultural changes according to the artefacts cannot easily be connected with the next period, the Lower Xiajiadian culture. There is a gap between these two cultures within the Xinglongwa-Hongshan cultural system. This gap very likely affects the result of the study in the transition to farming in this thesis.

Another example is the Sopohang cultural system in the Changbaishan region. During the early periods of the Sopohang cultural system, tool data is not available. For the analysis of economic styles based on tool complexes, I have to use the tool complexes derived from Zhenxing-Boisman cultural system. Such using tool complexes derived from two cultural systems to construct one complete transition process must have made this study less accurate. A future study based on individual culture and cultural system is necessary in order to trace the economic styles and generate a transition pattern in each system, and to compare each transition process between related cultural systems such as Sopohang and Zhenxing-Boisman, to find the relationship in the transition to farming between these two systems.

Further more, this thesis is not able to study the transition to farming in one culture. In northeast China, there is no relatively complete data for a development process within a single archaeological culture. For instance, the Hongshan culture continued to exist for 1500 years. Its material culture complex should show some changes, which illustrate the development and changes of this culture. However, these data are not available due to the current situation in the research on this culture. The study on the transition to farming within the Hongshan culture requires sufficient data of tool complexes in each period and each location, and sometimes even in each level of deposit in one site. The research on the transition to farming within one culture is also waiting for further study based on future data.

10.6.4 The study on an individual species

Apart from the culture and cultural system, another further study of individual species in relation to the study on the transition to farming is necessary. This thesis uses some occasional discoveries of crops, which involve only several species such as broomcorn millet, foxtail millet, rice, sorghum, soybean, wheat and hemp. There is no complete data set which reflects the whole process of domestication and cultivation in one species of crop. How each species was adopted or domesticated in northeast China is unknown. For these crops, as well as each livestock, the process of adoption or domestication and cultivation or husbandry for each species should reveals a relatively clear process in the transition to farming in northeast China.

Moreover, the process of adoption and domestication may also reflect a relationship between different groups of early human societies and possible trading between them. For example, some species such as soybean and hemp may be domesticated first in north and northeast China or nearby areas, and some may be adopted from out of this area, such as wheat and rice. The same process of domestication in crops is also applicable to the process of animal domestication. For instance, pig was thought to be domesticated as early as 8000BP first in north China, then diffused into northeast China. But there is no biological study to indicate the same species of pig is found both in north and northeast China. So pig might also be domesticated locally since there are wild species of pig widely distributed in northeast China. To answer this question requires future study on each species and the position of each species on the process of the transition to farming.

Rice perhaps is the one species that has drawn more attention in the study related to the transition to farming in East Asia during the last two decades. The study on rice has drawn an outline of the process of domestication from wild species, including the initial cultivation in the Yangtze River region in China and possible expansion route from China to Japan based on the microbiological analysis and cross cultural studies (Yoshinori 2002). However, as one of the routes of rice agriculture expansion to Japan, there are many gaps and questions need to be filled and answered. For example, the Liaodong and Korean peninsula are assumed to be a terrestrial route for rice agriculture to extend to Japan around 3000BP. But the data in relation to this is sketchy, for rice is found in only one site in Liaodong, Dazuizi and in a few sites in Korean peninsula. Besides there are only a few grains found in South Korea that have been precisely examined and AMS dated (Crawford and Lee 2003), and most rice grains found in northeast China and the Koran peninsula are without microscopic identification and AMS dating. The precise species and dates are the necessary evidence for tracing rice agriculture expansion through the Liaodong and Korean peninsulas into Japan. Therefore, future study on an individual species rice, on its process of adoption in the Liaodong peninsula from north China, is significant not only for the study on the transition to farming in northeast China but also in northeast Asia as a whole.

In conclusion, future study on the transition to farming in northeast China should include a variety of disciplines involving various research projects, such as the process of plant and animal domestication or crops and livestock adoption in the microbiological perspective, and different processes of the domestication or adoption within one culture or cultural system geographically and temporally. Economic and political studies on the indigenous population in northeast Asia and northeast China should also be included. As a part of northeast Asia, the study on the transition to farming in northeast China is just beginning. As a preliminary research, this thesis prospects the future multi-disciplinary studies in northeast China and northeast Asia which should involve many international collaborative teams.