PLUREL

Governance and Planning Scenarios

Module 3

November 2008

PERI-URBAN LAND USE RELATIONSHIPS – STRATEGIES AND SUSTAINABILITY ASSESSMENT TOOLS FOR URBAN-RURAL LINKAGES, INTEGRATED PROJECT, CONTRACT NO. 036921

D3.3.7

Analysis of regional spatial planning and decision making strategies and their impact on land use in the urban fringe

Hangzhou case study

Yang Jianjun, He Youjoun, Stephan Pauleit* (TUM), Martin Spiekermann, Irene Burkhardt

*Responsible partner and corresponding author
Tel: +49 (0)8161 71 4781; Email: pauleit@wzw.tum.de

Document status:

Draft:	completed
Submitted for internal review:	completed
Revised based on comments given by internal reviewers:	completed
Final, submitted to EC:	completed

SIXTH FRAMEWORK PROGRAMME

Contents

PLUREL

Abstract

This report presents the results from a study of the geographical, socio-economical and political situation of urban, peri-urban and rural parts of Hangzhou. The main issue of the Hangzhou case study is the process of extremely rapid and large scale urban development, and the challenges this brings to the planning and management of peri-urban areas.

- The study of urban development processes in Hangzhou in chapter 1 provided an overview over the land use history, three important turning points and recent trends of urban development. Hangzhou is an outstanding case in the PLUREL project as it is characterised by extreme urbanisation rates, with large, and dynamically evolving peri-urban areas.
- Planning is therefore dominated by an urban perspective. Peri-urban areas are recognised as an issue, and great efforts have been made, e.g. the formulation of specific policies to deal with these areas. The elaborate planning system (chapter 2) has a range of tools to deal with urban development. These include plans at different levels, both comprehensive and sectoral, the land acquisition, auction and compensation system, and regulations such as ten criteria for commercial land use. Fulfilment of the criteria rewards the developer/ owner of the enterprise with tax rebates. The criteria include, on the one hand, requirements for intensive land use (e.g. density of GDP and of overall investment in Yuan per km^2 floorspace), and on the other hand environmental standards.
- Three political discourses for urban development were identified: “land-use efficiency”, “social harmony” and “ecological city”. These are the official discourses expressed, e.g. in planning documents.

Three study areas were chosen in order to highlight different approaches to respond to the challenges of peri-urbanisation. The three case studies (chapter 3) show different strategies dealing with rural-urban relationships in peri-urban areas. Binjiang is an example for a large scale urban area. The aim is to create a new urban district which is largely self-contained in terms of functions and facilities. In terms of developing dynamics, it is a government approach, e.g. to build administrative and business office buildings and factories, based on an integrated plan. Xixi is an attempt to combine residential development with nature restoration of a wetland. In terms of developing dynamics, the role of the government is mainly to restore and protect the wetland park, and to arrange residents which were moved out from the park. Before the government's protecting action, land agents had developed much residential houses around this area.. Finally, the Zhuantang area stands for the combination of tourism, small scale urban development, farming and landscape protection. Main features of these different planning strategies are presented and discussed in the report.

Critical issues could also be noted. Questions discussed between the European and the Chinese case study partners centred around

- the spatial scale of development and the difficulties this may bring to develop a well-functioning city with high quality of life for its residents.
- Importantly, low consideration appears to be given to integration of agriculture in urban development.
- The integration of the former farmers into the social fabric of the new city is an issue in all three case study areas.

Introduction

Objectives of PLUREL case studies
This report is one of the PLUREL case study reports on 'Governance and Spatial Planning Strategies' in six European urban regions: Warsaw, Montpellier, Manchester, Leipzig, Koper and Haaglanden. An outside comparison is also made to Hangzhou, China which is the focus of this report. Each of the research teams in cooperation with regional authorities have studied the unique governance and planning strategies in their region. As well as the official policies, their results and outcomes, and the influence of a wider range of actors have been analyzed.

This analysis forms the basis for an assessment of the different regional strategies in terms of their physical, political, social and economic structures and dynamics. The case studies are being used by other Modules of the PLUREL project, to inform the modelling and policy analysis. Finally the different strategies and their assessment will be disseminated through good practice guidance handbooks and workshops in 2010.

Urban fringe land use issues
In order to bring in real-world experience to the Module 3 research, the regional stakeholders in each of the case studies identified four major issues related to land use:

- land pressure due to housing and business development in the urban fringe
- agriculture in the urban fringe under pressure
- high value nature areas in the urban fringe at risk
- integration of leisure and tourism activity in the urban fringe

Strategies: about actors and their means of influence
The many actors - policy makers and other stakeholders – respond to these issues not only through formal policies but through coalitions, resources, rules and discourses. The focus on 'strategies' includes this wider view of 'a deliberate course of actions that an actor has made/makes, comprising a succession of decisions and actions to achieve goals, objectives'. The strategies identified in the case study reports concern governance and spatial planning – including for instance the patrimonial structure of farming in France, the experiments in partnerships in the UK, or the re-invention of Warsaw as a global city.

Methodology and content based on a Joint Analytical Framework
The case study work follows a common 'Joint Analytical Framework' (JAF) that was developed on the basis of research proposals from the national research teams and consultations. The report first describes the urban region, following the boundaries of the administrative unit concerned. (Stadsgewest, Agglomération, etc.). It summarizes the land use history, the actual land use situation and major strategic issues for each of the case study regions. Second, the official government and spatial planning system is described. A third chapter describes a number of planning and governance strategies in more detail, uncovering the interactions between the different actors involved, what matters to them, and how they influence the urban rural interactions and the fringe. For some strategies this might be done ex-ante, for other ex-post. The effects in terms of sustainable development of the urban fringe is the subject of the second round of case study reports and developed in cooperation with the other PLUREL modules. In the case of Hangzhou this is done within three study areas.

Definition of the urban fringe
A central notion to the concept of 'urban fringe' is the location in the periphery of the built-up urban area. The wording 'peri-urban area', of French origin (*peri-urbain*) can also be used. It can be either an area that at the outer limits (seen from the urban perspective, motivating the word 'fringe') extends into larger (open land) arable or green areas, as in Warsaw, Koper and

Hangzhou; or it can also expand into the urban fabric of a new city or agglomeration, such as in Haaglanden, Manchester or Leipzig. This definition of the urban fringe is a spatial physical definition that is workable for all case study areas. The functional definition of a 'rural-urban region' can be based on employment patterns or a one-hour journey time from urban centres. For more densely populated areas of Europe the fringe territory can then extend right across larger agglomerations.

There are several dynamics, i.e. developments resulting from the urban influence, that especially characterize the urban fringe in economic, social terms but also environmental terms:

- recreational initiatives and land uses by urban dwellers;
- increased traffic flows to and from the urban area;
- overflow of urban uses and infrastructure that are incompatible with high density residence because of air pollution, noise, safety risks, or planned outside the urban area because of lower land prices, such as water storage, car dumpsites, waste disposal, residence of urban workers or urban rich, motor cross sites.

A distinctive feature is that the urban fringe is not considered by its own intrinsic values but merely as a solution to urban problems and as a cheap source of land. At times it is seen as a location of great contrasts, housing both very wealthy and very deprived communities. PLUREL was financed by the European Commission because several FP5 research projects requested attention for the urban fringe as an area with specific qualities and issues and often divided over several administrative areas. The case studies research the attempts of 6 European regions in the sustainable development of their urban fringes and they identify a new kind of policy agenda.

Responses to the urban fringe agenda

Ideally the urban fringe should become an area of high quality with a more independent role than only that of a spill over area. Past attempts to draw a juridical line between the urban areas and their green surroundings - like by the former Dutch Minister for Housing and Spatial Development, Jan Pronk - can be seen as an effort to realize this and to contain for instance the financial pressure of urban land markets. There are various possible approaches: to assign the fringe and green infrastructure the status of a municipality, or to assign land ownership and stewardship to a community land trust.

More sustainable development of the urban fringe into an area of high quality environment that serves the residents of both urban, fringe and rural areas is a concern of all regional authorities involved in PLUREL - the governance forms and spatial planning strategies contributing to this are in the focus of the following case study.

Chapter 1: Land-use and spatial development in Hangzhou and their turning points

1.1 Introduction

Hangzhou is the political, economic, scientific and cultural centre of Zhejiang province, and second only to Shanghai in the Yangtze delta in Southeastern China (Fig. 1). The whole region is densely populated and along with the Pearl River Delta (Hongkong-Guangzhou-Shenzhen) and the Beijing-Tianjin-Tangshan agglomeration is one of China´s three economic powerhouses.

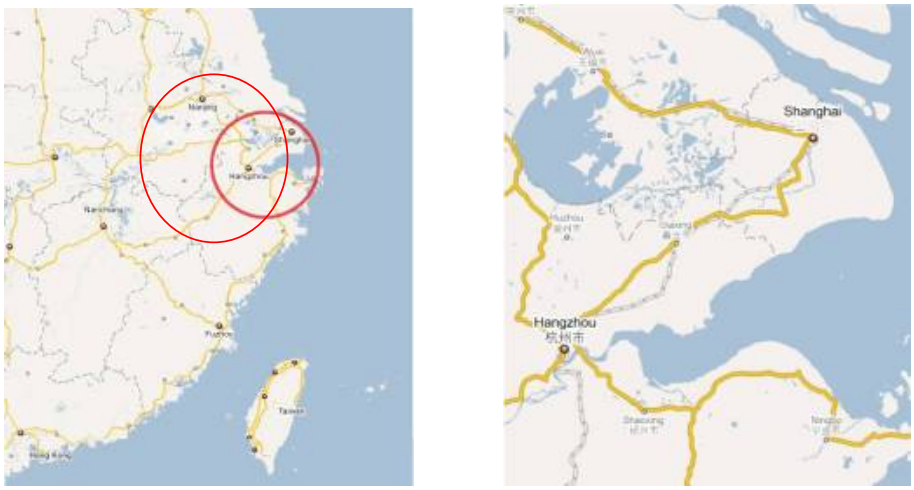


Fig. 1: Hangzhou, situated in the Yangtze Delta in South-eastern China

Hangzhou municipality covers a total area of 16,596 square kilometres (Fig. 2). In 2005, it had a population of 6.60 million. In European terms, the city area would be rather described as a region due to its size, yet politically organised in a more hierarchical way (see chapter 2). The area of Hangzhou City proper covers 3,068 km² with a population of 4.10million registered urban residents in 2005 (Hangzhou Statistical Yearbook 2005). The population density is 398 inhabitants per km² in Hangzhou municipality and 1335 inhabitants/km² in the city proper. In 2005, Hangzhou City's built-up area covered 314.45 km² with population of 2.52million and a density of 8004 inhabitants per km².(Hangzhou Construction Yearbook 2006).

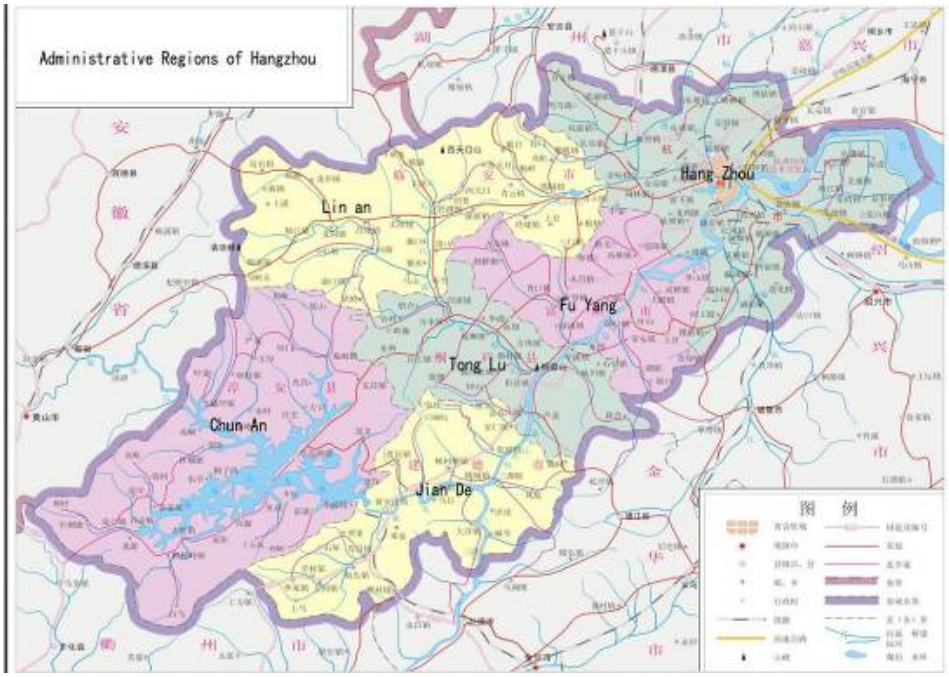


Fig. 2: Administrative units of Hangzhou municipality (source: Hangzhou Statistical Yearbook 2005)

The urban centre of Hangzhou is located at the lower reaches of the Qiantang River at Hangzhou Bay in the southern part of the Yangtze River Delta, and at the southern end of the Beijing-Hangzhou Grand Canal. The north-western and south-western part of Hangzhou is a mountain region with woodlands and more or less small scale agriculture. The north-eastern and south-eastern parts of Hangzhou are situated in the densely populated fertile north plain of Zhejiang, which boasts as a country of fish and the region's breadbasket. It is characterized by a dense network of streams and rivers. Of the total area of the municipality, hills and mountains take up 65.6%, the plain 26.4%, streams, rivers, lakes and reservoirs 8% (Hangzhou Statistcal Yearbook 2005).

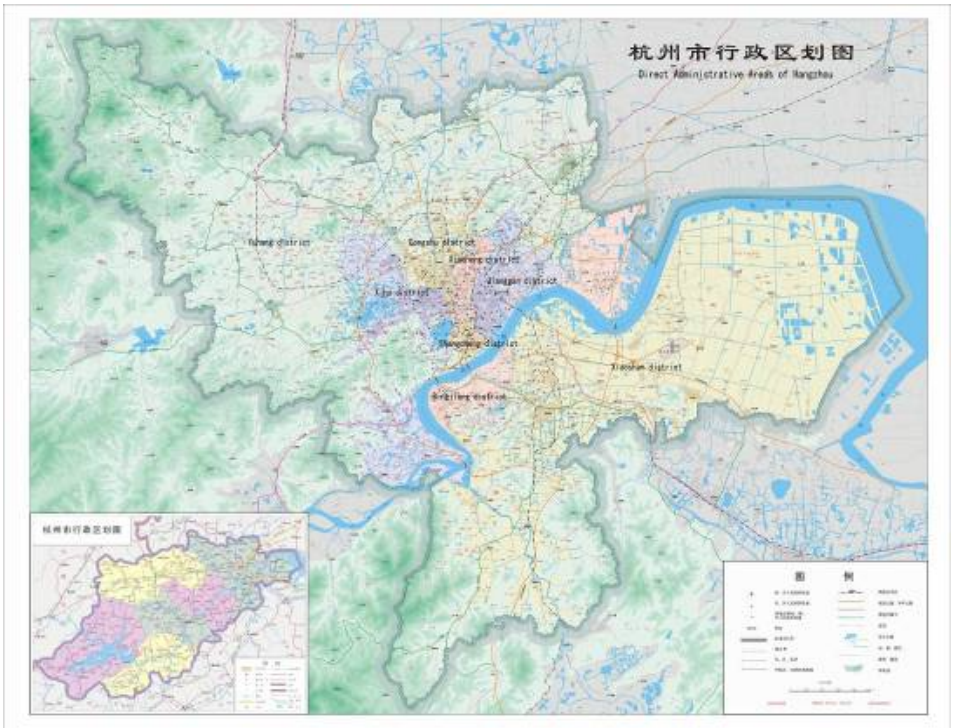


Fig. 3: The eight Direct Administrative Districts of Hangzhou city (source: Hangzhou Statistcal Yearbook 2005)

1.2 Brief history of land use (from foundation -1900)

The following account of the historical urbanisation and land use process in Hangzhou gives some basic information of a place unfamiliar to many Europeans and different in terms of cultural, political and socio-economic background.

The city of Hangzhou is listed as one of the seven ancient capitals of China. It was founded in 222 B.C. when the Qin Kingdom unified China into the Qin Empire. The Sui Dynasty (from 580 - 618) and the Tang Dynasty (from 618-907) were critical transition phases for the city in various aspects such as politics, economy, culture, etc. (Fig 3). Before the Sui Dynasty seized power various waterways had already been excavated in the coastal plains. During the Sui Dynasty the Grand Canal, 1,764km in length, running from Hangzhou in the south to Beijing in the north of China was linked together to form the largest man made waterway ever been built. It contributed greatly to the thriving of the Chinese economy for many centuries. During the Tang Dynasty the West Lake was transformed into the famous landmark preserved until today.

Hangzhou became the capital city during the Wuyue Kingdom (from 907-978). Named Xi-fu or Xidu, Hangzhou was repeatedly chosen as the capital of kingdoms and empires. Under the reign of Qian Liu, Hangzhou prospered economically and developed its own regional culture that continues to this day.

Driven by large-scale projects, urban planning and dynamical political influence, the urban area of Hangzhou had expanded during the 20 years in Wuyue Kingdom, which has now become the urban core of Hangzhou. The physical legacy of the Wuyue Kingdom was the creation of the system of canals and dikes which turned Hangzhou into the richest region in

agricultural terms of China for many centuries.

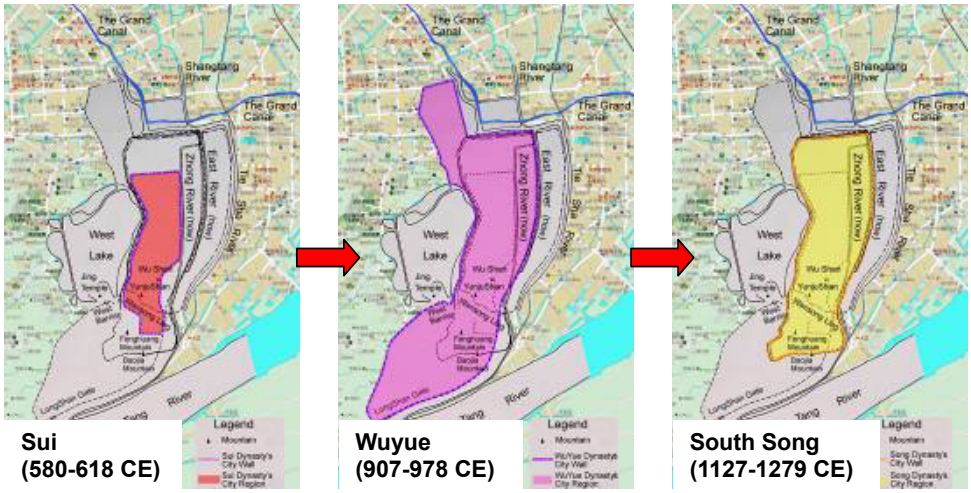


Fig. 4: Urban expansion of Hangzhou during Sui — Wuyue — South Song dynasty (source: Que Wei-min, 2001.)

During the Southern Song Dynasty (from 1127-1279), Hangzhou again became capital city. In this splendid period, economy, culture and urban construction were at their height throughout the history of Hangzhou. The population increased from around 200,000 in the year 1100 to approximately 450,000 by 1170. It is estimated that there were well over one million inhabitants by 1276, making it the most populous city in the world at the time (Needham, 1986). Almost no trace of this golden era has survived to present times as natural and man-made disasters destroyed large sections of the city between 1132 and 1275.

In the Yuan Dynasty (from 1279-1368) Hangzhou lost the status as capital city but still flourished in terms of economy and culture. It is the time when Italian Marco Polo visited the city and praised its splendour and vibrant commercial life. At that time, the city name changed from Lin'an to Hangzhou. The following Ming Dynasty (1368-1644) was a period of decline, when among other things the harbour slowly silted up.

In the Qing Dynasty (1644-1912), there were some marked changes in the layout of Hangzhou's districts: an inner military city was built for Ba Qi Jun - the army of 8 banners- and their families, which was called the Camp of 8 Banners. The city prospered during this time and population and urban land grew rapidly (figure 4).

During the Ming and Qing dynasties Hangzhou continued to prosper from its local industries, especially silk weaving, and it became the silk centre for all of China. The Qing dynasty ended finally for Hangzhou during the revolution of 1911, when the city was conquered by Chiang Kai-shek.

1.3 Land-use development in contemporary times (1900-2007)

From 1900 to 1949
When the rule of Qing Dynasty came to its end, the city walls as well as the military barracks were successively demolished for the expansion of the city, including parks and roads. Hangzhou widely lost economic status to Shanghai with its foreign stakes in the 1920s. During the times of internal warfare whole sections of the city were destroyed. *(*Van Dijk, and Moss, 2006*)*. Nevertheless Hangzhou still experienced considerable growth. From Figures 5 and 6, it can be clearly seen that the city of Hangzhou spread outwards along the Grand Canal to the south and the north.

Fig. 5: Hangzhou City, October 1913 (left) and 1932 (right) (source: Que Wei-min, 2001)

From 1909 to 1914, the railway lines of Shanghai-Hangzhou and Hangzhou-Ningbo had been successively built. In 1937, the Qiantang River Bridge was completed, turning Hangzhou into the transportation hub of Zhejiang province. Hangzhou also became a well-known scenic city which attracted large numbers of visitors.

From 1949-1978

After the foundation of the People's Republic of China, internal warfare came to an end. The social situation and the economy underwent fundamental changes. The scale of industrial production rapidly increased. Several large industrial zones were built then in the peri-urban area of the city.

As the new industrial zones were only several kilometres away from the built-up urban area, most of these zones were by and by connected with the city core, either due to the spatial expansion of the city or because of the centripetal development of industrial zones. As a result, the spatial structure of the city became more and more complex (Figures 6 and 7).

Fig. 6: Map of Hangzhou City, 1949 (source: Que Wei-min, 2001)

Fig. 7: Map of industry distribution in Hangzhou, 1983 (source: Hangzhou Municipal Government:Master plan,,May 1983)

From 1978 until 2001.

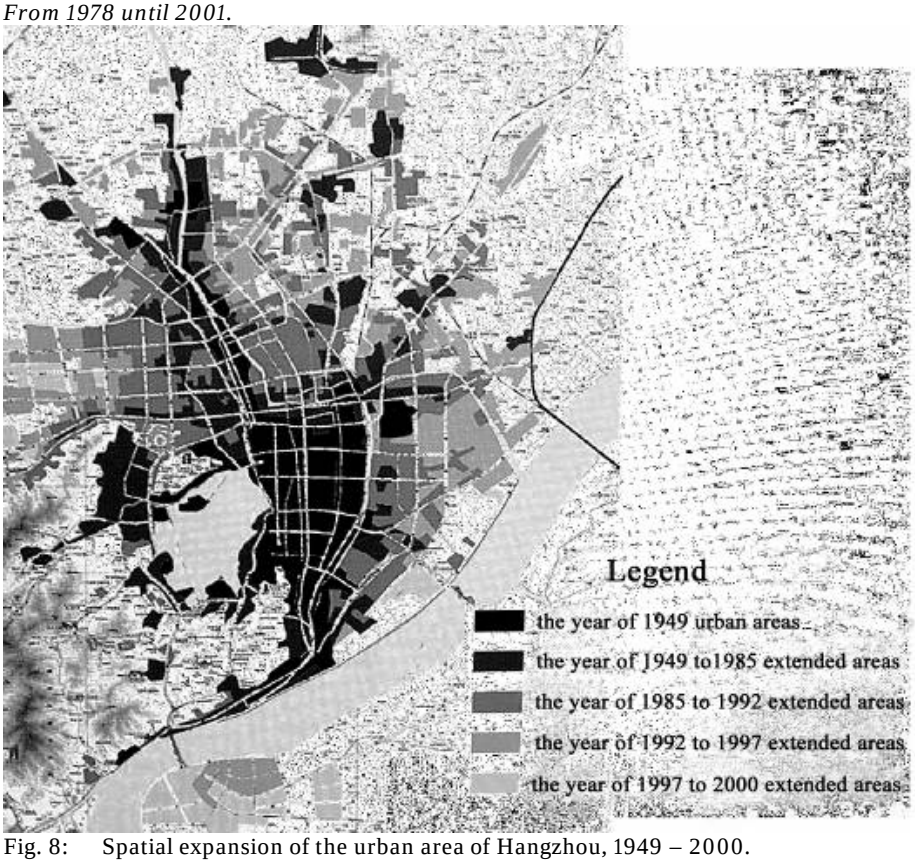


Fig. 8: Spatial expansion of the urban area of Hangzhou, 1949 – 2000.

The Chinese economic reform known as "Socialism with Chinese characteristics" was introduced in 1978. While the state maintained ownership of a large fraction of the Chinese economy, the market was opened to private parties. As a consequence, both urban and rural areas in Hangzhou experienced rapid development from 1978 to the early 1990s and the city sprawled outwards (figure 8). The effects of quick expansion led to an imbalanced urban spatial structure and put farmland under pressure. In order to control this undesirable development strategic spatial plans were developed (see chapter 2) .

Recent urban development status and trends (after 2001).
Between 2001–2005, the non-agricultural population in Hangzhou City increased from 1.93 million to 2.46 million and its proportion of the total population rose from 50.9% to 60.0% (Hangzhou Statisical Yearbook 2005). The population of the entire municipality grew on average by 1.7% between 1990-2000 (Webster et al. 2003, see also table 1 2002-2006). Most of the population increase has been located in the urban core (figure 9) where the annual average growth rate was 5.2%. According to Prof. Yao from Zhejiang University (oral comm., 18/08/07), the population of the city proper is currently 4.4 million. It is expected to peak in 2030 when it will have reached a population of 6.7 million (note: these figures refer to the eight districts of Hangzhou city -the "urban core, and "inner-peri-urban" areas in figure 9).

On the other hand, the peri-urban areas had a slower growth rate while the rural areas of the municipality even lost population. Migrants are 22% of the population. They have no residential status according to the hukou registration system (Webster et al. 2003). Migrants-

to-local ratios can be much higher in highly favoured localities (see figures in chapter 3 for Xixi and Binjiang).

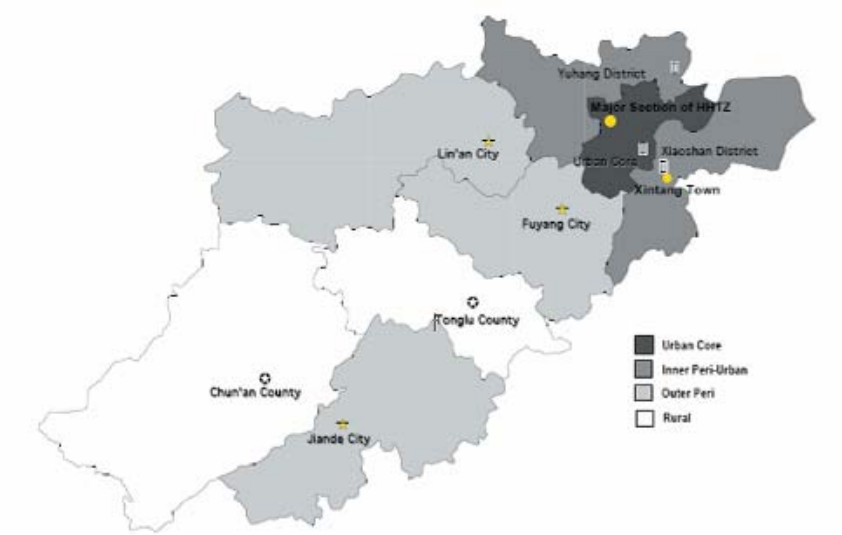


Fig. 9: Administrative units of Hangzhou municipality according to urban, peri-urban and rural zones (source: Webster et al. ,2003). See chapter 1.5 for an explanation of the criteria used for allocation of the administrative units to the urban – rural classes.

Urban growth has been driven by strong economic development. Hangzhou's GDP increased in the period of the 10th Five-Year Plan between 2001 and 2005 by 13.6% per year. In 2005, the per capita GDP of Hangzhou exceeded US$5,000 (Leman 2005). The annual growth rate was 1.7% higher than the respective figure in the period of the ninth Five-Year Plan and 3.6% higher than the target proposed by the Tenth Five-Year Plan. The economic growth rate was 4.8 and 0.8 percentage points above the average growth rate of the nation and the province, respectively.

Webster et al. (2003) call the current economic development the third stage of the Hangzhou region since the reforms from the 1980s. It is characterised by maturation driven by increasing competition with emerging clusters/ enterprise zones in other areas where labour and land is cheaper; price pressures from buyers; the response of the firms to these pressures in trying to move up the production chain (higher quality products); a strong decline of the agricultural sector; and demographic changes.

Population growth and land use change has been strongest in the urban core and the inner peri-urban area (i.e. close to the city proper) of Hangzhou municipality (Webster et al., 2003). The satellite images in figure 10 give an impression of the speed and scale of change in the core area of Hangzhou city within the short period of 10 years. The development of peri-urban areas will be further analysed in the following section.

Some of the dynamics of urban growth in Hangzhou and the pressures they cause on the environment can also be seen from table 1 which was produced to provide comparable data with the six European case studies. For instance, the number of households increased on average by 12,900 units per year between 2002 and 2006, and the population increased by 53,278 people alone in 2006. Most of this population growth is due to migration gains but there has also been a natural increase of the population. The amount of land classified as

urban has grown by 12.5% in 2005. Private car ownership is reported in table 1 to have even increased by an enormous 27.1% per year when averaged over the five year period.

Peri-urban areas grow differentially: there is strong growth in the (south-)east along the Hangzhou – Ningbo corridor whereas the north stagnates. The growth in the east is supported by infrastructure development (bridges over the river, etc.). This growth led to a strong loss of farmland. The municipality lost 8 percent of its total cultivated land in the ten-year period between 1991 and 2001 (Webster et al., 2003). Most of the loss occurred in the inner peri-urban area. The 1991–2001 rate of loss in the inner peri-urban area was 4.78 times faster than its rate of population growth. Cultivated land has even increased in the urban core but from a low level.

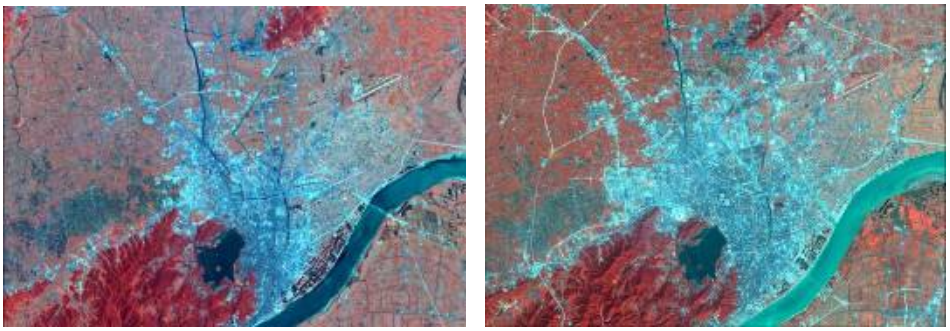


Fig. 10: Land use change in the Hangzhou City between 1990 and 2001. Urban areas are in grey. Strong expansion can be seen to the north and northwest, and the east. More recently, development jumped over the Qiantang River in the south.

On 12th May 2001, the reform of administrative divisions, by which adjacent towns became part of Hangzhou city, laid the foundations for the long-term, coordinated urban development of Hangzhou. Importantly, the idea of a monocentric city was abandoned in favour of polycentricity in order to relieve the pressure from the urban core. New centres were created in the west and the south. Due to several new bridges, urban development now began on the south bank of Qiantang River. Central facilities such as the Town Hall will be relocated from the old city centre to the riverside. Binjiang district on the South bank, which is still under construction, will become a part of the new city centre. Due to the development along Qiantang River and towards Yuhang the city also started to develop into the West Lake area in the west.

Tab. 1: Basic data of Hangzhou city, 2006 *(*Sources: Hangzhou Statistical Yearbook, 2002~2006;Hangzhou Construction Yearbook, 2002~2006; Hangzhou national economic and social development statistical bulletin, 2002~2006*)*

Land use (Hangzhou City)	Urban (residential, commercial and industrial areas)	5.0%
	Infrastructures	1.0%
	Forest	59.6%
	Farmland	15.0%
	Horticulture and open space:	5.4%
	Unused land	5.3%
	Water surfaces	7.7%
	Other	1.0%
	Total	100.0%
Social / demography	Total population in 2006	4,095,200
	Annual population growth in % between 2002 and 2006	2002/03:1.60 2003/04:2.14 2004/05:1.97 2005/06:1.14
	Net migration / births / deaths (persons) in 2006	41274/33260/21156
	mortality (‰)	5.14
	Annual household growth (averaged over five years, from 2002 – 2006)	12,900
	Mean percentage growth in households	11.2%
	Education levels Pre-school child care admission/ Primary school enrolment/ Junior high school admissions/ Gross enrolment of higher education (as percentage of total population)	96.6/100/100/47
Economic	Manufacturing / services ratio	0.99
	Primary sector (agriculture / forestry) employment ratio (%)	9.19
	Net unemployment (%)	3.62(2005)
	GDP per person	66476RMB
	exports ratio (%)	67.17
Environmental		
	Energy demand per person (Gjoule)	486880783
	Household waste per person	
Urban form & infrastructure		
	% public / private transport	
	Private transport growth trend % (increase of private car ownership/year in %)	27.1
	Rate of urbanisation of land use(%)	12.5 (2005)

Fig. 11: Hangzhou city centre. High-rise developments are replacing lower density developments. (Photos: left. S. Pauleit; right: Yang J.)

Fig. 12: Xiasha – a large scale urban extension. (Photo: S. Pauleit)

Fig. 13: A smaller scale, upmarket residential development close to Xixi wetland park. (Photo: S. Pauleit)

Fig. 14: Sprawl in the rural zones due to extension of farm houses. (Photos: S. Pauleit, left: north of Hangzhou; right: south of the airport in the south-east).

Fig. 15: Canal at the backside of farm-houses (Xixi area) (Photo: S. Pauleit)

Fig. 16: One of the few streets with older buildings in Hangzhou (Photo: S. Pauleit)

Fig. 17: West Lake - world famous cultural heritage (Photos: S. Pauleit. Left: northern part of the Lake; right: southern part of the lake).

1.4 Discussion: Critical turning points and issues in recent urban development of Hangzhou City

From 1949 to the end of the 20th century, the city grew with increasing speed due to economic growth. Overall, urban development experienced three critical turning points, and a distinction can be made between five stages in the development of the spatial structure of the core city as shown in table 2.

The first turning point happened at the end of the 1950s. The foundation of the People's Republic of China led to fundamental socio-economic changes. Putting emphasis on the industrial development several industry zones had been established outside of the city borders.

Since these compounds were only several kilometres away from the existing urban built-up area, most of these zones became connected with the urban core. While the city developed outwards the industrial areas developed towards the city. As a result large areas of mixed land use of small scale agriculture, residential areas and heavy industry developed. The urban spatial structure thus became more and more complex and problematic.

The second turning point happened in the early 1990s because of the opening-up and socio-economic reforms. The following strong growth of the urban economy took place caused rapid urban expansion and transformation of rural areas. Concurrently, land-use inside the city intensified. Traditional urban development guidelines could not effectively resolve the conflicts between competing urban functions. Urban expansion, fuelled by market forces, was restricted by the administrative divisions into rural and urban land before the administrative reform. Moreover, the disorderly expansion of townships, the construction of regional traffic systems, the barriers of the Qiantang River in the south and of the West Lake confined urban development. Moreover, three major problems need to be highlighted:

- The congestion of the inner city restricted the development of its tourism functions,
- The development of higher level service functions was seriously restricted in the developing urban areas,
- The environmental quality of the West Lake area declined.

The fundamental cause for the conflict was the enormous urban growth, on the one hand, and the concentration of urban functions in the historic city centre, on the other. Therefore, there was a need to develop a better distribution of public services and a system of sub-centres.

The third turning point happened when on 12 May, 2001, the State Council dissolved Xiaoshan municipal county and Yuhang municipal county to incorporate them as Xiaoshan District and Yuhang District into Hangzhou City. This change of the administrative region has provided the opportunity for the city of Hangzhou to integrate surrounding urban cores into long-term planning.

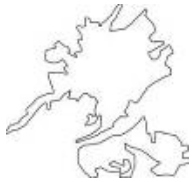
The basic idea for urban development can be summarised as “districts coordinating, conflicts mitigated and across-river and along-river development”. Conflicts mitigated is understood here as the change from a monocentric development pattern with the overcrowded urban core while the fringe was lacking in facilities towards a more balanced polycentric development. This is partly achieved by the leap over the river (e.g. Binjiang district, see chapter 3) and the shift of the central urban and business district from the West Lake area to the waterfront area of Qiantang River. The future concept and spatial structure of the city can thus be described as “dual centres and dual axes” with an urban axes linking the old and the new city centre while Qiantang River is considered as an ecological axes.

Figure 10 shows the development of built-up areas from 1949 to the end of the millennium. It can be clearly seen, that apart from some new industrial settlements, that the city boundaries in the late 40ies did not differ much from the medieval city.

After 2000, urban development even intensified, especially on the southern bank of Qiantang River and in the eastern city sections.

Table 2: Summary on the development of urban spatial structure of Hangzhou

Periods of spatial development	**Spatial development**	**Form of spatial expansion (scales differ between the figures)**
Relative stable period (Yuan Dynasty-1949)	Lay out the city surrounded by water: the Canal, Tiexia River, the West Lake and the Qiantang River	
Three axes period (1949-1960s)	The old city radiated outwards along water bodies, resulting in three finger-like development axes: the axis of the Grand Canal in the north, the axis of the West Lake and the axis of the Qiantang River in the south	
"Hand-shape" period (1960s-the middle of 1980s)	Influenced by the 1959's planning of industry zones, the northern suburb of the city gradually developed into a multiple axes layout in the shape of a hand. The axis of the Grand Canal further expanded; the axis of the West Lake further developed toward the west while the axis of the Qiantang River did not further expand due to the physical barrier of the river. New linear urban axes developed along Shangtang River, Airport Road and Genshanxi Road. These corridors as well as the axis of the Grand Canal and the axis of the West Lake gradually formed the hand-shaped layout in the city core of Hangzhou. Moreover, the city began to develop across Tiesha River in the east (see arrows on the map to the right).	
"Filling-in between fingers" period (the middle of 1980s-1990s)	The land between the five axes located in the north rapidly filled in, and the east side of Tiesha River was further built-up.	

"Internal adjustment" and "getting across river" period (1990s- 2007)	Due to enormous pressure of rapid urban development under limited availability of space for outward expansion, the city needs to be constantly adjusted, redeveloped and reconstructed, and at the same time develop and integrate new urban settlements south of the Qiantang River.	

Main physical, social and environmental challenges for urban development and land use change in the peri-urban areas

The following issues for urban development and land use change in the peri-urban areas were identified based on this chapter and additional round table discussions with various stakeholders held in 2007 and 2008 during field visits of the European project partners. The round table discussions included representatives of different departments of the Hangzhou City Government: Planning Bureau, Environment Bureau, Forestry and Water Management Bureau; officials from districts, towns and economic development zones; private developers; researchers from Zhejiang University. Main issues are (the order does not indicate any prioritisation):

- Pressure on farmland and natural resources due to strong urban growth. This growth expresses itself in two forms:
    - Redevelopment and continuing densification of the inner city. It was not possible in this study to measure this process but from observations (frequent construction sites with new high-rise buildings) and interviews it is clear that the urban core undergoes strong densification at present (Figure 11).
    - Rapid extension of urban areas (sprawl) due to strong economic development (industries, housing and recreation) and population increase. This increase is mainly caused by in-migration from rural areas, towns and cities (both from within the municipality but even more from other regions in China). The population increased in 2005 alone by more than 50,o00 inhabitants. An important trend that needs to be recognised for future planning, however, is that due to the success of the "one child policy", the population will start to age in the coming decades. The percentage of elderly poeple in China is projected to triple from 8% to 24% between 2006 and 2050 (United Nations 2005.

      Urban extension happens in various ways: planned large scale extensions e.g. of Economic Development Zones (Figure 12), planned extensions with mixed and smaller scale developments (Figure 13); "unplanned", spontaneous urbanisation in rural areas (farmers extending their houses to establish industries and accommodate migrant workers) (Figure 14). The population density in the so called rural areas surrounding Hangzhou is already very high for European standards. According to Prof. Yang (oral comm., 2007), it is approximately at 300~1000 inhabitants per km^2 by township. Accordingly, rural landscapes around Hangzhou are fairly densely built with a pattern of three- to four-storey high farm houses in often dense rows along canals and fields in between (Figure 14). The average area of cultivated land is less than 0.6 ha (Yang, oral comm., 2007) but farmers are considered to be quite well off economically as they work in non-agricultural industries and can rent out houses to migrant workers.
- As a consequence, there is a strong loss of highly productive farmland as data from Webster et al. (2003) indicated in this chapter. Hangzhou is famous for its cultural landscape heritage with silk production, tea (Longjin tea), flowers and other cash crops, and it is called "The land flowing with milk and honey". The sprawl in the rural

zones also leads to environmental pressures (water pollution, waste, Figure 15). While significant investments are made into creation of green spaces (see, for instance, case studies on Xixi wetland and Binjiang in chapter 3), these cannot keep up with the pace of urban development. The representative from the Hangzhou Bureau of Forestry and Water Management highlighted the strong need of extending the forest cover close to and within the built areas for environmental improvement and provision of recreational areas.

- Landless farmers due to urban development projects. The main issue seems to be less of economic nature as farmers are quite well off due to generous compensation but it is rather the social integration of the former farmers into the urban society which causes problems. Compensation mechanisms are further explained in chapter 3.
- Congestion of the inner city in terms of population and economic investment. One of the effects mentioned during the round table discussions was the strong increase of land prices in the inner city as a consequence. However, as Webster et al. (2003) point out, there is still potential for adjustment of land use in the urban core as producing industries still occupy significant amounts of land due to long-term leases.
- “Social harmony” has become an important political and planning discourse: everybody should have a share in the current economic development. However, reality can be quite different with an increasing gap between economic winners and losers.
- Living conditions of the urban and the rural population, e.g. often poor quality of houses, lack of access to facilities and transport, low environmental quality.
- Environmental resources (soils, water) and environmental quality (air quality, surface water, handling of waste and waste water).
- Built heritage in the city which is threatened by urban redevelopment (Figure 16).
- Recreation and tourism. Two main issues are the preservation of the existing cultural heritage for which Hangzhou is famous world-wide (West Lake area, Figure 17) and creation of new attractions for the strongly increasing urban population.
- Transport infrastructures, in particular to improve the access from peri-urban areas to the city, while the planned metro line will improve public transport within the core city. The increase of car ownership also means that more provision has to be made for parking cars.

1.5 Definition and development of peri-urban areas (PUA)

In a previous study, Webster et al. (2003) made a distinction between urban core, inner peri-urban, outer peri-urban and rural areas for Hangzhou municipality. The distinction of peri-urban areas was based on "location adjacent to cities proper, location relative to the freeways, field judgments, and key informant interviews with government officials in regard to ongoing development and linkages with cities proper" (Webster and Seto, 2002, p. 27, note 13). The zones differentiate in terms of their economic character and development trends (Webster et al. 2003). The primary and secondary sectors predominate in the outer peri-urban and rural zones. The primary sector is still the leading source of employment in the rural and outer peri-urban area, accounting for over 60 percent of employment in the former, and 44 percent in the latter.

The tertiary sector of services concentrates in the urban core and the inner peri-urban zone. Over half of all employment in the inner peri-urban area is already in the tertiary sector. Moreover, investment in fixed assets concentrates in the urban core and is still strong in the inner peri-urban zone but declines in the other two zones (Webster et al. 2003).

However, the level of manufacturing is still relatively high in the urban core compared to other Asian cities (Webster et al., 2003). A possible explanation is that enterprises lack in motivation to move because they were granted cheap long-term leases. Therefore, the differentiation between the zones has not been as sharp as one might expect. While Webster et al.'s distinction of urban, peri-urban and rural zones is helpful to understand the bigger picture of urbanisation processes in Hangzhou municipality, it is of limited use for our research where the focus is on detailed studies of land use strategies within peri-urban areas. Therefore, a more fine-grained distinction of peri-urban areas was attempted. Focus was placed on what Webster et al. (2003) called the inner peri-urban areas surrounding the urban core of Hangzhou proper because it is here where land use dynamics are greatest and the interactions between rural and urban land uses and respective interests most intense.

Peri-urban areas are transition zones between urban and rural areas, where commercial networks and industrial enterprises are widely spread, while the original rural land-use pattern is still preserved to a certain extent. Therefore peri-urban areas display a characteristic diversity of land-use types, in which arable land, horticulture, urban built land, transport infrastructures and water bodies are interspersed, commonly in a rather disorderly way. In this study, it was assumed that analysis of the land use pattern would allow distinction between urban, peri-urban and rural areas. An approach based on information theory and interpretation of satellite imagery (figure 18) was developed and applied to identify and delineate peri-urban areas. Figure 19 gives an overview over the approach. A full description of the approach and the results can be found in the appendix.

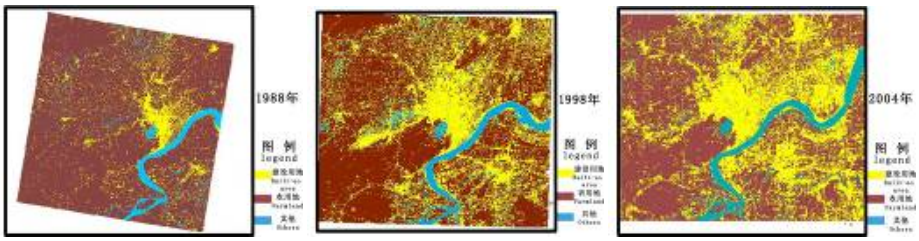


Fig. 19: Classified satellite imagery covering the core area of Hangzhou City for the years 1988, 1998, 2004. Pictures are appr. at the same scale. Yellow: built-up; brown: unbuilt; blue: water (source: Landsat TM, made available by Yang J. and Yao Z.)

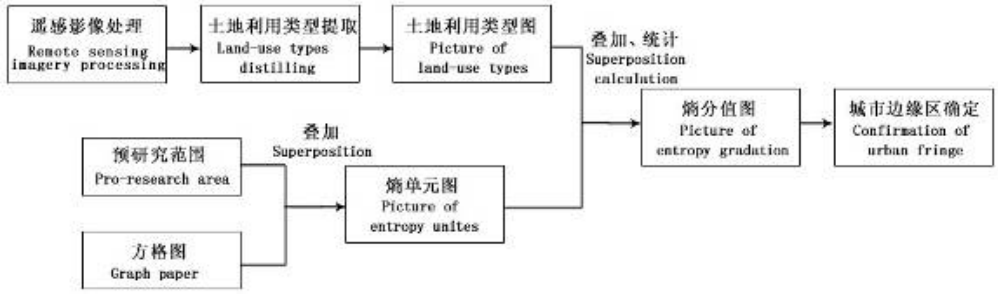


Fig. 19: Approach to the delineation of peri-urban areas

Figure 20 shows the development of the peri-urban area from 1988 to 2004. The red line marks the inner boundary between core city and peri-urban area. The blue line marks the boundary between peri-urban and rural area. According to the results from this analysis, tl peri-urban areas expanded by 471km² between 1988 and 2004, corresponding to an increa of 458%. They covered in 2004 19.7% of the area of Hangzhou City. Urban core areas expanded by 158km² during the same period, corresponding to an in increase of 668%. Th urban core covered 6.1% of the City's area.

The status quo in 2004 was chosen as the base for delineating the study areas.

Table 3: Development of peri-urban areas in Hangzhou

	Urban core areas (km²)	Peri-urban areas (km²)	Percentage cover(%) of peri-urban areas
1988	27.895	131.786	4.30
1998	109.198	325.744	10.62
2004	186.319	602.923	19.65

Note：Total area is 3,068km².

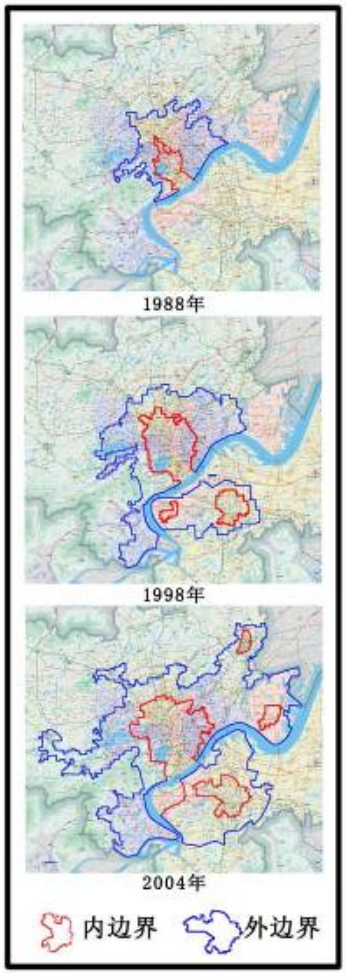


Fig. 20 Inner (red) and outer boundaries (blue) of the peri-urban areas in 1988, 1998 and 2004. The area within the red line are urban core areas.

Chapter 2: Government system and land use policy

The following chapter gives a short introduction to the Chinese government system. Of importance for the understanding of urbanisation processes, including the making and implementation of land use policies are:

- the hierarchical organisation of the government system, and in particular the differences between urban and rural areas, on the one hand, and cities and towns or townships, on the other hand.
- the different planning instruments available for urban planning.
- the land acquisition and auction system.

2.1 Government system in general

In China, cities can be categorized at the following three levels (Figure 21):
- cities directly under the jurisdiction of the central government (e.g. Shanghai),
- cities directly under the jurisdiction of the provincial government (e.g. Hangzhou) and
- county-level cities (e.g. Fuyang City directly under Hangzhou's jurisdiction).

Different levelled cities have different powers in relation to planning as will be explained further below.

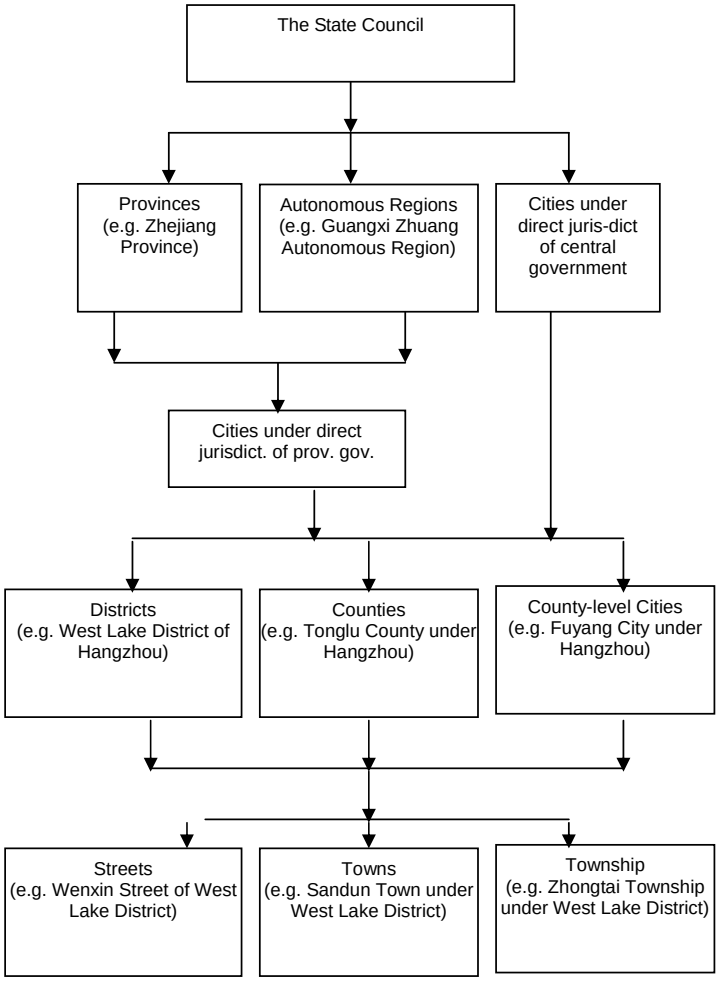


Fig. 21: Planning hierarchy in China

2.2 City government system

China is a socialist country, and among the city decision-making bodies, the major ones are the Chinese Communist Party Committee, People's Government, People's Congress, People's Political Consultative Conference, People's Court and People's Procuratorate (Figure 22).

The City Chinese Communist Party Committee is the core of the city's power structure, acting as the political lead of the whole city. Although the committee's jobs are focused on the party organisation, discipline checks, politics and laws, etc. a certain number of important city administrative affairs (including important urban planning and urban construction projects) should be submitted to the committee for final decision after having been debated by the People's Government.

The City People's Government, as the local administrative body, is the administration decision-making and administering body. The principal functions are to execute directions made by higher-level administrative body's, organise the implementation of decisions made by

City People's Congress, formulate and implement the city's national economic plan and financial budget, decide on important policies and measures for economic and social development, identify and organise the implementation of important construction projects as well as urban administration measures, etc.. In the field of urban planning and construction, the City People's Government generally assigns the administrative departments in charge of urban planning and urban construction to be responsible for the organization and implementation of important construction projects.

The City People's Congress with its Standing Committee is the supreme power body in the city. Its functions are to prepare local regulatory documents, and review and approve plans, budgets and other important affairs made by People's Government, etc. It discusses and approves urban planning, and supervises and reviews the urban planning and urban construction projects.

The main function of City Political Consultative Conference is to consult on the policies of the city, and organise the necessary surveys and inspections. It does not have decision-making power in urban construction and urban planning, however.

Principally, the task of the City People's Court is to correct by force illegal action in construction by accepting, hearing and judging cases which are in conflict with laws. The court prosecutes criminal actions in urban planning and urban construction.

In summary, in the system of urban planning and urban construction, the Hangzhou Municipal Committee of the Communist Party of China (CPC) plays a decisive role in the decision-making process for urban planning and urban construction in general. The Party makes decisions on principles for urban planning but does not interfere in the day-to-day decision making. This is the task of the People's Government which prepares and implements plans and building projects. It is advised by the Political Consultative Conference. The People's Congress is focused on law-making as well as supervision. Important plans must obtain the approval of the People's Congress.

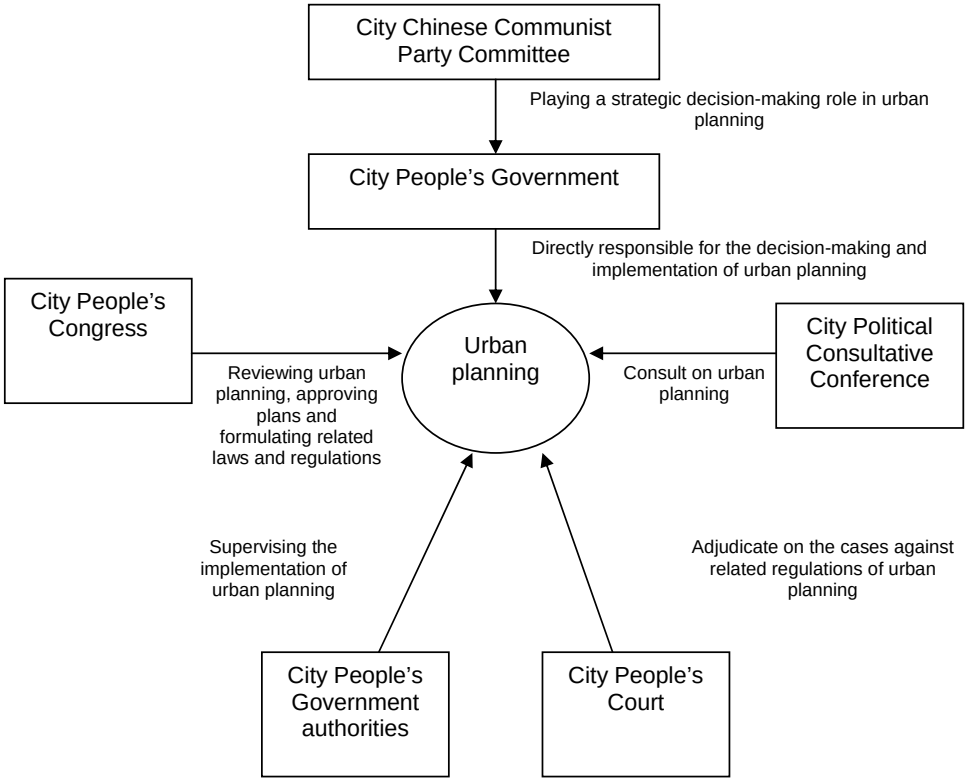
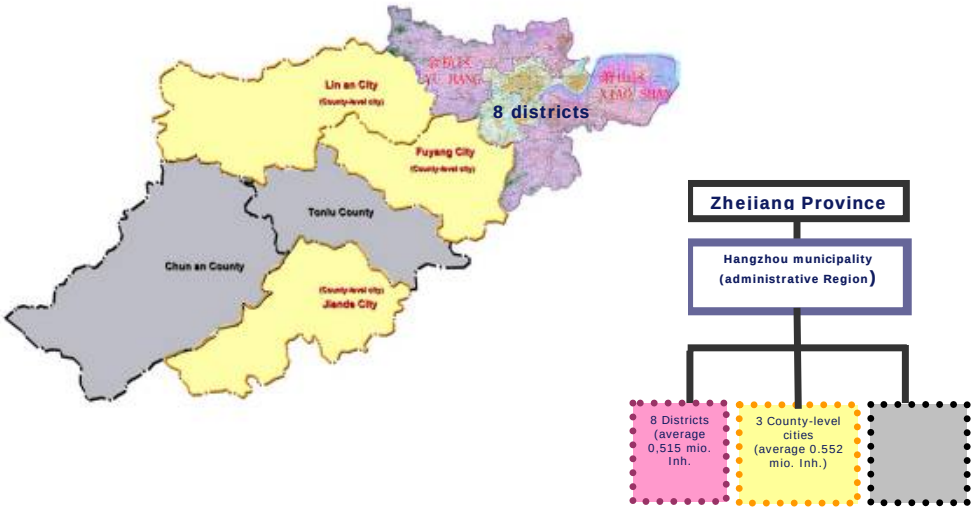


Fig. 22: Organisation of local government and their respective functions in urban planning and construction

2.3 Functions of city government in the core city and peri-urban areas

The next lower administrative levels of the city government are the districts, the counties and county-level cities. Hangzhou is comprised of 8 districts (0.515 million people on average), which comprise the city proper, 2 counties (0.425 million people on average) and 3 county-level cities (0.552 million people on average) (Figure 24). The next lower level is represented by villages, towns and streets. The West Lake District in Hangzhou (0.568 million people), for instance, has 6 streets (50,000 people on average), five towns (36,000 people on average) and 2 villages (19,000 people on average).



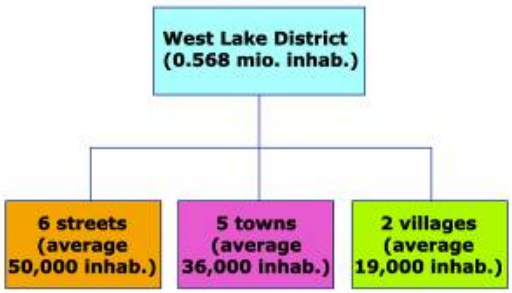


Fig. 23: Administrative units of Hangzhou municipality and their hierarchy (source: Hangzhou Statistical Yearbook 2005)

Generally speaking, streets in cities are the urbanised areas and most of them lie in the core city, while towns and villages under a district are still in the area undergoing urbanisation, most of them lying in the peri-urban area. In terms of functions, towns and villages as well as streets carry out their daily affairs under the guidance and supervision of the city government and the district government. Compared to the City People's Government, towns and villages as well as streets have limited powers, for example, in terms of budget and revenues from taxes, land acquisition, urban planning and construction.

Differences exist between towns and villages and streets. Streets act as a branch of the city government. Therefore, only street offices are established to exert their authority under the

direction of higher level government, whereas town and village governments are a governmental organizations with certain executive functions, such as the preparation of town and village plans.

2.4 Planning authorities and instruments in Hangzhou

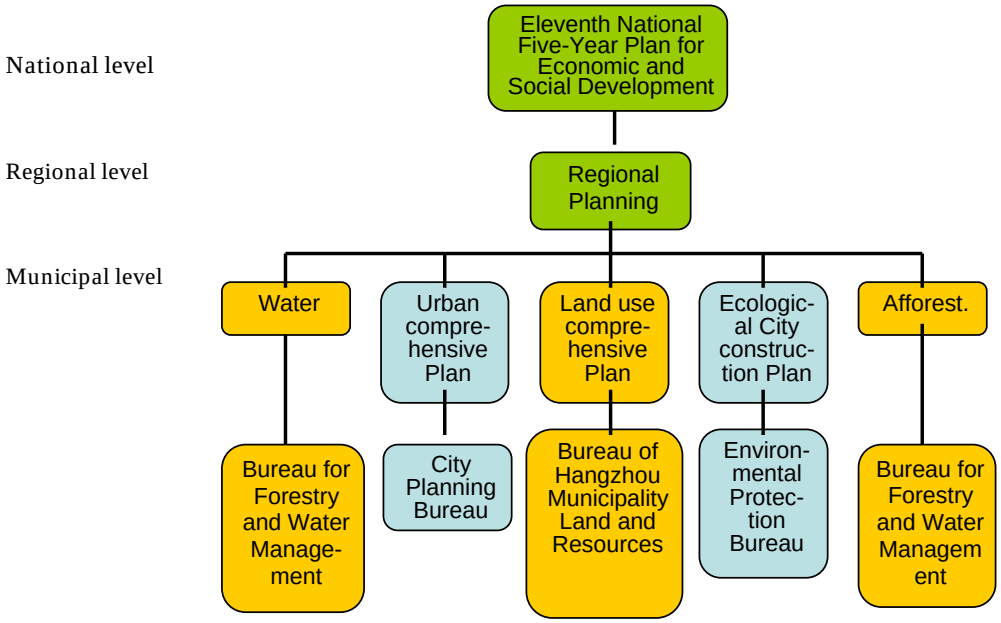


Fig. 24: Overview of planning authorities and instruments in Hangzhou (green: national and regional level; orange: municipal level; blue: Hangzhou city level)

2.4.1 Eleventh Five-Year Plan for Hangzhou's Economic and Social Development

The "Eleventh Five-Year Plan for Hangzhou's Economic and Social Development" is an important foundation for the city government to regulate economic development, supervise markets, social affairs and provide public services. The Five-Year Plan mentions among the overall goals for urban development:

- To construct a network metropolis, and make overall plans for a coordinated development of the region;
- To develop a circular economy (whereby the revenues generated in the city through economic activity largely remain in the city), and construct an ecological city;

To protect the famous historical city and cultural heritage, and accelerate the development , promote all-round social progress.

National legislation is not only conducted via plans but also by special preferential policies like national development zones. For example the tax revenues are kept to a large extent within these zones.

2.4.2 Master Plan of the Municipality of Hangzhou

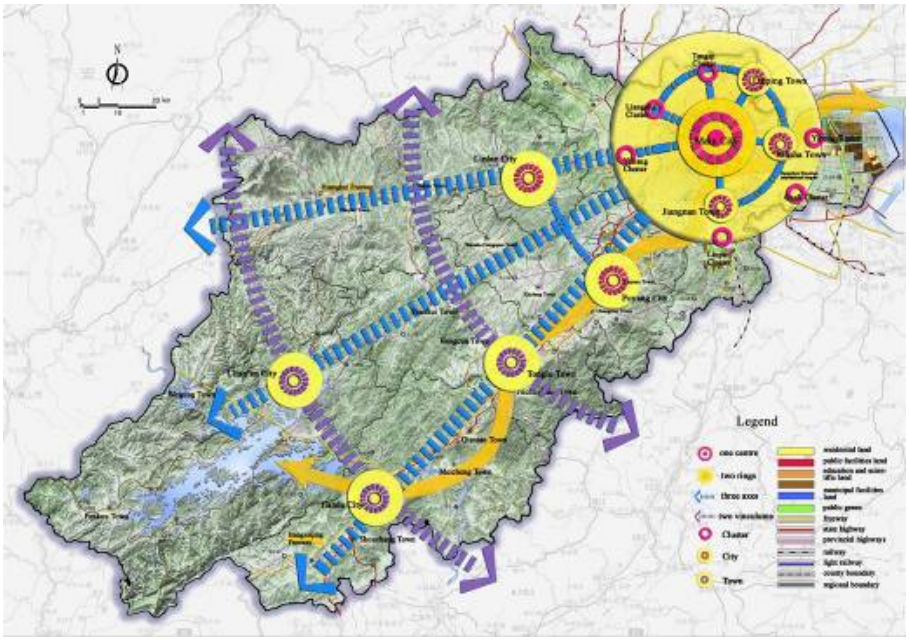


Fig. 25: Municipal Master Plan (source: Hangzhou Statistical Yearbook 2006)

The Municipal Master plan of Hangzhou (figure 25) is an instrument for strategic urban planning. It aims to optimize the allocation of resources, coordinate arrangements for development of regional infrastructure, and urban and rural public facilities. It also promotes a unified action system for urban and rural development, and aims to support and coordinate sustainable development of economy, society and environment. The plan determines the spatial structure of Hangzhou municipality (figure 25). It consists in particular of

- The four-tier hierarchy of central city (Hangzhou), central city at county level, local central towns and cluster towns.
- The urban spatial layout of "one centre, two rings; three axes, two vinculums; one circle , some points"; The two rings are an inner ring of three urban centres around the core city and a ring of urbanisation along the circular expressway (Figure 25). The three axes are (1) the north – south axes between the existing city centre and the newly built centre at Qiantang River, (2) the axis along Qiantang River, and (3) the axis following the expressway to the west. The main purpose of this spatial strategy is to achieve a more balanced distribution of population and economic development which relieves the pressure from the city core and concentrates growth in the peri-urban area, thus counteracting the tendencies of urban sprawl in the rural areas. An important goal of the plan to support this development is the construction of a network of transport and telecommunications infrastructures. The most important environmental goal of the plan is to protect water resources.

2.4.3 Comprehensive Land Use Plan of Hangzhou municipality

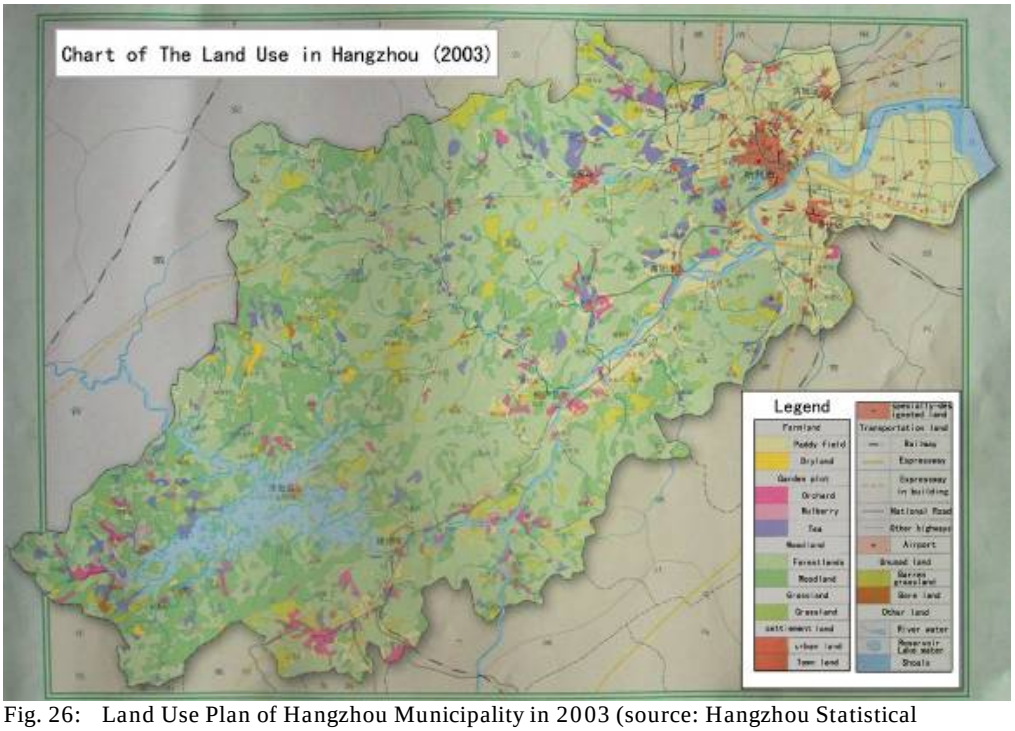


Fig. 26: Land Use Plan of Hangzhou Municipality in 2003 (source: Hangzhou Statistical Yearbook 2003)

The Comprehensive Land Use Plan (figure 26) aims to protect the agricultural land and ecologically valuable areas, and to promote intensive urban land use. It is designed to define the quantity and type of land uses and their spatial layout. Based on scientific study, it proposes adjustments to the structure of land use in order to optimize allocation of land resources and promote intensive urban land use, and to ensure economically and socially sustainable development. The content of the plan includes an assessment of land-use potential, the designation of city functions and population planning, land use restructuring, urban land development and designation of major urban construction sites, transportation and water conservancy projects, agricultural land uses, land for tourism, land consolidation and reclamation.

2.4.4 Sectoral plans for protection of natural resources at municipal level

There are several sectoral plans for the protection and sustainable use of natural resource at municipal level. Two of them are briefly presented below to show the kind of approaches taken.

Ecological City Construction Plan and Ecological Forest Master Plan

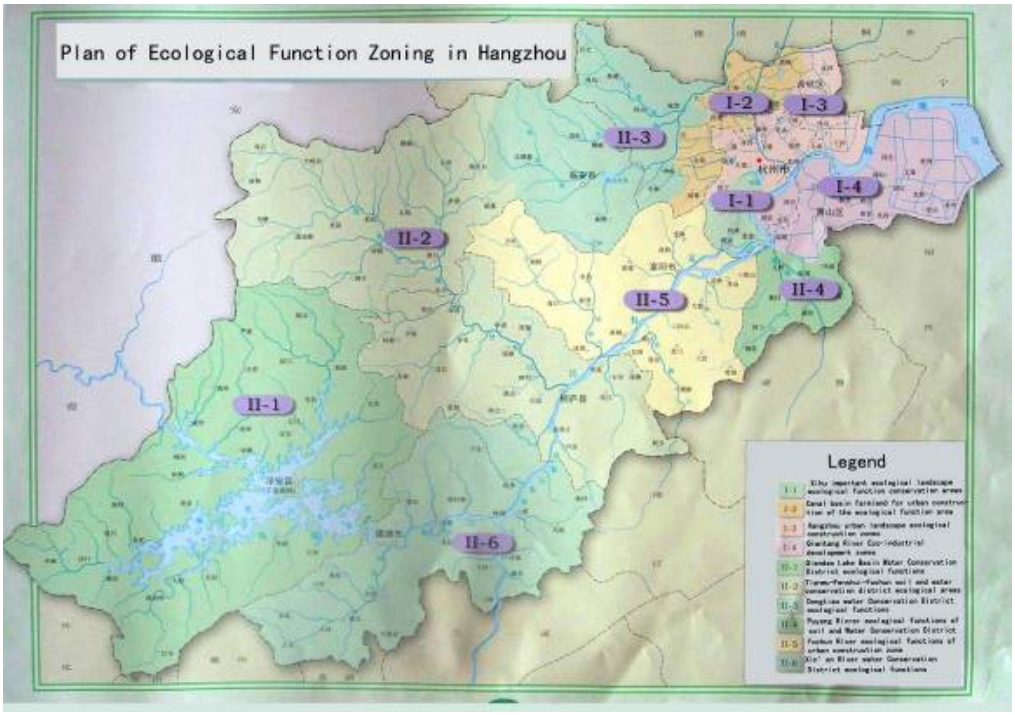


Fig. 27: Plan of Ecological Function Zoning in Hangzhou municipality (source: Hangzhou Municipality)

Hangzhou aims to implement the plan for the ecological development of the city until 2015 (figure 27). The Ecological City Plan is based on ecological principles, methods and the philosophy of systems engineering, to promote economic growth based on improved the quality of the environment, and in doing so realize Hangzhou's sustainable development goals of "health, vitality, civilized, harmonious beauty".

Ecological Forest Master Plan

This plan (figure 28) has been prepared by the Hangzhou Forest and Water Management Bureau. It outlines the development of a network of forests for protection of natural resources (water, soils, biodiversity). The main elements of the network lie in the mountain landscape to the west of the city. These are mostly woodlands along the ridges of the mountains, in river valleys and around the Lake of Thousand Islands in the west. These forests are protected from exploitation. However, the green network shown on the plan also extends into the built area of Hangzhou City.

The plan forms the basis for activities of the Hangzhou Forestry and Water Management Bureau. These figures under the term “Urban Forestry” include not only activities for protection, management of forests and afforestation schemes but they also aim to diversify farming (e.g. promotion of fruit tree planting and horticultural crops) to improve the livelihood of farmers. “Village greening” is an activity to promote recreation and tourism in rural settlements close to the urban areas (figure 29). The approach of the Hangzhou Forestry

and Water Management Bureau thus aims to combine strategic planning with project based activities.

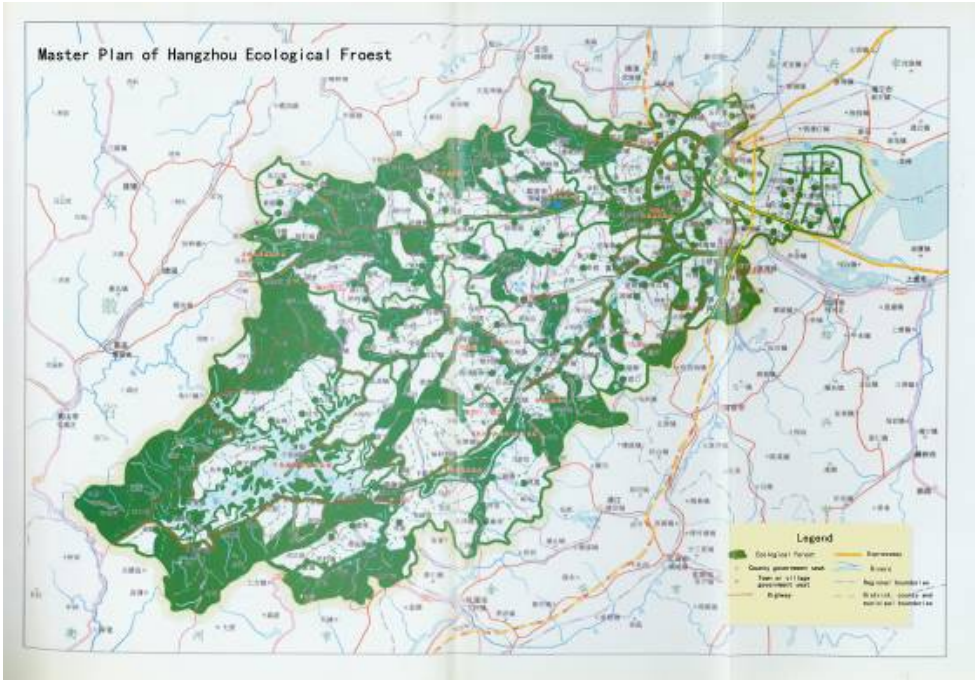


Fig. 28: Ecological Forest Master Plan for Hangzhou municipality (source: Hangzhou Municipality)

Fig. 29: Promotion of tourism by “Village greening”. This activity includes, for instance, investment into road infrastructures, village beautification, and support of business to set up recreation resorts such shown on the picture above (Photos: S. Pauleit).

Furthermore guidelines have been set up to enhance the protection of natural resources and an ecologically sound environment. E.g. in Binjiang one guiding motto for the development of the area was: “blue air, clean water, greenness and quietness”:

2.4.5 Strategic Plan of Hangzhou City

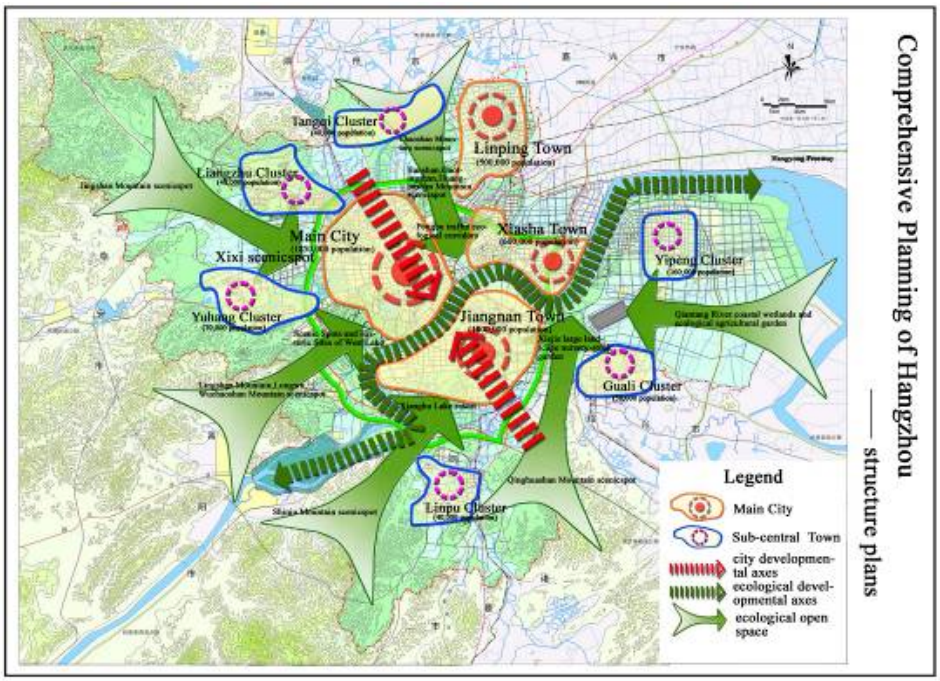


Fig. 30: Spatial structure for Hangzhou in the Strategic Plan (source: Hangzhou Planning Bureau)

The Strategic Plan is the programmatic plan for urban development (figure 30). The Strategic Plan is based on detailed analysis and research. The Strategic Plan aims to make Hangzhou unique as an international tourist town, a technology-intensive industrial centre at national level as well as an ecological city. The spatial structure (figure 31) emphasizes industrial development, tourism, and landscape as the three main aspects, and it determines an polycentric spatial structure of "one main city (big red circle), three secondary towns (delineated by red lines and red circles); double hearts (old and new city centre) and two axes (red arrows of the urban development axis from north to south and green arrow of the ecological axes along the Qiantang River), six settlement clusters (delineated by blue lines and violet circles, all connected by the circular expressway shown in light green colour), and six ecological belts (green arrows)".

It puts emphasis on the urban spatial development strategy—"south develops (new urban development across the Qiantang River), north adjusts (restructuring of urban areas), east enlarges (Xiasha town), west optimizes (high quality residential, new urban facilities, nature protection and tourism in the Xixi area and Zhuantang area)". This spatial strategy in particular aims to strengthen competitiveness of Hangzhou in global competition.

2.4.6 Hangzhou City Comprehensive Plan

The Comprehensive Land Use Plan of Hangzhou City (figure 31) designates land use functions within the city, the goals for their development and their projected size. The State Council has formally adopted the Comprehensive Plan for Hangzhou (2001—2020).

The Comprehensive Plan for Hangzhou confirms the spatial structure of" one main city, three vice towns, six settlement clusters" of the municipal strategic plan and the move from the city core to the new city centre at Qiantang River. It determines the future size of the city population and the amount of land for urban construction. Areas for immediate urban development are shown. It sets out the standards, norms and criteria for its main built structures.

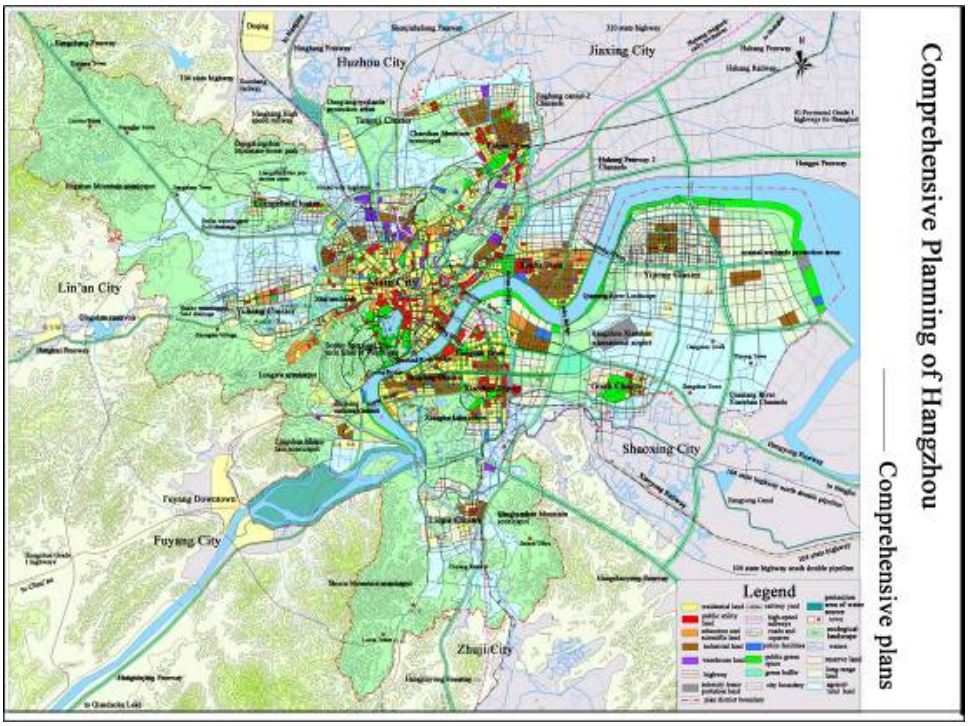


Fig. 31: Comprehensive Plan of Hangzhou (source: Hangzhou Planning Bureau)

2.4.7 District Planning

District planning is conducted on the basis of the Comprehensive Plan in order to further control and define the use of land, determine the function and capacity of each plot and to coordinate the construction of various infrastructure and public facilities. It includes goals for extension of the infrastructures necessary for urban growth as well as protection of natural resources, and promotion of tourism. An example of a district plan is shown in figure 32.

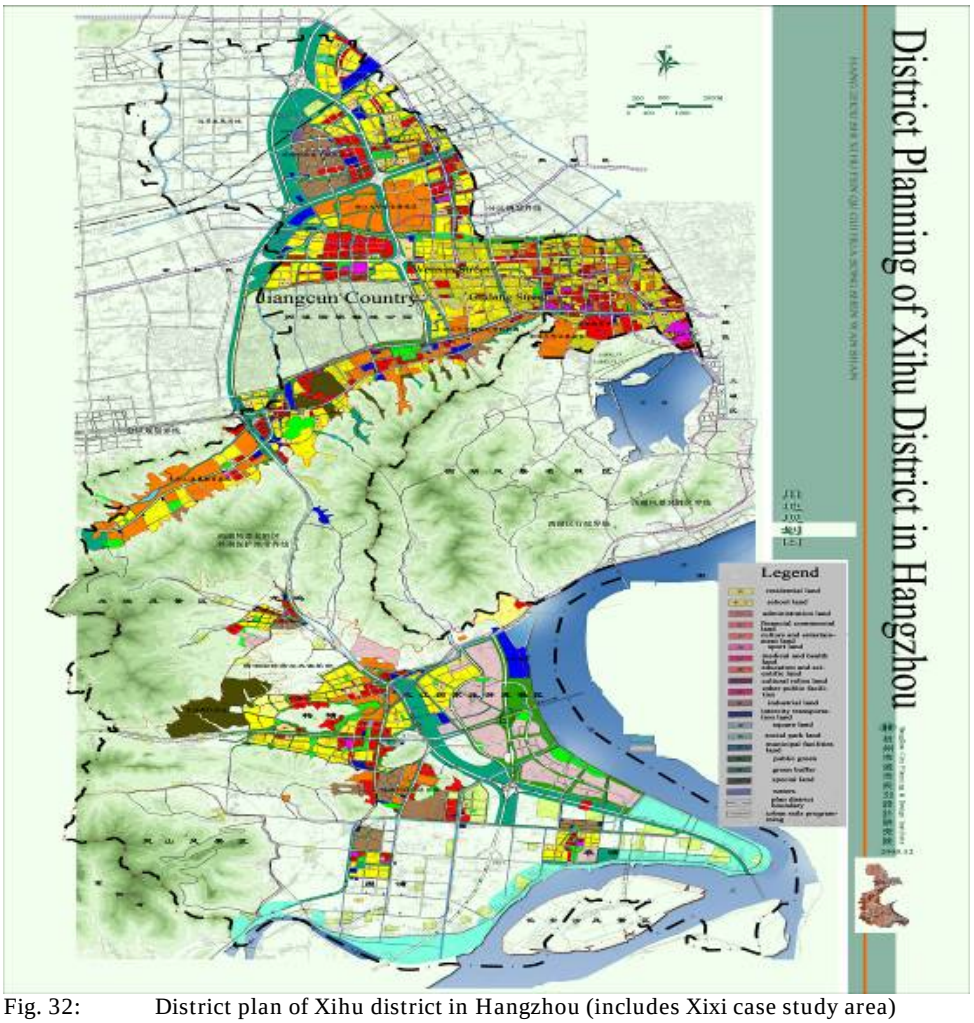


Fig. 32: District plan of Xihu district in Hangzhou (includes Xixi case study area)

2.4.8 Regulatory Plan

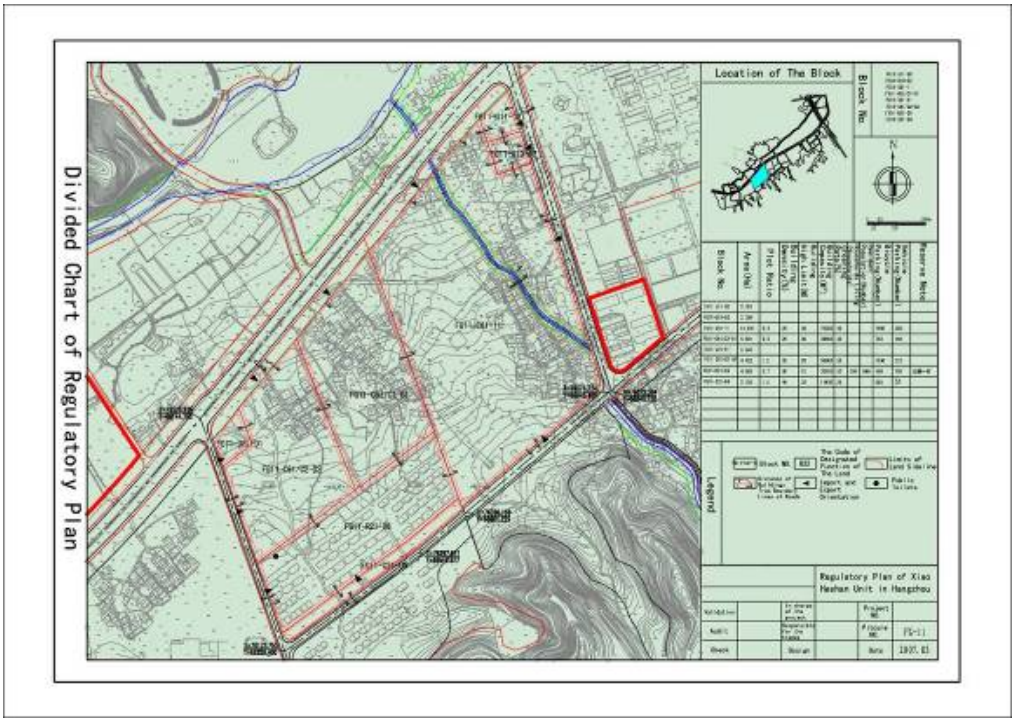


Fig. 33: Regulatory Plan (source: Hangzhou Planning Bureau)

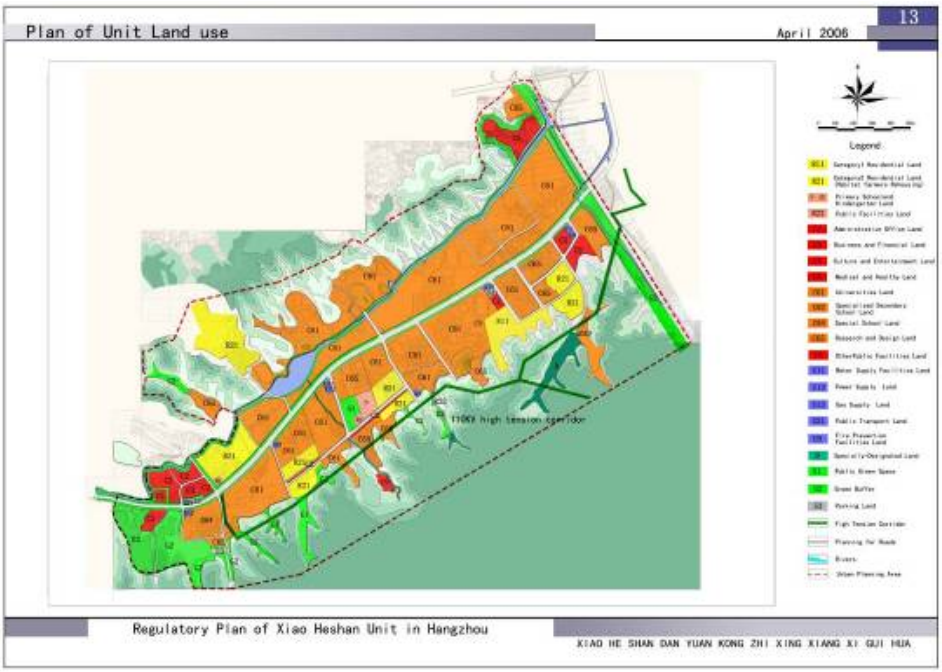


Fig. 34: Regulatory Plan of Xiao Heshan Unit in Hangzhou (April, 2006) (source: Hangzhou Planning Bureau)

The Regulatory Plan (figures 33 & 34) is based on and further details the Comprehensive Plan or the District Plan to effectively control land use planning and management. The Regulatory Plan determines the function of land use, population density and size/capacity of buildings, municipal utilities and transport facilities, internal and external road links. It frames control indexes and management requirements, and it is the frame for the site plan.

The Regulatory Plan includes 10 categories of indicators and provides 10 categories of guiding targets. The content of the plan includes the following elements:

- Designation of different types of land use, regulations for the different types of buildings.
- Areas, which are suitable or not suitable for urban development, or where it is conditionally allowed;
- Height regulations for buildings, building density, plot ratio, greening rate indicators;
- Peaks of traffic entrance and exit, parking space; building retreat from boundary lines of roads and distance between building;
- Location, size, colour, etc. of the proposed construction;
- Determination of the levels of the boundary lines of roads, control and elevation coordinates;
- According to the capacity to determine the direction of the project pipeline, diameter and
- Engineering facilities in line;
- Corresponding land-use and building regulations.

2.4.9 Land ownership, land acquisition and compensation

Land Ownership System
The socialist system of publicly owned land has two forms in China: one is national ownership, which is called national land, and the other is collective ownership, which is called collective land. Land in urban areas (excluding peri-urban areas of the city which are not designated as urban land) fall into the category of national land, whereas land in rural and peri-urban areas is collectively owned by farmers, exclusive of land that belongs to the state according to laws.

Land acquisition system
With the continuous development of cities, it is inevitable that cities expand into rural areas. Article 2 in the Land Management Statute provides that "Out of public benefits, the state can acquire or expropriate land according to laws and give compensation accordingly." The acquired land will be in the ownership of the state. The land use right can be transferred as urban land for a certain period through auction or by transfer, but the land will remain under state ownership.

In Hangzhou, there are rules and regulations for the acquisition of collective land in rural area as well as for the compensation and resettlement of the population. Hangzhou issued a series of policies and statutes, such as Management Ordinance on House Removal on Acquired Collective-owned Land in Hangzhou (199.8), Measurement on Acquisition of Collective-owned Land in Hangzhou (2000.5), Compensation and Resettlement Standard and Tax and Fee Standard for Land Acquisition in Urban Area of Hangzhou (2000.2), Provision on House Removal Subsidy and Temporary Transitional Fee Standard for Houses on Collective-owned Land (2002.7), and more.

According to these policies and statutes, the City Land Management Department is responsible for the review, coordination and management of acquisition of collectively owned land in the urban area, while the District People's Government is responsible to carry out the acquisition of collectively owned land in its jurisdiction. The land acquisition procedure is as follows:

- The Planning Department is to identify various kinds of land for urban development according to plan (which plan?);
- Construction units apply projects plans and site selection planning to the Planning Department;
- The City Land Management Department is to issue the announcement to freeze land acquisition in the land acquisition area;
- City and District Land Management Departments make the land survey on acquired land, prepare schemes for agriculture land use transfer and acquisition, and submit them to higher-level people's government for approval;
- After the schemes are approved, the City Land Management Department makes the land acquisition assignment paper known to lower levels, and issues a proclamation to the towns and village where the land is located;
- The District's People's Government organises the registration of land acquisition for compensation;
- They prepare a land acquisition compensation and resettlement scheme and then make the announcement, and at the same time accept the dissent opinions on the scheme;
- The compensation and resettlement scheme is revised, and then submitted to the City's People's Government for approval;
- The City Land Management Department issues a Construction Land Warrant to the construction units, and then residents having lived on the acquired land begin to move out.

- When plans for the development of the land are made, the land is auctioned. The land remains in state ownership but the land use rights are sold as long-term leases (70 years).

Land compensation system
Compensation for land acquisition includes the land compensation fee, resettlement subsidy, land attachment compensation fee and green crop compensation fee. The land compensation fee is paid in line with the grade of land and the crop species which are formerly grown on the land. Farmers who lost their land and job are also granted a resettlement subsidy. Resettlement is carried out in accordance with the *Comprehensive Compensation Standard for the Land Acquisition for Resettlement in Civic Centre of Hangzhou*.

Further details on the compensation scheme are presented in the case studies in chapter 3.

2.5 Discussion:

China has an elaborate system of land use and urban planning. It consists of comprehensive and sectoral plans at different levels of the planning hierarchy. Relevant plans at municipal, city, and district levels were briefly introduced. These outline the goals for economic, social and environmental development; control of the spatial structure of Hangzhou, guiding the land use pattern, and regulating the land use at a detailed level.

Within this study, it was not possible to make a more detailed analysis of the planning instruments, their content and power to control land use . It is difficult to discuss these issues systematically, such as the mechanisms of plan making, balancing of sectoral goals and interests, and implementation, for they are complex. However, some general challenges for planning in peri-urban areas were identified:

- The co-existence of the government, private market forces and public interests drive urban development. This is probably the biggest overall challenge for planning. While planning is still largely a top-down activity, the reforms since 1978 have led to an increasing number of actors entering the planning game, in particular private developers (table 3). However, direct participation of the public and NGOs participate in decision-making on plans is still in the beginning.. In peri-urban areas, farmers appear to be well compensated when their land is expropriated (see chapter 3). It can be concluded that the state/ the municipality are the strong actors in planning, while the role of other actors, mainly private investors, citizens and farmers, is still limited but increasing,.
- Speed of urban development: long-term plans such as the urban Master plan which has a time perspective of 20 years is already dated after short time, and therefore requires constant revision. A major challenge for planning is the design of a flexible planning system that can adapt to the quickly changing conditions for urban development whilst maintaining basic strategic principles. A study on green space planning in Weihai City (Li Liu, 2008) showed that often less importance is attributed to plans while the city leadership can make decisions on annual key projects.
- Horizontal coordination between the city and adjacent towns, and between districts and villages at the next lower levels of the planning hierarchy which are in strong competition in terms of attracting investors. Uncoordinated development as a result is one of the biggest challenges in the peri-urban areas. This issue will be further discussed in chapter 3 (Xixi case study).
- Vertical and horizontal integration of plans: This issue could not be deepened in this case study but it became obvious that a range of sectoral strategies co-exist, e.g. for landscape protection, urban development, infrastructure development, but how well these themes are integrated remained unclear. From observations and the study by Li Liu (2008) on green space planning in Weihai it can be shown, that greening activities are, for instance, integrated with road planning (in the form of often broad green belts

along main roads), and standards for greening of new urban extensions exist (35% of green cover in residential areas).

- The planning system does not recognise peri-urban areas as a category of its own, and there are no specific strategies for peri-urban areas. Instead, a clear distinction is made between urban and rural areas. For instance, development densities and building heights can be much higher in urban areas. Land in urban areas is owned by the state while it is collectively owned by the farmers in rural areas. Urban development therefore needs to start with incorporating rural areas into the urban zone.

Due to the strong pressure of urbanisation, the urban perspective has been strongly prevailing in planning, recently. However, the need to protect farmland is now moving high on the agenda in China, and this issue is also recognised in Hangzhou, even though its position is still weak in comparison with urban development goals.
Comparison with the satellite images of figure 18 in chapter 1.5 shows that the ecological corridors of the City's Strategic Plan are already to some degree urbanised. It is difficult to protect ecological green space close to the city core. Moreover, from the satellite images it can be seen that the farmland areas (light blue areas in figure 32) shown in the Comprehensive Plan of Hangzhou city are more or less densely developed due to extension of the farm houses.
However, during the last visit of the European project partners in November 2008, a detailed plan for one of the green corridors in the southwest was shown "Protection and Development Plan of Western Urban Hangzhou" (see also chapter 3.1). Further study of this plan was not possible within the time frame of this first part of the case study but the existence of this plan, which precisely delineates the green corridor and makes detailed recommendations for land management based on scientific analysis of the area, shows that protection and management of landscape in the corridors is now taken more seriously. Plans for the other five green corridors are currently in preparation (Yang J., oral comm., 2008).
Sector authorities and plans such as the Ecological Forest Plan also show that urban and rural issues are increasingly seen together. While forestry was a typical activity of the mountainous countryside, "urban forestry" has now become a planning discourse. The Ecological Forest Plan is not restricted to the rural areas but green corridors are also designed for the new urban extensions, for instance south of the Qiantang River. Urban forestry is broadly defined in this context. It does not only include afforestation and forest management for ecological purposes but also diversification of farming (e.g. horticultural products, fruit trees) and the promotion of tourism and recreation ("Village greening"). Certainly, the role of the municipal Forestry and Water Management Bureau is weak in decision-making on urban development, and decisions on green space are made by the City's parks department. But overall, the need to find approaches that create a better balance between urban and rural needs is recognised. Some emerging strategies for more integrated approaches towards development of peri-urban areas such as in the Xixi area will be analysed in chapter 3.

Tab. 3: Main actors in planning.

Stakeholders Meeting in Hangzhou, August 14, 2007					
Land use issues	**Private Companies**	**Non-Profit**	**Government Municipality**	**University /Research institutes**	**Civil initiatives**
Climate change	Mr. Xu, Hangzhou Benxing Scientific Company for Environmental Protection and Energy Savings	not relevant	Mrs.Chen, Hangzhou Forestry and Water Resources Bureau, Mr. Mu, Zhejiang Environment Protection Bureau	Mr.Rao, Zhejiang University	not existing
Urban green spaces	Mr. Zhang, Zhejiang Tianrun Ornamental and Landscape Planning and Design Comp.	not relevant	Ms. Ding, Hangzhou Xihu District Planning Bureau	Mr. He, Chinese Academy of Forestry	not existing
Land use efficiency	Mr. Zhu, Binjiang Real Estate Comp.	not relevant	Mr. Jiang, Party Secretary Zhuantang Township , Mrs. Chen, Hangzhou Forestry and Water Resources Bureau,	Mr. Yang, Zhejiang University, Mr. Rao, Zhejiang University	not existing
Tourism	Ms. Hu, Hangzhu Changyun Tourism Comp.	not relevant	Mr. Jiang, Party Secretary Zhuantang township	Ms. Yao,Zhejiang University	not existing
Shrinking population in rural areas	Mr. Zhu, Binjiang Real Estate Comp.	not relevant	Mr. Jiang, Party Secretary Zhuantang township	Ms. Yao,Zhejiang University	not existing
Transport	_	not relevant	Ms. Fu , Xia Cheng Division, Hangzhou Municipal Bureau of State Land and Resources	Ms. Yao,Zhejiang University, Dr.Yuan,Zhejiang University	not existing

Urban development	Mr. Zhu, Binjiang Real Estate Comp.	not relevant	Mr. Peng, Hangzhou Economic and Technology Development Zone, Ms. Fu , Xia Cheng Division, Hangzhou Municipal Bureau of State Land and Resources	Mr.Yang, Zhejiang University	not existing
Land auction	Mr.Zhu, Binjiang real estate comp.	not relevant	Mr. Peng, Hangzhou economic and technology development zone	Mr. Yang, Zhejiang University	not existing
Farm land protection	Mr.Jiang,Hangzhou Keda Modern Agricultural Science Comp.	not relevant	Mr. Zhen, Department of Farmland Conservation and Planning, Hangzhou Municipal Bureau of State Land and Resources	Ms. Li, Zhejiang University	not existing

Chapter 3: Spatial planning and decision making strategies and their impact on the urban fringe - case studies

3.1 Selection of study areas

Among the PLUREL case studies Hangzhou is the largest agglomeration both in terms of population and surface area. Moreover, it is difficult to get information, not least due to the great speed of urban development. Therefore, it was agreed to concentrate on three sub-cases to analyse in more detail the challenges of peri-urbanisation and strategies that affect land use change in these zones.

Three study areas outside the actual core city were selected. They represent different geographical and socio-economical parts of the peri-urban area and also different urbanisation pressures and development paces. The proposed study areas are displayed in figure 35.

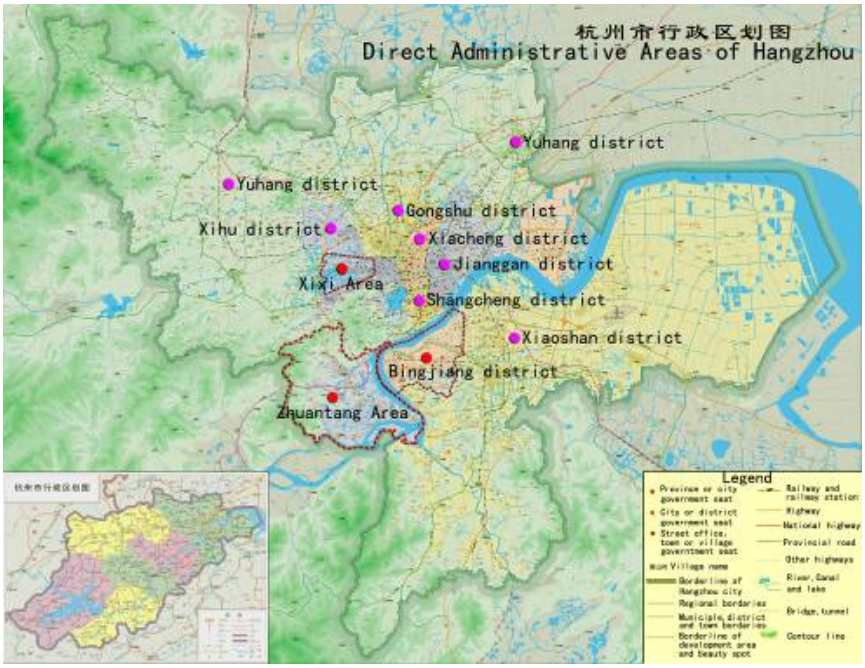


Fig. 35: The three sub-cases: Zhuantang, Xixi and Binjiang

Zhuantang area - a case for conservation and controlled growth
The Zhuantang area is located in the southwest of Hangzhou at a distance of appr. 15 kilometres from the city centre. It covers a total area of 156.35 square kilometres (Figure 20). The Zhuantang area has been developed as a tourism and ecological protection area in Hangzhou while the area is lagging behind in terms of urban devevelopment. In recent years, the regional development strategy and spatial planning have suggested changes to this policy in Zhuantang. Urban and economic development have adapted since. The area represents an attempt to combine moderate urban development with tourism and protection of the cultural and ecological heritage. It can therefore be described as a case for conservation and controlled growth.

Xixi Wetland – a case for landscape restauration and up-market residential areas
The Xixi area is located at the north-western side of West Lake District (Figure 20). It covers an area of 23.06 km^2. The study area comprises Xixi National Wetland Park and Jiangcun Township. Historically the Xixi Area was a plain with a large pond and river network used for fishing, with wooden farmhouses and small scale agriculture. It was renowned for its scenery and therefore a place that famous people and intellectuals during several dynasties loved to frequent. However, the recent urbanisation process has destroyed a large part of the Xixi wetland area.

In recent years the core area has been transformed into a national nature reserve serving ecological, conservation and recreation purposes. The former dwellers have been moved from the site and given new homes and compensation ground on the edges of the newly established park. The planning goal is to supply the surrounding quarters with green space, improve the image of the area and create a specific identity for this part of the city.

In addition, Xixi Wetland Protection Project is an innovation in wetland protection practice and in urban management in Hangzhou. Xixi wetland serves as a case where landscape restoration is combined with development of up-market residential areas.

Binjiang District – a case of rapid large scale development from low to highly productive commercial conditions
Binjiang District is situated at the south bank of Qiantang River (Figure 20). The total area is 73.33 km^2. It is connected with the civic centre of Hangzhou through three newly built bridges. The district borders the Qiantang River in the west and the north, and Xiaoshan District in the east and the south. The distance from the city core is appr. 7km. It is planned to become the civic sub-centre and main science location of Hangzhou in the future.

The development of Binjiang District dates back to 1990 when it was still part of Xiaoshan and more or less rural land. At present the area has about 190,000 inhabitants. Approximately 5,000 export firms for electronics are located in Binjiang, about 10% of these are foreign firms.

Binjiang is an example for large-scale peri-urban development led by the government. An effective transport network is an important aspect, also a higher green space ratio than in previous development zones. A special service in the area is a free education system for 15 years, including 6 years primary school, 3 years secondary and 3 years high school.

Basically, Binjiang District hardly pays any taxes to attract investment. Money paid to the municipality flows back in terms of subsidies.

Therefore, Binjiang district is a case of peri-urban areas with a rapid large scale development from rural to urban structures and from low to highly productive commercial conditions.

3.2 Land use development, spatial planning and strategies for the Zhuantang area

3.2.1 General information on the Zhuantang area

Location
Zhuantang area is located at the southwest fringe of Hangzhou City and it covers 156.35 square kilometres in total. The distance between Zhuantang and Hangzhou downtown is about 15km. As a stop on the way to the tourist destination of the "three rivers and two lakes", Zhuantang is surrounded by mountains and woodlands, with a beautiful natural environment. The highway around Hangzhou city passes the whole area from north to south with entrances from the West Lake Scenic Area in the east, and the Qiantang River in the south.

Administrative regions
The Zhuantang area includes Zhuantang town, Longwu town, Yuanpu town, Zhoupu township and Zhijiang National Tourist and Holiday Resort (table 4). There are some large urban areas with specific functions in this region: Zhuantang Science and Technology Economic Zone, Fushan Ecological Resort, military land, driving school of the municipal police station, a school of the Chinese Academy of Art, Zhijiang campus of Zhejiang Industrial University, and the Longwu and Linshan scenic areas.

Tab. 4: Administrative units of Zhuantang district (2006)

Administrative units	Area (km2)
Zhuantang town	42.30
Longwu town	27.85
Yuanpu town	34.94
Zhoupu township	41.38
Zhijiang National Tourist and Holiday Resort	9.88
Total	156.35

Current population
The population growth in the Zhuantang region is slow. A large part of the population in this area is still rural, i.e. employed in agriculture. This proportion surpasses the average level in urban Hangzhou and West Lake area by far, which makes it a typical agricultural region in Hangzhou´s urban fringe.(table 5)

Tab. 5: Population structure in Zhuantang district (2006)

Town name	Total Population	Part1		Part2	
		Migrating population	Household population	Townspeople	Rural population
Zhuantang	47,375	6,586	40,789	41,163	6,212
Longwu	31,905	1,933	29,972	6,886	25,019
Yuanpu	«13,699	2,289	11,410	7,514	6,185
Zhoupu	23,408	887	22,521	4,188	19,220
Zhijiang national holiday resort	9,810	7,415	2,395	9,810	/
Total	126,197	19,110	107,087	69,561	56,636

Current land-use situation
As the connecting part between suburbs of the inner and the outer urban fringe in western Hangzhou City, Zhuantang has the typical character of an urban fringe. This means that it becomes an extended space for some city-related land-use functions. Important transport corridors of the inter-urban transportation routes and the outer artery cross the area. Therefore, the “Road and Protection Forests” cover a large part of this area, as well as the “City Water Resources Protection Zone” (table 6)

Tab. 6: Current land-use in Zhuantang region(2006)

Classification	Area/ ha	Proportion	Land-use	Land area in ha	Proportion
Construction Land	1192.99	7.63	Residential	340.13	2.18
			Public facilities and commercial (e.g. schools, shopping centres)	254.28	1.63
			Industrial	212.81	1.36
			Warehouses	1.05	< 0.01
			Intercity transport	70.12	< 0.01
			Municipal utilities	12.44	< 0.01
			Green space	8.72	< 0.01
			Village residential land	293.44	1.88
Non-construction land	14442.01	92.37	Farmland	4156.30	26.58
			Horticulture	1240.96	7.93
			Forest	3610.41	23.10
			River & water area	4445.65	28.43
			others	988.69	6.32
Total	15635.00	100.00		14647.00	100.00

3.2.2 Spatial planning and land-use development

1949~late 1990
During this period, Zhuantang region became a part of the Hangzhou Scenic and Water Resources Protection Area, where it was assigned the function of a production base for agricultural products for supply of the city. As a consequence, the social and economic development was restrained in many aspects because of environmental protection policies within the area. Industrial and residential development projects were restricted from expanding into the Zhuantang region, and the industrial development within towns was limited as well. Moreover, industrial development was restricted as the city's main sewage pipe did not reach this area. Therefore, in this period, the pattern of land-use was simple, new buildings were mainly limited to farmers' residences while farmland and ponds occupied the majority of the land.

From 1990 to now
The step into the 21st century marked a significant change, as the government made a series of policies for the development of Zhuantang region, which brought progress into the area and responded to the needs for local economic growth. Three steps can be identified:

(1) In 2001, Hangzhou's Municipal Committee and Government put forward development strategies for the westward expansion of tourism. The implementation of this strategy provided opportunities to develop the Zhuantang region.

(2) The "Protection and Development Plan of Western Urban Hangzhou" was completed and adopted by municipal government in December 2001. The plan prescribes a pattern of one central town, four tourist towns, one science and technology zone, and six scenic tourist sites. Zhuantang town was suggested to become the central town and the main base for tourism and services in western Hangzhou, especially the Shangsi area. Therefore, it has become the focus for urbanisation of the western city and westward expansion of tourism. The "Protection and Development Plan" is based on a scientific analysis to determine the scale of development of Zhuantang, Longwu, Zhoupu, Yuanpu and some other towns.

(3) The "Comprehensive City Plan of Hangzhou" (2001-2020) proposes a spatial development strategy for eastward urbanisation, westward expansion of tourism, urban development along the riverside, and new development across the river (it would be nice to have such a description under top 2.4.6). One of the ecological corridors shown in the strategic plan (figure 31) is developed in the Zhuantang region. Overall, the Zhuantang region entered a new phase of development to adjust the industrial structure in the western city, to accelerate infrastructure construction, to upgrade comprehensive service functions, and to build up a tourism and ecological protection zone.

In 2002, the Hangzhou Municipal Committee and Government reinforced this new direction in a guideline for the protection and development of the western city. The guideline stressed that development should be based on the principle " to realize the balance and mutual benefit between development and environmental protection", in order to develop western Hangzhou into a major zone for tourism with a classy environment and an attractive scenery.

In 2006, the amendment of the "Protection and Development Plan for Western Hangzhou" (southern area, figure 36), suggested to further strengthen its function as an outstanding tourist attraction. The plan designated two special zones for tourism, ecological protection, and integration of urban and rural development.

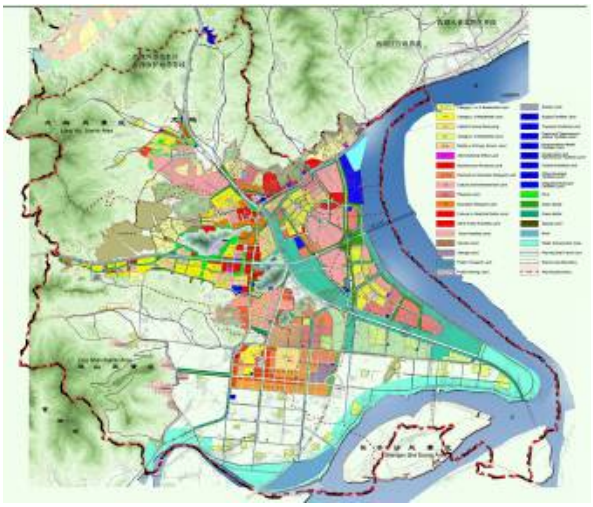


Fig. 36: Land use plan of the Zhuantang area (source: Hangzhou Planning Bureau)

As an outcome of these plans and policies, the land for construction expanded and land-use related to urban functions started to increase in the Zhuantang region. Figure 37 shows that in 1988, built-up areas were scattered among a few rural residences in farmland in the northern and western parts. By 1998, they had extended toward the river side of Qiantangjiang, and large pieces of farmland and water area began to appear in the east and south part of the region. By 2004, the fast expansion of built-up areas created several urban cores, which accommodated the construction of public and private residential estates and tourism

facilities. All of these developments resulted in the loss of farmland within the region.

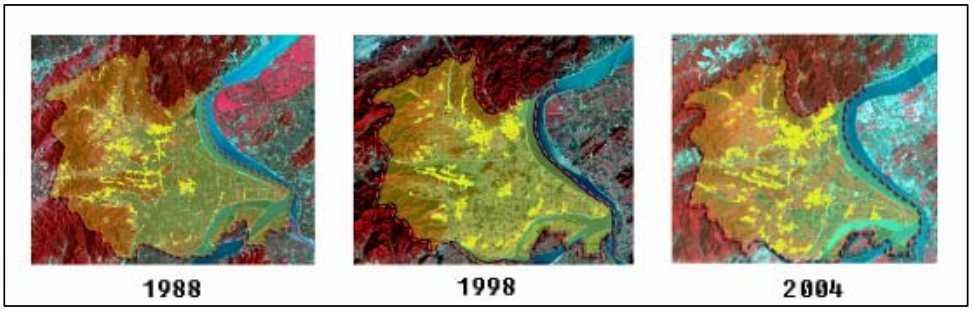


Fig. 37: The development of urban area (yellow) in Zhuantang district

3.2.3 Challenges in the development of Zhuantang area and the role of stakeholders

Growth of residential areas
Suburbanisation through the spread and redevelopment of housing (figure 38) is a common phenomenon in the Zhuantang region. It is also the main motivation to push the development in this region. The main interested parties concerned in the housing project are the municipal government, real estate developers, urban residents and village people.

Fig. 38: Residential area before and after redevelopment (Photo: Yang J.)

(1) Municipal government
The 1990s saw the phenomenon of suburbanisation around the urban core areas of Hangzhou. The Zhuantang region was not developed due to the protection of the West Lake Scenic Area and its function of providing water resources for the city. In the 21st century, Hangzhou government made the overall “Plan for Hangzhou City” (year 2001-2020). With the “Protection and Development Plan for Western Hangzhou”, tourism and urbanisation of the central city became the main drivers for development in the Zhuantang region.

(2) Real estate developers
Due to the location close to the main city and close to attractive landscapes at the foot of mountains (Pinfeng mountain and Wuyun mountain) and the Qiantang River, Zhuantang region has become the first choice for real estate developers for the high-end market.

(3) City residents
The City residents' changing attitude towards consumption and preferences for attractive residential locations has greatly changed with the improvement of living standards, the transformation into market economy and an improved urban and rural infrastructure. The expansion of residential areas into suburban zones accelerated due to the transfer of living and leisure functions from the city to the outskirts such as Zhuantang.

(4) Farmers
The land for real estate development comes originally from the confiscation and auction of farmer's land. In this process, on the one hand, farmers have the wish to move into new house so as to improve their living conditions, on the other hand, the government is required to compensate those farmers who lose their lands.

Tourism
Zhuantang is an ideal area for the extension of tourism from Hangzhou city. Hence, the development of tourism is one of the main push factors for local development. Conflicts between tourism development and environmental protection seem to be unavoidable. The interest parties concerned include the municipal government, tourism developers, and tourists.

(1) Municipal government
Hangzhou municipal government approved the development strategies for westward expansion of tourism in 2002. The overall "Hangzhou City Plan" in 2006 stated the goal to develop an Asian style city for tourism and leisure. Based on these strategic guidelines, the development of tourism in the Zhuantang region made real progress. At the same time the importance of sustainable development became a government issue. The functional positioning in the amendment of the "Protection and Development Plan for Western Hangzhou" (southern area), approved in 2007, was to develop Zhuantang as a resort for tourism and recreation within a high quality ecological environment, attractive scenery, prosperous economy, stable social conditions, wealthy living conditions, a demonstration zone of ecologically friendly development and integration of urban and rural development. The planning principle is to actively protect the environment and exploit its resources cautiously.

(2) Tourism developer
The development of tourism was mainly effected through investment by the government. However, with the progress of market economy, tourism development is increasingly driven by developers, which put severe pressure on the environment. The municipal government has adopted the policy to support the developer's profit on condition of environmentally non-destructive development (i.e. no heavy polluting industries, an environmental plan is required for factories).

(3) Tourists
The Zhuantang region is well suited for the development of holiday resorts; where people can relax and enjoy nature. However, if the tourist numbers surpass the ecologically capacity, it will be harmful to the environment. Therefore, planning aims to limit tourist numbers (indirectly by limiting the amount of hotels etc.) in order to keep a balance between economic development and protection of the environment.

Agriculture
Zhuantang region for long time had an agricultural production base. The first primary sector still remains a major industry within this area. However, recently much farmland was confiscated and auctioned for urban development, which has caused an enormous impact on

agriculture, and farmers' living conditions. The interest parties involved in this process are the municipal government, the village government, developers and farmers.

(1) Municipal government
The scattered pattern of villages and rural residences in the fringe area cause three negative impacts in urban and rural development. These are low density of urban development, low intensity of land-use and a low economic profit. To make full use of the land for urban development, the government confiscates the farmland in the Zhuantang region and sells it on land auctions. The allocation of new residential areas, most of which are multistory houses and to a smaller degree town houses, is arranged thereafter. Generally 60m² of residential space are assigned to each person.

10% of the confiscated land is reserved for farmer's use (see below and chapter 3.2 for further details). The government also offers a life-long pension to those farmers whose village has been reorganised. Moreover, the government spares some high quality farmland from development. The results from current research for the amendment of the "Protection and Development Plan for Western Hangzhou" (southern area), suggest that future development should emphasize environmental protection, carry out an evaluation of the land resource and divide the whole region into four types of zones to effectively secure the farmland:

- a zone where construction is prohibited,
- a zone with restrictions for construction,
- a zone which is suitable for construction and
- the already built areas.

(2) Rural government
10% of the confiscated land, together with some direct financial compensation, is run by a cooperative organised by the rural government. Village people receive a certain amount of the shares every year, which contributes to their income after the reorganization.
(3) Developers
Generally, the rural cooperative will search for a developer to attract investment. In this sense, the developers increase the economic growth of the rural collective. However, the goal to maximize economic benefits can have a negative impact on the local environment.

(4) Rural people
The major problem faced by rural people living at the city fringe is how to survive after land confiscation. At present, most of them rent out the additional houses allocated to them, and they move into the city to work, or they simply live on the collectively-run reserved land and from the compensation paid to them. The protection of rural people's income is a significant issue during land-use exploitation and protection.

3.2.4 Discussion

The major challenge for the Zhuantang district is how to maintain the balance between the promotion of economic development and the protection of the environment. In order to achieve a good spatial structure and enhance Hangzhou's role as an international scenic tourist city, Zhuantang area has been designated as the scenic and water source protection area in the urban planning scheme of Hangzhou for many years. It also served as an agricultural production base for the city. Moreover, the new overall urban spatial planning scheme of Hangzhou assigns Zhuantang area to become an important ecological zone for Hangzhou. It forms the ecological belt in the southwest, one of "the six ecological belts" in the metropolis, mainly designated as an ecological belt between the city core and the city clusters. In the strategy of "Tourism Westward", the development of Zhuantang area is described as the expanding urban tourism and ecological protection area, which requires strict control of the amount and density of urban development.

Therefore, Zhuantang area has been greatly limited in its economic and social development. In comparison with other towns in the peri-urban area of Hangzhou, Zhuantang area has developed very slowly in recent years with a weak economic basis and laggard social undertaking, and the gap to prospering areas is widened. It has become "the backward area" during the development of Hangzhou. Therefore, Zhuantang's local demand for development is strong. In 2006, the new Protection and Development Plan for the Western Area of Hangzhou has proposed a strategy of protection and development for the Zhuantang area to achieve a win-win situation between nature protection and economic development. The planning approach can be described as far less dynamic than in the eastern parts of Hangzhou, more dedicated to nature conservation and giving economic targets less importance.

3.3 Land-use development, spatial planning and strategies for the Xixi area

3.3.1 General information on the Xixi area

Xixi Area is located in the northwest of West Lake District in Hangzhou. The study area includes Xixi National Wetland Park and its neighbouring area including Jiangcun township, which are called the western city. Historically, Xixi area was a plain with a large pond and river network, which was known for its beautiful environment rich ecology, and it was the place that famous people and intellectuals in different dynasties loved to frequent.

The study area, 5-6km away from the city core, reaches Gucui Road in the east, the east side of Ring Road greenbelt in the west, Tianmushan Road in the south and Yuhangtang River in the north, with a total area of 23.06 km^2. The area is separated from the famous West Lake Scenic Area only by a hill. The core of the study area is wetland.

Administrative regions division
In order to make statistics, the selection of the study area is made according to administrative units (table 7). It includes Jiangcun township, Wenxin Street and Gudang Street. It is a part of West Lake District.

Tab. 7: Administrative region division of Xixi District (2006)

Administrative units	Area (km^2)
Jiangcun township	14.43
Wenxin Street	4.08
Gudang Street	4.55
Total	23.06

Data source: Statistics Yearbook of West Lake District (2006)

Population

With the rapid urbanisation of Hangzhou over the last decade, Wenxin Street and Gudang Street are now basically built-up areas. The original rural inhabitants have become urban citizens along with the demolition of villages for housing construction (table 8). In parallel, the municipal government of Hangzhou officially launched the protection and development of Xixi National Wetland Park in 2003, and accordingly the farmers who originally lived in the wetland have been resettled outside.

Tab. 8: Population distribution and composition in Xixi District (2006) unit: person

Street (township) name	Total population	Among		Among	
		Non-registered population	Registered population	Urban population	Agricultural population
Wenxin Street	76,098	33,209	42,889	76,098	0
Gudang Street	54,906	16,566	38,340	54,906	0
Jiangcun Township	19,228	3,534	15,694	8,205	11,023
Total	150,232	53,309	96,923	139,209	11,023

Data source: Statistics Yearbook of West Lake District (2006)

Land-use

Historically, the Xixi wetland area extended over 60km^2. A decade ago, the western city region was a wetland covered with persimmon forests and reed ponds. Due to the rapid westward of urbanisation, the water area in Xixi Wetland was rapidly destroyed. Today, Xixi area is a peri-urban area with a mix of built land and open land. Farmland and water surfaces still predominate the area (table 9).

Tab. 9: Land-use in the Xixi area (2006).

Categories	Area (ha)	Percentage (%)	Land use type	Area of Land use (ha)	Percentage (%)
Construction land	909.47	39.44	Residential	393.10	17.05
			Public and commercial facilities	123.53	5.36
			Industrial	283.07	12.28
			Roads	48.78	2.1
			Green spaces	60.99	2.6
Non-construction land	1397.48	60.56	Farmland	540.77	23.45
			Horticulture	209.12	9.07
			Water surfaces	647.59	28.08
Total	2306	100,00		2306	100,00

3.3.2 Spatial planning and land-use development

Land-use change

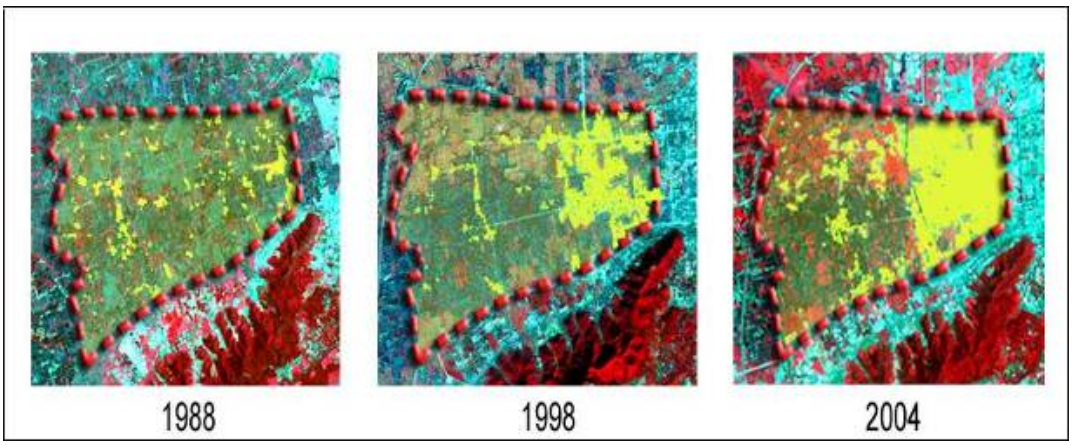


Fig. 39: Development of built-up aras (yellow) in the Xixi area.

Figure 39 shows the land-use change in the built-up area in 1988, 1998 and 2004 (the yellow parts in the images are the built-up areas). These images reflect the "westward" process of urbanisation in Hangzhou: the urban land has expanded to the west year by year, the agricultural land has been decreasing and the wetland area has been shrinking.

From the figure, it can be seen that Xixi area in 1988 was dominated by farmland, where water networks were densely distributed with only a few settlement points sporadically dispersing there. On the image of 1998, a continuous stretch of built land (residential real estate) can be seen in the east part of Xixi area (i.e. today's Wenxin Street and Gudang Street). At the same time, the inhabitants originally living in Xixi Wetland constructed buildings and expanded their houses without authorisation. Therefore, residential area had also sprawled into the wetland. With the continual advancement of urbanisation, the eastern part of Xixi area had been totally urbanised until 2004. Gudang Street and Wenxin Street were taking shape to become the urban area.

Land use planning

(1) 1950s - the early 1990s
After the foundation of the PR China in 1949, many plants and houses had been established in the hilly areas at the south bank of Xixi Wetland, and a majority of scenic spots had been damaged. The excessive emphasis on industrial and transportation development and neglection of the scenic resources protection led to the uncontrolled development in the Xixi Wetland area.

However, the urbanisation process was very slow in Xixi area before 1990, and the spontaneous urban sprawl could not change the basic pattern of the area which was centred on farming, fish ponds and mulberry forests.

(2) The early 1990s until the present: “Jiangcun Phenomenon”
In 1996, everything changed when Jiangcun Township, which had been part of Yuhang County City was incorporated into Hangzhou. The commercial residential area of Jiangcun (i.e. today’s Wenxin Street), located in the east part of the study area, was touched firstly by the new wave of urbanisation.

Formerly, the area had been a part of Yuhang City, so there were no supporting infrastructures of relevance. As there were even no standard urban roads, real estate developers obtained the available land for development at extremely low land use prices, the lowest one being only 30,000-50,000 yuan per mu, corresponding to appr. 4.6 – 7.7 Euro per m^2 (calculated with conversion rates from September 2008, where one yuan was appr. worth 0,103 Euro; 1 mu equals 666.66m^2).

In May 1996, Jiangcun Village was incorporated into the West Lake District of Hangzhou by administrative reform. In the same year, the large-sized residential district in the western urban region took shape with the development of the first generation of commodity housing such as residential quarter of Kangle , Dangui Apartment, Jindu Garden, Nandu Garden, and Hupan Garden.

In 1998, the welfare-oriented public housing distribution system was abolished, and a series of housing reform policies had been successively issued. At that time, the only area that could supply a large number of houses for Hangzhou's citizens was Jiangcun area at the periphery of the city. The high-grade residential communities such as Osmanthus Town Quarter were highly valued by the market. Then, the competition of over 40 developers in succession transformed the western city region into the mainstream hot area of the real estate development of Hangzhou.

In less than 10 years, more than 300ha of large residential compounds have been developed on a surface area of 4 km^2 by dozens of real estate developers, and more than 150,000 inhabitants lived there in 2006. The area has become the largest residential district in Hangzhou.

However, due to the strong development of the western city region, propelled by the spontaneous development activities of real estate developers, the supporting infrastructures have not kept pace with the development. In the beginning, there were no supermarkets and only few main roads and bus lines in the entire commercial area of Jiangcun Village.

Recently, vigorous intervention of the government, some amendments, complementation and adjustments have been made in terms of urban planning, supporting facilities and infrastructures construction, while the new Zijingang Campus of Zhejiang University and Cangqian University Park have contributed to the increased prosperity of the commercial residential district of Jiangcun and its mixed, up-market residential, commercial and economic character. The land use price of Jiangcun Township is 10 million yuan per mu (corresponding to appr. 1,545 Euro per m^2 area) (http://www.hangzhou.gov.cn/)
"The Jiangcun Phenomenon" of the 1990s is considered a success story in the peri-urban housing development because of the successful integration of Jiangcun as a new district into Hangzhou city and the combination of public planning with private development. A serious problem, however, was that housing development was made in advance of infrastructure development. At the same time, it contributed to urban expansion and peri-urbanisation in Hangzhou.

(3) Xixi National Wetland Park
Xixi Wetland has been inevitably eroded by the rapid westward urban development. The wetland area decreased from originally 60 km^2 to the present 10 km^2.
The environment of Xixi Wetland has been seriously impacted by the increasing number of farmers housing, the filling of wetlands, the discharge of waste water from nearly 230 industrial enterprises to the wetland and the sewage of nearly 10,000 inhabitants. Statistics of the Environmental Protection Bureau of Hangzhou show that the water quality of most water

bodies in Xixi Wetland in 1997 was still Category III and some even Category II. However, in 2000, the water quality of the vast majority of water bodies had declined to Category V. Immediate measures were necessary, to protect and restore the valuable ecological area. In 2001, the development strategy of "Tourism Westward" accelerated the tourism development in the western region of Hangzhou. In November 2001, Hangzhou reviewed and passed the Protection and Development Planning Programme for the Western Region of Hangzhou for the protection of the environment. Accordingly, the "Xixi Wetland Cultural and Ecological Tourism Area" had been planned and realised in line with the local conditions, so as to further promote the qualities of the area for tourism.

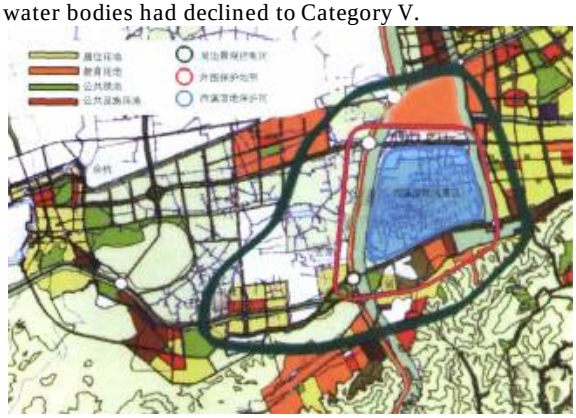


Fig. 40: The scope of Xixi Wetland Reserve. Black line: wetland area; surrounded by street network of urban extensions.

In 2002, Xixi Wetland was listed by the government of Hangzhou as the key project of "Tourism Westward".

In 2003, the municipal government of Hangzhou officially launched the comprehensive Xixi Wetland Protection Project.

In 2004, the Xixi Wetland Reserve Master Plan (figure 41) was officially approved by the municipal government of Hangzhou. Hereby, Hangzhou is committed to develop Xixi Wetland into a national-level wetland park that shall become an international model for renaturation of wetland areas. According to this plan, Xixi Wetland was divided into three areas:

Fig. 41: Master plan for Xixi Wetland Park

- core protection area,
- periphery protection area
- neighbouring control area,

Among which the core protection area has a total size of 10.08 km². The financial input for the whole protection project is estimated at 3-4 billion Yuan. The plan will be implemented in three phases.

At present, appr. 1.5 billion Yuan have been spent. After completion of the first phase, an area of 3.2 km² has been officially opened to the public on May 1, 2006. The second phase is presently carried out. The actual total area of Xixi Wetland is 11.5 km², of which 70% is water surface, including 2,773 fish ponds of various sizes.

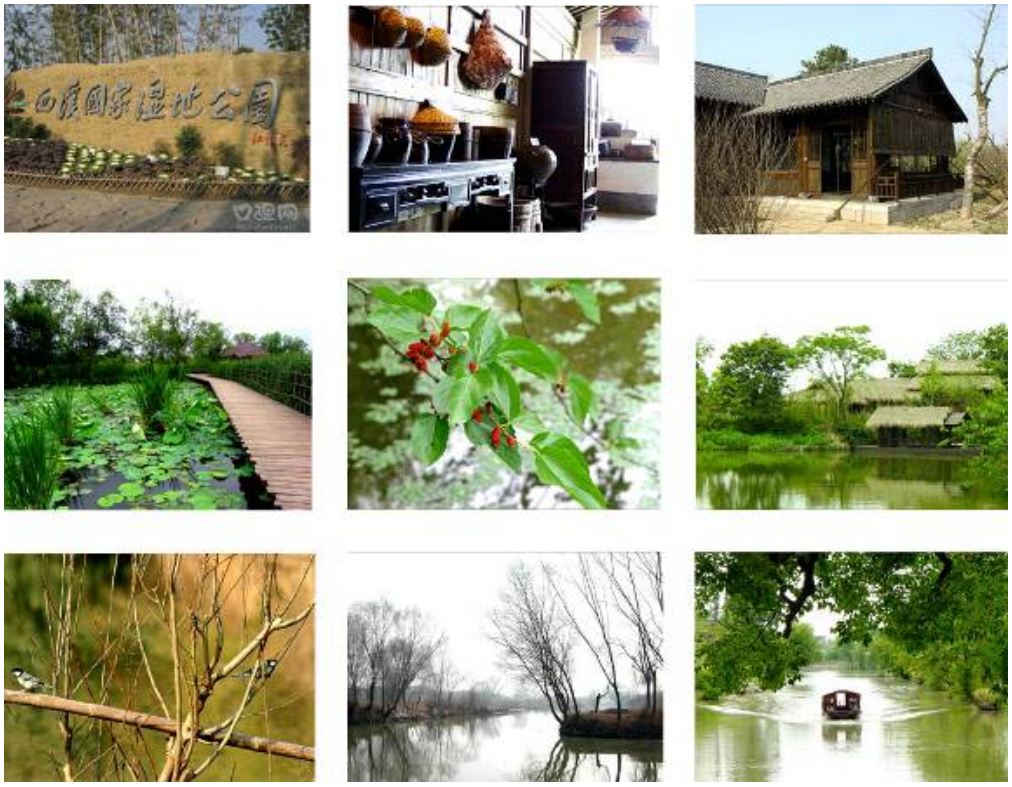


Fig. 42: Impressions of Xixi Wetland

The protection project of Xixi Wetland involves multiple interests. One of the most prominent problems is how to ensure the livelihood of the relocated people who had originally lived there. The entire protection project of Xixi Wetland will demolish and resettle more than 2,500 farmer households, involving 13,000 people in 9 administrative villages.

In addition, wetland management is also vital to wetland protection. As Zhou Shao-Xiong, the planner of Xixi National Wetland Park in Hangzhou, pointed out: "If managed improperly, negative effects of tourism on the environment can not be ignored. Tourism development will necessarily increase the number of tourists as well as tourist activities in the tourism area, and meanwhile it will bring with the eco-environmental problems such as the increase of parking lots, damage to walks, land erosion, water pollution, the increase of livelihood sewage emission and solid garbage, traffic jam and air pollution, and the decrease of wildlife species and eco-vegetation in the wetland."

To restore the environment in the wetland, resettlement, reconstruction of historical sites and the conflict between commercial operations and effective management deserve further consideration in the development of the Xixi peri-urban area with Xixi Wetland as its core.

(4) The New Town of Jiangcun

The area of the New Town of Jiangcun had remained a rural landscape before 2006, because of Xixi Wetland acting as a natural barrier. Now, the New Town of Jiangcun Township, located between Zijingang Campus of Zhejiang University and the Xixi National Wetland Park, has become the new development hotspot, in line with city planning goals of "optimizing the west". Construction of the New Town of Jiangcun started in April 2008 and is foreseen to be completed at the end of 2009.

In response to the lack in overall urban planning of the commodity-residential district of Jiangcun, which resulted in fragmented "spontaneous" development and the lack of a coherent urban image, the New Town of Jiangcun is developed according to a comprehensive town development plan including the development of supporting infrastructures.

In 2007, Hangzhou approved the newly issued design scheme for the New Town of Jiangcunin accordance with Detailed Regulatory Planning for Jiangcun. The scheme proposes that the development of the new town will focus on the two themes which are tourism services for Xixi National Wetland Park and the industries' service development around Zhejiang University.

As core residential district of the demonstration area of "Harmonious Hangzhou", the New Town of Jiangcun integrates commerce, business offices, recreation, tourism facilities and residential areas together with the civic centre.

The development of the New Town of Jiangcun marks a shift from commodity-housing-oriented development to a new urban planning layout with modular development of the suburban area.

Xixi Paradise (figure 43) occupies 26 ha land with a total area of over 150,000 m^2 and an overall investment of 2 billion yuan. It integrates public tourism facilities, a wetland museum, a business complex, an international hotel clusters and top-level residential area.

Fig. 43: Master Plan of Xixi Paradise

Fig. 44: Architecture with tea cup figure designed by Javier Pioz

3.3.3 Challenges in the development of Xixi area and the role of stakeholders

Housing development

The rapid urbanisation of Xixi area has been caused to a large extent by the suburbanisation by development of residential areas. At present, the western city region has become the largest residential area in Hangzhou with 150,000 residents. It has also brought a series of contradictions and conflicts of interests.

(1) Government institutions
The former division of administrative units has had great negative effects on the development of Xixi area, which is especially obvious in the development process of the commercial residential district of Jiangcun.

Urban planning and development are operated in the jurisdiction of the governments at different levels. Since Jiangcun Township was under the Yuhang County which prepared its own urban plan and land-use plan, the development of the commercial residential district of Jiangcun was not coordinated with the plan of Hangzhou, and moverover the plans lagged behind development. As a consequence, there are only sound supporting facilities within the commodity-housing areas , but there are no supporting infrastructures for the whole region, such as schools, hospitals, buses, pipeline gas, square, public green spaces, etc.

Recently, many amendments, complementation and adjustments have been made in terms of urban planning and the construction of supporting infrastructures, while human resources such as Zijingang Campus of Zhejiang University and Cangqian University Park have been introduced, which led to the prosperity of the commodity-residential district of Jiangcun and supported the economic development.

(2) Real estate developers
In 1996, when the inclusion of Jiangcun into Hangzhou City was bound to be a fact, shrewd real estate developers came in crowds to obtain land-use rights at very low prices for real estate development. The developments were neither well planned nor supported by facilities and infrastructures. The development lacks in overall urban planning and the urban image was poor.

(3) Urban residents
In the development process of the commodity-residential district of Jiangcun Village, some up-market residential areas appeared such as Osmanthus City, Sunbelt, Star Garden, attracting large number of people to live in. According to statistics, the households living in the commodity-residential district have reached 37,000, with a population of 114,000. This is the largest commodity-residential district in Hangzhou. People who bought housing there have a certain consumption capacity.

At the beginning of the development of the commodity-residential district, there were relatively sound supporting facilities for various buildings, however the entire western urban region had a lack of supporting infrastructures, such as schools, hospitals, buses, gas pipelines, public open space, green spaces, etc. With more people living in the region, some municipal-finance-based supporting infrastructures began to be constructed under the unified urban planning of Hangzhou. At present, there are 6 primary schools and 4 middle schools with nine-year schools included.

Guarantee of farmers' interests
In the process of the development of peri-urban areas, a prominent problem is how to satisfy the interests of farmers who lost their land. The implementation of the Xixi Wetland Protection Project requires resettlement of nearly 10,000 inhabitants. The compensation to the land-lost farmers as well as the guarantee of their future livelihood has brought huge social pressure to the implementation of the project.

(1) Government institutions
Xixi Wetland Protection Project is an example of how the government deals with the conflicts between individual and public interests. In the area covered by the first and second stage of the wetland restoration project, there are 10 administrative villages with 53,000 inhabitants. A large amount of sewage as well as wastewater from fish and geese breeding, and enterprises

has had a strong negative impact on the water quality of Xixi. Moreover, cultural heritage such as the inscription boards left by the ancestors to Xixi Wetland were gradually lost.

In order to resettle the original inhabitants, the government set up several settlement points to provide farmers with housings, and at the same time provide social security and venture funding to the farmers to encourage them to become self-employed or find a job. The municipal government of Hangzhou spent 4 billion yuan to acquire land and resettle farmers, so as to fully satisfy the individual interest of farmers.

(2) Farmers
The land-lost farmers are the vulnerable group in the process of peri-urban area development. A large amount of land compensation fees cannot guarantee their livelihood for ever, and furthermore, the land-lost farmers have no specific labor skill and therefore have difficulties to find a new occupation.

Fig. 45: Location of resettlement houses for farmers from Xixi Wetland

The resettlement houses at the north of the park (figure 45) are mostly multi-storey apartment blocks, such as Xixi Garden which will be completed in 2009 and Jiangcun Garden which has been completed. Resettlement is carried out in accordance with the *Comprehensive Compensation Standard for the Land Acquisition for Resettlement in Civic Centre of Hangzhou*. In general, households with a floor space of 200m² will get in compensation two resettlement apartments, one for their living and one for renting out. In addition, the farmers can get land compensation fee, resettlement subsidy (including self-employment subsidy) and compensation for crops. Hangzhou is the first city across the country to implement a compensation standard of 10% reserved land, i.e. allocating 10% acquired land area to the village collectives, which can be used for the economic development of the village collectives.

3.3.4 Discussion

The development process of the study area reflects both some general issues of peri-urbanisation in Hangzhou and specific features as regards the impact of strategic decision-making.

Firstly, Xixi Wetland Protection Project is an innovative approach to urban wetland protection and restoration. Xixi Wetland is neither a pure tourism project, nor a pure environmental restoration project, but a comprehensive protection project in combining the two. In this respect, the project can be considered as a model for areas with similar challenges.

The project follows six principles: (1) ecology has priority, (2) minimal intervention, (3) repairing the old buildings, (4) focus on culture, (5) sustainable development and (6) people-orientedness, in order to integrate urban development, farming, cultural landscape, and ecology wetland.

The concept of “protection & utilization” has been adopted within the context that prominent conflicts between economic development and natural environment need urgently to be addressed by coordinating the multiple stakeholders. Xixi Wetland Park achieves the balance between protection and utilization very well. Now, the inhabitants are resettled, water systems are connected, the water is cleaned and the project is implemented.

The construction of Xixi Wetland illustrates some new ideas that the municipal government of Hangzhou applies to manage the city: (1) the construction of Xixi Wetland keeps pace with the development of the entire city. It is a component of the westward policy of Hangzhou and considered as an important step in urban development; (2) the construction of Xixi Wetland helps Hangzhou to strengthen the image of a tourism city. The construction of Xixi Wetland will reduce the pressure on the West Lake area; (3) Xixi Wetland demonstrates application of ecological concepts.

Secondly, the inconsistence among urban planning and the division of administrative units posed serious constraints on the urban development in the west of Hangzhou.

It is concluded that Xixi demonstrates the need for coordinated urban planning across administrative divisions. Special attention should be paid to the integrated development of urban and rural space. A regional perspective should be adopted, including realignment of administrative divisions and nature restoration and urban development should be combined to create win-win situations as the Xixi wetland park demonstrates.

3.4 Land use development, spatial planning and strategies for Binjiang District

3.4.1 General information on Binjiang District

Location
Binjiang District is located appr. 7 km away from the city core at the south bank of Qiantang River, with a total area of 73.3 km^2. It is connected with the city core of Hangzhou through three bridges. It is to become the future sub-civic centre and high-tech industries town of Hangzhou. Binjiang District has good transport connections. The distance to Hangzhou Xiaoshan International Airport is only 15 km. Moreover, the Shanghai-Hangzhou-Ningbo Expressway follows the border of the district.

Economic and social development
Binjiang District has become the most vigorous economic growth zone of Hangzhou based on software industry, IC design, animation industry, and communication industry. There are nearly 5,000 enterprises in the High-tech Industries Zone of Hangzhou (Binjiang District), 445 enterprises of which are foreign-invested enterprises from 32 countries such as the USA, Japan, Britain and Korea.

During the Tenth-five-year Plan period, the total production value in the entire district increased from 6.1 billion yuan to 15.06 billion yuan, corresponding to an average annual growth of 19.8% (8.8% for the entire country, 12.8% for Zhejiang Province and 13.6% for Hangzhou); the total income from technology, industry and trade increased 3 times from 22.8 billion yuan to 91.2 billion yuan; the total financial income increased 3.4 times from 840 million yuan to 3.7 billion yuan, corresponding to an average annual growth of 43.5% (14.7% for Zhejiang Province and 29.5% for Hangzhou) (13.6% for Zhejiang Province and 29.3% for Hangzhou).

Tab. 10: Economic and social development indicators for Binjiang District, 2002-2005

Indicators	2000	2005	Average annual growth rate
GDP	6.1 billion yuan	15.06 billion yuan	19.8%
Total income from technology, industry and trade	22.8 billion yuan	91.2 billion yuan	32.0%
Among: High-tech technology industry	17.78 billion yuan	70.2 billion yuan	31.6%
Fixed asset investment	1.41 billion yuan	8. 95 billion yuan	44.7%
financial income	8.4 million yuan	3.7 billion yuan	34.5%
Among: local financial income	3.5 million yuan	1.8 billion yuan	38.8%
Total export	350 miilion US dollars	2.08 billion US dollars	42.8%
Structure of primary, secondary and tertiary industries	3.8% - 81.2% - 15.0%	1.3% - 68.7% - 30.0%	——

Total contracted foreign investment		1.377 billion US dollars (*)	
Total utilized foreign investment		739 million US dollars (*)	
Total contracted national investment		21.381 billion yuan (*)	
Total utilized national ivestment		13.49 billion yuan (*)	
Per capita income of farmers	7011 yuan	10000 yuan	7.4%
Urban registered unemployment rate		4.4%	
Natural population growth rate	4.6‰	3.5‰	
Total introduced talents		53537 persons (*)	
Among; senior talents		3135 persons (*)	
R&D investment		2.58 billion yuan	
Total constructed urban roads		123 km (*)	
Total newly added urban green spaces		4.26 million m2	
Total multi-stories housings constucting		3.465 million m2 (*)	
Total multi-stories housings completed		2.068 million m2 (*)	
Total multi-stories housings in use		1.285 million m2 (*)	
Total resettlement		3,816 households	

Data source: Statistics Yearbook of Binjiang District (2006) * in the table is the totalled value

Administrative units
There are 3 streets under Binjiang District: Puyan Street, Xixing Street and Changhe Street, with 12 communities and 23 administrative villages (table 11).

Tab. 11: Administrative region division of Binjiang District (2006)

Administrative units	Area (km2)
Xixing Street	15.16
Changhe Street	30.42
Puyan Street	26.44
Total	72.02

Data source: Statistics Yearbook of Binjiang District (2006)

Population
Due to urban development, Binjiang District has demolished villages for constructing residential areas, as a result of which the agricultural population is continuously decreasing. At the same time, the migrant population including entrepreneurs and immigrating workers has been increasing in number (table 12).

Tab. 12: Population distribution and composition in Binjiang District Unit: person

Street Name	Total po-pulation	Among		Among	
		Non-registered population	Registered population	Urban population	Agricultural population
Xixing Street	45,082	23,236	21,846	38,098	6,984
Changhe Street	64,898	23,533	41,365	55,886	9,012
Puyan Street	88,621	25,035	63,586	77,598	11,023
Total	198,601	71,804	126,797	171,582	27,019

Data source: Statistics Yearbook of Binjiang District (2006)

Land-use

Tab. 12: Land use in Binjiang District (2006)

Categories		Area (ha)	Percentage	Land use function	Area of Land use (ha)	Percentage
Construction land		3068.70	41.85	Residential land	986.45	13.45%
				Public facility land	94.93	1.29%
				Industrial land	620.21	8.46%
				Special land	21.56	0.29%
				Transportation land	358.28	4.89%
				Green spaces	100.93	1.38%
				Residential land in town and village	886.34	12.09%
Non-construction land		4264.30	58.15	Cultivated land	1,600.70	21.83%
				Gardens	677.42	9.24%
				Forest land	309.19	4.22%
				Rivers and water bodies	1445.16	19.71%
				Others	231.83	3.15%
Total		7333.00	100		7333.00	100,00%

3.4.2 Spatial planning and land-use development

Land-use development process of Binjiang District
Diagram 3.11 is the remote sensing images which show the land-use situation in the built-up area of Binjiang District in 1988, 1998 and 2004. These images vividly reflect the rapid advancement of urbanisation in 1998-2004, in which urban land had increased and agricultural land had dramatically converted to other land uses.

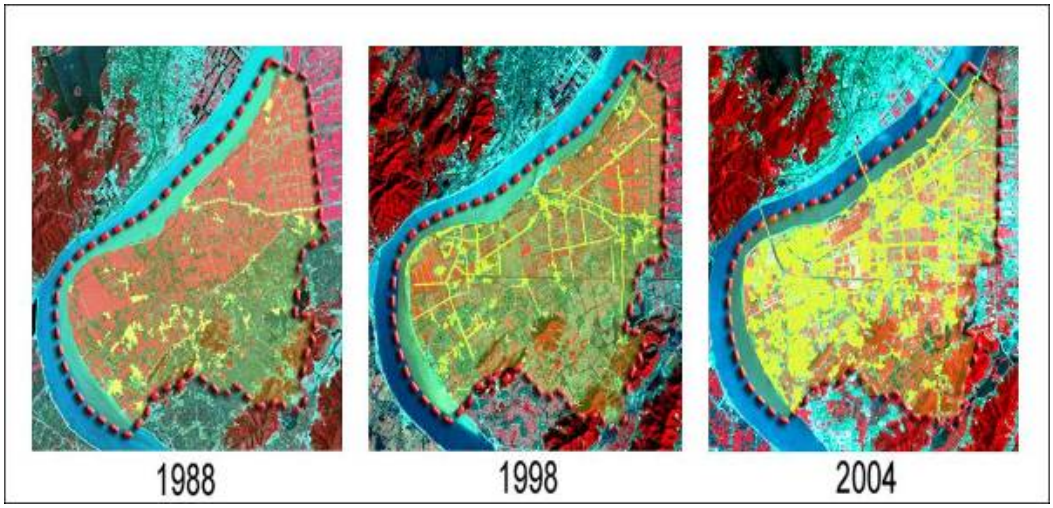


Fig. 46: Development Of the built-up areas (yellow) in Binjiang District.

In 1988, most land in Binjiang District was basically agricultural land (figure 46), with a few farmer settlements sporadically scattered in between. In 1996, the High-tech Tech Industry Zone was officially established, and the government invested largely to construct urban infrastructures. Up to 1998, it can be seen from the images that the road network took shape. Different from Xixi Wetland which is characterized by gradual sprawl, Binjiang District has been developed under the guidance of the government, so the road system was the first to take shape. Later, from 1998 to June 2004, the urbanisation process in Binjiang District has been very fast. The grid-shaped road system has been completed and a large stretch of agricultural land has been converted to construction land.

Analysis of development of Binjiang District

(1) Before 1996
The development of Binjiang District started with the establishment of Hangzhou High-tech Industry Development Zone on March 1990. On March 1991, this zone was approved by the State Council as the national high-tech zone, and it is also the only national high-tech industry development zone in Zhejiang Province.

Xixing, Changhe and Puyan had been the administrative regions under Xiaoshan County City, and were included into Hangzhou with the six towns of Sandun, Jiubao, Xiasha, etc. when Hangzhou adjusted its administrative division in 1996. In December of the same year, Binjiang District was set up. Binjiang District was then a typical peri-urban area. The development of Hangzhou had been limited along Qiantang River, and there were large stretches of plain land at the south bank of the River.

(2) 1996 to the present
In 1996, the State Council approved the set-up of Binjiang District, and in June 1997, Binjiang District was officially established. As then policy objective of the government was to promote economic growth and industrialization, the function of Binjiang District was monotonous, centred on industrial development.

In 2001, with the approval of the State Council, Hangzhou made a great adjustment of the administration division. The cities of Xiaoshan and Yuhang were abolished and merged into Hangzhou as Xiaoshan District and Yuhang District. After the adjustment, Binjiang District was located at the centre of the new Hangzhou. The urban pattern along and across the river

provides new space and impetus for the development. Binjiang District has gradually evolved into the central area of Great Hangzhou.

The main role of Binjiang District has also shifted from the original economic development zone to an urban zone, together with Xiaoshan City as one of three sub-civic centres of Hangzhou (the other two are Linping Town and Xiasha Town).

In 2002, City Government of Hangzhou decided to adjust the administration system of High-Tech Zone and Binjiang District. Since then, the Zone and the District are jointly administered.

As a national high-tech development zone, Hangzhou High-tech Zone benefits from a special national preferential policy (for instance, a large part of the tax revenues is kept within the district). These policies have promoted the rapid economic and social development of Binjiang District.

In 2002-2006, the total land area sold reached 2.5859 million m^2, and the annual land area sold was more than 500,00m^2, among which near 30% of land sold was used for the construction of residential areas. In the District, the road system has taken shape. Of the 23 administrative villages in the District, 18 villages' land had been collected and 35,000 farmers have become citizens.

According to statistics, the total area of cultivated land decreased by 13,615 mu within five years in Binjiang District, about 32.9% of the land when the District was set up. The District set up a farmland protection zone with the Changhe National Comprehensive Agriculture Development Zone to protect and promote agriculture and resource protection as well as recreation.

Binjiang District established the guiding principle of "environment -orientation". In the planning and construction, much attention is paid to environmental protection and great efforts have been made to treat pollution, guide the direction of industrial development and greening of the environment: "blue sky, clear water, greenness and quietness".

According to the urban plan, Binjiang District will form a landuse structure whereby the northen part along Qiantang River will become a comprehensive area of public services, R&D and residences, the industries zone is in the central part, and the southern part is the R&D, residential and ecological protection area (figure 47).

Fig. 47: Land use structure of Binjiang District

3.4.3 Challenges in the development of Binjiang District and the role of stakeholders

Industrial development
(1) Government institutions
The development of Binjiang District benefits from the exceptionally advantageous policies. The preferential policy that the state grants to the high-tech industrial development and the special policy endowed by the municipal government of Hangzhou, as well as the preferential policies that Binjiang District grants to foreign-invested enterprises create a good environment for investment in high-tech and high-additional-value industries.

Furthermore, the efficient and low-cost urban management model promotes industrial development. The district government of Binjiang sets up government institutions according to "small institution and better service" as well as "simplification, unification and efficiency", and improves the efficiency and level of administrative service.

Most importantly, Binjiang District attaches importance to industrial development. The "Eleven-five-year Plan" proposed the strategy of "vitalizing the district with industry", and stressed the importance of large-scale, international and ecological development of high-tech industry with strong competitiveness and good growth prospect. These are "the two strong industries (communication equipment manufacturing and software), the two quality industries (IC design and digital TV) and the two new industries (kosplay and internet games)"

(2) Enterprises
Big enterprises can play a agglomerating and pulling role in the industrial development. On the one hand, Binjiang District actively aims to introduce the world top-500 enterprises, and the headquaters of nationally known enterprises and regional R&D centres of multi-national corporations into the district, and on the other hand, it promotes the development of the modern service sector such as business and trade, finance, insurance, and intermediary services.

(3) Talents
Binjiang District makes efforts to create a modern-style garden city with a strong business atmosphere, good innovation facilities and good living environment. It aims to attract talents through perfecting the infrastructures and supporting services in the zone and providing an environment for economic and social development.

It is hoped that the attraction of talents will contribute to the improvement of scientific and technological innovation capacity. Along with the concentration of foreign-invested enterprises and high- tech enterprises in the new town, a mechanism that can improve the quality of entrepreneurs and increase talent capital has been established, and additionally the construction of higher-education park establishes collaboration and support among industry, colleges and research institutes, which will be conducive to the growth of innovation organization and innovation capacity.

Farmers' interests
(1) Government institutions
Binjiang District has a size of 73 km^2, with only 30,000 mu (2,000 ha) cultivated land and only 0.4 mu (267 m^2) cultivated land per agricultural person. Therefore, land is a very valuable resource. To exploit land resources to a largest extent, and by doing so improve the land utilization effectiveness, and to support urban development, Binjiang District builds multi-stories settlements in the countryside to reduce the space demands by farmers' houses. The District has special policies to ensure that the new citizens can afford the housing. The former farmers can buy up to 50m^2 floor space per person at a low price of 670 yuan/m^2 (67 Euro per m^2).

The Land Management Bureau of Binjiang District has estimated that the development of multi-storey housing will only require 40% of the land that the individual houses occupy which were built by the farmers. This means that 2,000 mu (133ha) of land will be saved if 10,000 farmer households are moved to the multi-stories housing. Sufficient income is generated from the land sold to subsidise the construction of these multi-storey houses by the government.

The the government of Binjiang District prepared and issued policies such as *Countryside Multi-stories Housing Purchase Measures of Binjiang District* and *Countryside Multi-stories Housing Selection Measures of Binjiang District*, to support farmers with respect to: (1) new flat; (2) house price; (3) environment and supporting facilities.

In addition, Binjiang District integrates those who are transformed from farmers to citizens into the urban employment system, and helps them in finding jobs, getting training to qualify for jobs or becoming self-employed.

Binjiang District also gives incentives and preferential supporting policies to support enterprises in the District to employ the local unemployed land-lost farmers. Moreover, Binjiang District provides social security for land-lost farmer to ensure their basic lives.

(2) farmers
With these policies, the farmers in Binjiang District have a better quality of life. Most former farmers who attended skill training are smoothly reemployed. In addition, villagers older than 60 years receive a pension and poor villagers receive the basic life security, while the cooperative health provides medical treatment.

By the end of 2007, the permanent population in Binjiang District had been 96,154, the actual unemployment rate had been as low as 2.6%, the total rate of people covered by pension insurance had reached 94.11% and that of people covered by health care had reached 99.4%. The resettlement communities for farmers have a higher standard in planning and design than other urban communities. They include a hospital, nursery, primary school, and shops. Flats have a high standard, including internet connection. According to the policy, every household can have two or more apartments: one for their living and the other(s) for renting, to ensure a stable household income in the future. The flats are sold at a price which is held much below market values. In addition, farmers' multi-storey apartments contain floor space for commerce and services at the ground floor to promote economic activities.

3.4.4 Discussion

In the context of economic globalization and strong economic development, China is facing a phase of extremely rapid urbanisation. The proportion of the urban population is expected to increase from currently appr. 45% to 70%. The excessively high density of population and economic and social activities will impose huge pressure on the management of cities.

The development of "new towns" is one way to deal with these challenges. Binjiang District is an example of this approach. It is a top-down planning approach where the government plays a leading role. While Binjiang was originally planned as an industrial zone, goals have shifted to the creation of a mixed science city with distinctive urban character, a beautiful environment and good provision of urban functions and facilities.

There is a wealth of innovative practices in the development process of Binjiang District, which can give reference to the development of peri-urban areas in the future.

(1) Financing mechanism for investments: The District was enabled to retain most of the revenues generated in the district through sale of land and tax. A company for investment into infrastructures and the Economic and Technology Development Company were established. The District used financing by the market for investment into infrastructures, etc. According to

the principle of "who invests, who benefits", the District fully opens up the field of urban infrastructure construction, introduces diversified urban construction funds, holds public auctions for bus routes, road names and the right for outdoor advertisement, and pushes green spaces tending, road cleaning, installation of street lights and traffic signs through private companies.

(2) A flat and efficient administrative management system has been established. In accordance with the idea of “small government, better services”, the District integrates ten bureaus such as Statistic Bureau, Planning Bureau, Economy and Trade Bureau, etc. into a flat institution set-up, simplifies approval procedures, and develops and creates capable and efficient institutional environment. The District focuses on the support to key industries and enterprises, reduces the burden on enterprises, promotes the new town as a “no-fee zone”, and strengthens the attractiveness of the new town for talents, investment and enterprises. In accordance with international practices, an institutional framework is developed which can cope with international economy.

(3) A flexible and effective land-use system has been developed. The District adopted land policies based on the principles of strict control for the land to be exploited, and to unify the confiscation and selling of land. A land use plan is made by government, and for instance, all infrastructures are developed by the government first. The District makes efforts to intensify land use in order to reduce urban sprawl.

4 Summary discussion and conclusions

Hangzhou is a special case in the PLUREL project. Situated in China, it represents a type of urban area, development process, and planning culture which is very different from the six European case studies. Study methods had to be adjusted to this special case. While many figures are presented in this report, the focus was placed on providing a more general picture of urbanisation processes in a large Chinese city by qualitative analysis.

The overriding theme for the Hangzhou case study is the process of extremely rapid urban development, and the challenges this brings to the planning and management of peri-urban areas. Main issues identified were (see Chapter 1.5):

- -Extreme speed of land conversion from agricultural to urban. This process is due to planned urban extensions, which take the form of large scale development zones (e.g. Binjiang) or more small scale developments (Xixi area), but also more or less uncontrolled filling-up of "rural" areas due to extension of farmhouses. These processes put valuable farmland and natural resources under great pressure. "Land-use efficiency" in response to sprawl and "ecological city construction" in order to provide good environmental quality (from the connection to sewage systems and waste management to provision of green spaces) have become important political discourses in urban development. A third important discourse is that of "social harmony" to reduce the widening gap between winners and left-behinds of the economic development. The protection of farmland is now even prominent on the national policy agenda.
- Intensification of land use in the core city by reconstruction of low density land built areas is one of the strategies pursued to restrict urban sprawl. While this strategy has some potential, as Webster et al. (2003) pointed out, it leads to problems when cultural heritage and open space/ green spaces are destroyed. Negative social impacts on existing communities can be feared as land prices will increase, and residents are resettled from their existing location. Therefore, it seems important for the sustainable development of the urban core to carefully balance desirable goals of intensification (more efficient use of land to restrict sprawl, better quality houses, etc.) with the need to maintain "social harmony" and ecological functionality of the core city. One of the tools used by the City of Hangzhou in this context is a set of ten criterias for industrial development. Fulfilment of the criteria rewards the developer/ owner of the enterprise with tax rebates. The criteria include, on the one hand, requirements for intensive land use (e.g. density of GDP per floor space pre year, and of overall investment in Yuan per m2 floorspace), and on the other hand environmental standards. These issues would merit more analysis but the focus of our study was on peri-urban areas.
- The enormous growth of peri-urban areas poses particular challenges for planning. The cases of Binjiang and Xixi show two approaches to respond to these challenges. Binjiang can be characterised as a centralistic, large scale development approach where the development of the entire new urban extension is controlled by government. This has been made possible through the set up of a decision-making entity which has to quite some degree autonomy terms of planning and budgets. It sets a strict frame for private developers. The approach appears to be successful in that a high-density urban development is implemented with high standards in terms of provision of infrastructures, quality of flats, etc.

However, critical issues could also be noted. Questions discussed between the European and the Chinese case study partners where

- The spatial scale of development and the difficulties this may bring to develop a well-functioning city with high quality of life for its residents. Certainly, the new urban district contains all the necessary facilities, it has a network of green spaces, etc. but does it develop any social quality comparable to that observed in older residential areas in the city centre? The width of streets, and the overall lack of a fine grain seems to make this very difficult. It may also be asked whether the location and design of the green spaces promotes social activity. Many of the green spaces are located in broad belts along roads to serve visual improvement. So-called ecological corridors along the canals in the district are mostly planted but inaccessible for use. Green space for private use such as allotment gardens were not foreseen in the new urban district.

- Importantly, low consideration appears to be given to integration of agriculture in urban development. Certainly, it is an important issue and the whole development Binjiang can be seen as an attempt to reduce the consumption of farmland but the role of agriculture as an "urban greening activity" is not yet considered in Binjiang, e.g. for providing recreational space and leisure facilities, or the storage of stormwater runoff. Goals of self-sufficiency of Hangzhou in terms of food supply seem to rank low on the political agenda. Perhaps, the greening of small villages in the western part of Hangzhou is the most advanced attempt to combine farming with urban functions. The discussion on the future role of farming in the urban region could not be deepened in this first part of the Hangzhou case study but this will be a task for the next stages, in particular for the development of scenarios of sustainable relationships between rural and urban land use. Questions to be addressed may include whether a model for agriculture can be developed which is highly productive for food supply of the urban population, and at the same time offers recreational opportunities, and protects the environment – to serve overall as the carrier of the green corridors designated in the City's Strategic Plan.

- In this context, The Xixi area offers a somewhat different development model. It gives a stronger role to private developers whereas the government sees its role more in "seeding" the area with incentives in the form of social and technological infrastructure (e.g. Zhejiang University campus). While in the beginning, private enterprise dominated – leading to problems of uncontrolled urban development with a lack of facilities – incorporation of adjacent towns into Hangzhou city has now enabled a more coordinated planning approach and thus redressing the balance between private and public interests.

  A central part of the Xixi approach is the restoration of the Xixi wetland area as an ecological and recreational core area. The importance of this project cannot be underestimated as a model as it demonstrates a new approach to provision of urban green space which restores and integrates cultural and ecological values into the new urban area. It is also a tool for development of upmarket residential areas surrounding the park.

- The Zhuantang area, in turn, differs from both Binjiang and Xixi as urban development is much more restricted and while tourism and environmental protection are important functions for this area. However, recent policies mean more emphasis on urban and economic development, and this has led to more pressure on farmland and environmental resources. A combination of tourism, protection of cultural and natural values and urban development is therefore the main challenge for this area. The "Protection and Development

Plan for Western Hangzhou" is an important instrument for this strategy, which also comprises investment into road infrastructures to improve the accessibility of the area and the creation of tourist facilities. In comparison to the other two case study areas, the future of this part of the city seems still to be less determined which may make it a suitable case for the scenario study in stage three of the project.

- The integration of the former farmers into the social fabric of the new city is an issue in all three case study areas. During urban development farmers loose their land, and are resettled into the new urban district. This means a loss of their former basis for living and a complete change of their life-style. The City of Hangzhou has developed a package of measures to respond to these challenges. In particular, it grants generous compensation to the farmers, including compensation for the lost land and homes, subsidised acquisition of new flats, including one flat for letting to migrant workers. The farmers also receive 10% of the land for setting-up business in a cooperative. Importantly, the farmers get citizenship in the new urban district, which means access to schools for their children, health care, etc., and they are covered by the state pension and social security system. Therefore, the former farmers are now economically considerably better off than before. One of the social problems of integration of the farmers into the new urban district is obviously that the children of farmers are not particularly motivated to seek work as they can live from the income from renting out flats, the share in the co-operative, and/ or receiving state benefits.

In conclusion,

- The study of urban development processes in Hangzhou in chapter 1 provided an overview over the land use history, important turning points and recent trends of urban development. Hangzhou is an outstanding case in the PLUREL project as it is characterised by extreme urbanisation rates, with large, and dynamically evolving peri-urban areas.
- The planning perspective is therefore dominated by an urban perspective. On the other hand there seem to be different philosophies for the development of peri-urban areas. The elaborate planning system (chapter 2) has a range of tools to deal with urban development. These include plans at different levels, both comprehensive and sectoral, the land acquisition, auction and compensation system, and regulations such as the ten criteria for commercial land use.
- Three political discourses for urban development were identified: "land-use efficiency", "social harmony" and "ecological city". These are the official discourses expressed, e.g. in planning documents.
- The three case studies (chapter 3) show different strategies dealing with rural-urban relationships in peri-urban areas. Binjiang is an example for a large scale urban extension. The aim is to create a new urban district which is largely self-contained in terms of functions and facilities. In terms of planning, it is a government approach. Xixi is an attempt to combine residential development with nature restoration. In terms of planning, the role of the government is more restricted than in Binjiang to a coordinating and providing role. Finally, the Zhuantang area stands for the combination of tourism, small scale urban development, farming and landscape protection.

References

Fu Lihua, Qian Jiangu, 2006. The Discussion of Development of Special Areas in Larger City - The Zhuantang Area in Hangzhou as an example. Zhejiang Economic, 2006
Hangzhou Historical Museum, 2005. Map on the history of Hangzhou city and West Lake. Zhejiang Ancient Books Press.
Leman E., 2005. Metropolitan Regions: New Challenges for an Urbanizing China. World Bank/IPEA Urban Research Symposium, 2005: Metropolitan Regions: New Challenges for an Urbanizing China http://www.worldbank.org/urban/symposium2005/papers/leman.pdf, Accessed November 2008
Needham, 1986. Science and Civilization in China, Vol. 1.
Que Wei-min, 2001. Map Explanation on Hangzhou City and West Lake. Zhejiang People's Publishing House, Hangzhou.
United Nations, 2005. World Population Prospects: The 2004 Revision.
Van Dijk, M., Moss, A., 2006. China through the Looking Glass: Hangzhou.
Wang Kaiyong. A comprehensive diagnosis of the city's structurehttp://www.iciba.com/city/
Webster D.R. Cai J., Muller L., Luo B., 2003. Emerging Third Stage Peri-Urbanization: Functional Specialization in the Hangzhou Peri-Urban Region. Asia-Pacific Research Center, Stanford University, Monograph, http://aparc.stanford.edu/publications/emerging_third_stage_periurbanization_functional_specialization_in_the_hangzhou_periurban_region/ acccessed January 2009
Zhubo, 2003. Analysis of the extension of Hangzhou city [J]. Urban Planning 5.

Hangzhou statistical reports, planning documents and websites

City Development Research Group of Zhejiang Provincial Development Planning Commission, 2003. New district construction in the process of urbanization.
Hangzhou Construction Yearbook, 2006
Hangzhou High-tech Industry Development Zone, the official website.
Hangzhou Municipal Government, 1983. Master plan, May 1983.
Hangzhou National Economic and Social Development Statistical Bulletin, 2002~2006
Hangzhou Planning Bureau, 2003. Towards the ear of Qiantang River. Tongji University Press.
Hangzhou Statistics Bureau, 2002-2006. Hangzhou Statistical Yearbook.
Hangzhou West Lake District Statistical Yearbook 2006.
Spatial Constraints during Urban Development and Countermeasures, website.
Statistics Yearbook of Binjiang District (2006)
The Plan of Protection and Development in the Western Region of Hangzhou.
Xihu District Statistical Bureau, 2002-2006. Xihu District Statistical Yearbook.
Zhou Tiejun, 2005. Experience from Xixi Wetland Protection and Construction.

Annex:
Definition of Peri-Urban Areas in Hangzhou

The purpose of this study was to identify and delimit peri-urban areas for the Hangzhou case study area and to assess the development of the peri-urban areas in the recent past.

The definition and delimitation of peri-urban areas in Hangzhou was an important task for the further analysis of land use dynamics within the peri-urban zone and identifying strategies for developing sustainable relationships between rural-urban land use in these zones. Until now, no commonly agreed definition of peri-urban areas does exist for the case study area. In a previous study, Webster et al. (2003[1]) made a distinction between urban core, inner peri-urban, outer peri-urban and rural areas for Hangzhou municipality. The distinction of peri-urban areas was based on "location adjacent to cities proper, location relative to the freeways, field judgments, and key informant interviews with government officials in regard to ongoing development and linkages with cities proper" (Webster and Seto, 2002, p. 27, note 13[2]). This definition of peri-urban areas provides a useful overview over the position of the different parts of Hangzhou municipality with regards to urbanisation. However, being based on rather larger administrative entities, it is of limited use for our research where the focus is on detailed studies of land use strategies within peri-urban areas. Therefore, a more fine-grained distinction of peri-urban areas had to be found. Focus was placed on what Webster et al. (2003) called the inner peri-urban areas surrounding the urban core of Hangzhou proper. It is the inner-peri-urban areas where land use dynamics are greatest in Hangzhou. For instance, analysis of land use statistics shows that appr. 14 percent of the cultivated land area in the inner peri-urban zone was lost between 1991 and 2001. "The 1991–2001 rate of loss in the inner peri-urban area was 4.78 times faster than its rate of population growth" (Webster et al., 2003, p.17). .The loss of agricultural land in the outer peri-urban area and the rural area was considerably lower with 6.5% and 5.1%, respectively, and the urban core even regained some agricultural land, albeit from a very low level. Therefore, it seems appropriate to concentrate on the inner peri-urban areas in this study as the rate of land use change is highest and conflicting demands on land are particularly strong here.

1 Basic Theory and Methodology

1.1Land-use information entropy model

The Chinese research group developed and applied a methodology for identification and subsequent delimitation of peri-urban areas based on their spatial character.

Peri-urban areas are the transition zone between urban areas and rural areas, where many commercial networks and industrial enterprises with apparent urban characteristics radiate from the city, while the original rural land-use pattern is preserved to a certain extent on the other hand. As a consequence, peri-urban areas are typically characterised by a diversity of land-use types, in which arable land, gardens, urban construction land, transportation land and water bodies are interspersed, often without any apparent spatial ordering.

It was assumed that an approach founded in information theory would be suitable to identify and delimit the peri-urban zones of Hangzhou. Information entropy is a measure of uncertainty, and the greater the uncertainty, the less ordered is the system. According to

[1] Webster D.R.. Cai J., Muller L., Luo B., 2003. Emerging Third Stage Peri-Urbanization: Functional Specialization in the Hangzhou Peri-Urban Region. Discussion paper, Asian-Pacific Research Center (APARC), Stanford University, 52 pp. downloaded from http://APARC.stanford.edu, 2007.
[2]Webster D.R., Seto K., 2002. Challenges of Peri-urbanization in the Lower Yangtze Region: The Case of the Hangzhou- Ningbo Corridor. Discussion paper, Asian-Pacific Research Center (APARC), Stanford University, 37 pp. downloaded from http://APARC.stanford.edu, 2007.

probability theory, mathematical expectation was calculated for the self information of the event X = xi, and then the average self information was obtained, which was recorded as:

When x represents the information source, H (X) represents the average self information of information source, known as information entropy. Based on the analysis of information entropy model and land-use system, land-use information entropy model was established:

Where: w is land-use information entropy, where the order is small, when w is large and visa versa. X is the percentage of land area occupied by a land-use type in the sample. I is the number of land-use types in the sample. In general, the number of land-use types in urban areas and rural areas is lower, being either built land or agricultural land, resulting in a smaller information entropy value (i.e. there is a higher degree of order). There is a greater diversity of land-use types in the peri-urbans, on the other hand, as farmland and different types of built land are interspersed. Therefore, the information entropy value is larger. From the city core to peri-urban areas and then to rural areas, the information entropy will grow with the transition from the urban core to the peri-urban zones and then decrease again in the transition from peri-urban to rural.

1.2 Methodological approach

The study employed ETM + images for Hangzhou city proper and the surrounding area to extract land-use types, and then grouped the land-use types into two categories, i.e., agricultural land and built land, based on which the entropy units were divided to calculate the value of every entropy unit. Finally, the change of entropy values was analyzed along transects, through which peri-urban areas were demarcated. The approach is illustrated in Figure A1.

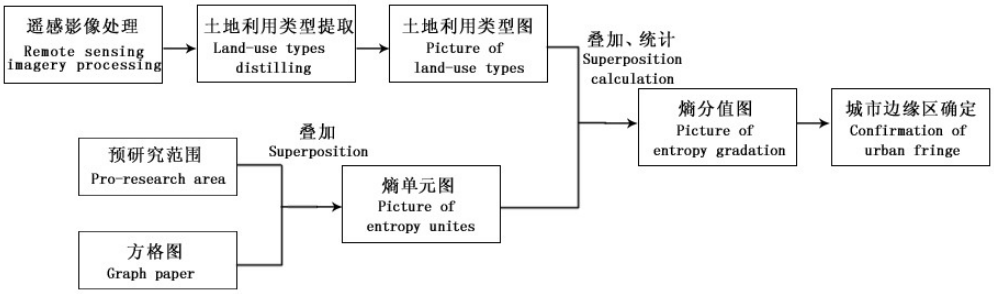


Figure A1: Approach for delimitation of peri-urban areas in Hangzhou.

1.3 Information extraction

Landsat-7 remote sensing images taken over Hangzhou in 1988, 1998 and 2004 were the data source for land cover analysis. The second, third, fourth bands were selected as the original images for the classification after analysis of information characteristics of the different bands of ETM + images, (see Figure A2).

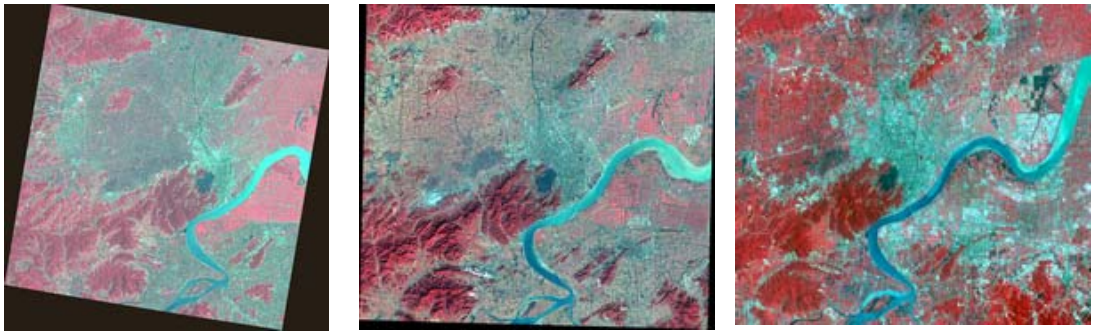


Figure A2: Remote sensing images of Hangzhou from 1988, 1998 and 2004after geometrical correction

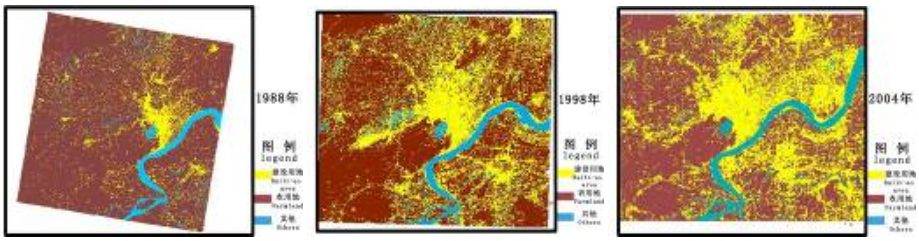
Before the extraction of information, remote sensing images were geometrically corrected by means of quadratic polynomial models and bilinear re-sampling technique. The ground control points (GCP) needed for the geometrical correction were identified from land-use plans of Hangzhou of 1992, and the correction accuracy is 0.3445 pixels. The study adopted the parameter-based AOI extension provided by ERDAS8.5 to select training areas in order to assess classification accuracy. The error matrix for the training areas of remote sensing images is shown in Table A1.

The error matrix values for the training areas of remote sensing images in the study area are all above 85%, water bodies having highest accuracy of 94.7 % and gardens the lowest accuracy of 85.7%. In fact, 9.5 % of the pixels situated in gardens were misjudged as arable land. However, this did not affect the results in this study as both arable land and gardens were counted as agricultural land. Similarly, the relatively high classification errors among urban built land, rural built land and transportation land does not affect the final results of this study, either, as these were combined into the category of built land.

Table A1 Error matrix for the training areas

土地利用类型 Land-use types		农用地 Farmland			建设用地 Built-up land		其他 Others	
		耕地 Agrarian	林地 Forest	园地 Garden plot	城市建设用地 Urban built-up area	农村建设用地 Rural built-up area	水域 Water	山体 Hill
农用地 Farmland	耕地 Agrarian	230	3	4	2	4	3	0
	林地 Forest	10	45	3	1	0	0	2
	园地 Garden plot	19	2	42	0	1	1	0
建设用地 Built-up land	城市建设用地 Urban built-up area	0	0	0	186	6	0	0
	农村建设用地 Rural built-up area	6	1	0	9	117	0	0
其他 Others	水域 Water	0	0	0	0	0	72	0
	山体 Hill	0	0	0	2	0	0	16
合计 Sum		265	51	49	200	128	76	18
精度(%) Precision(%)		86.7	88.2	85.7	93.0	91.5	94.7	88.8

The maximum likelihood criterion was adopted for the classifier-supervised classification of the images. After the classification, the land-use types were merged into agricultural land, built land, and other land. The latter are in particular water bodies (Signature Editor-Edit-Merge) (See Figure A3).



A3: Classified satellite imagery covering the core area of Hangzhou City for the years 1988, 1998, 2004. Pictures are appr. at the same scale. Yellow: built-up; brown: unbuilt; blue: water (source: Landsat TM, made available by Yang J. and Yao Z.)

1.4 Application of land-use information entropy model

In previous studies of peri-urban areas in Beijing (Cheng and Zhao, 1995) a 1 by 1 km grid was chosen as the units for measuring entropy. In this study a more fine grained grid of 300 by 300 m was used. Geometrically corrected and classified images were firstly converted from the raster format into the vector format, and then the entropy units of 300 m × 300m were drawn. In total, 24,650 units were distinguished. The information entropy value was then calculated for each unit (Figure A4).

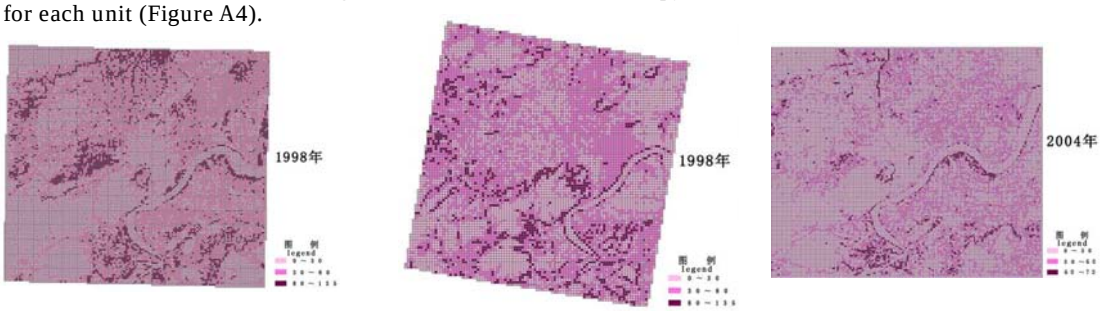


Figure A4. Distribution maps for information entropy value of different periods

2 Identification and delimitation of peri-urban areas

2.1 Analysis of entropy values

(1) Contrast: The entropy values ranged from 0 to 133.57. High entropy values of 60- 75 were mainly distributed around the West Lake and Xixi Wetland as well as in Zhuantang District and Bingjiang District. These regions were the main areas for urban development in Hangzhou during the study period.

(2) Order: A general pattern for the distribution of entropy values could be discerned in the study area. From the periphery to the city core a succession of three zones can be distinguished: in the outer zone, entropy values are mostly below 30, indicating low-entropy, orderly and stable agricultural areas that are not impacted by urbanization; in the

intermediary zone, entropy values are above 30, representing high-entropy due to heterogeneous, chaotic land cover patterns; and in the inner zone, the entropy value are mostly below 30, representing low-entropy, orderly and stable urban areas.

(3) Inter-distribution. A closer look revealed that units with different entropy values were found within the three zones, that is, units with low entropy value were located in zones with high entropy value as well as units with an overall high entropy value locating in zones with an overall low entropy value. The former are agricultural areas that have been not touched by urban expansion. The latter are mainly built-up residential or industrial areas within the West Lake and Zhuantang Districts,

2.2 Delimitation of peri-urban areas

(1) Delimitation of the inner boundary

With the study area, entropy sections were drawn respectively along the northeast, the north, the southeast, the west and the north to identify the transition between urban, peri-urban an rural areas (Figure A5). Changes of entropy values were not gradual but point could be identified where values strongly changed. These points represented the transition from urban to peri-urban zones and from peri-urban to rural zones.

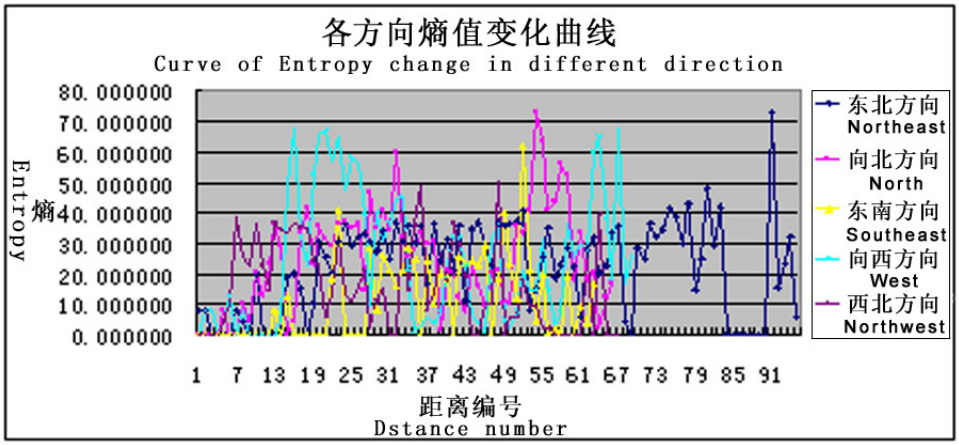
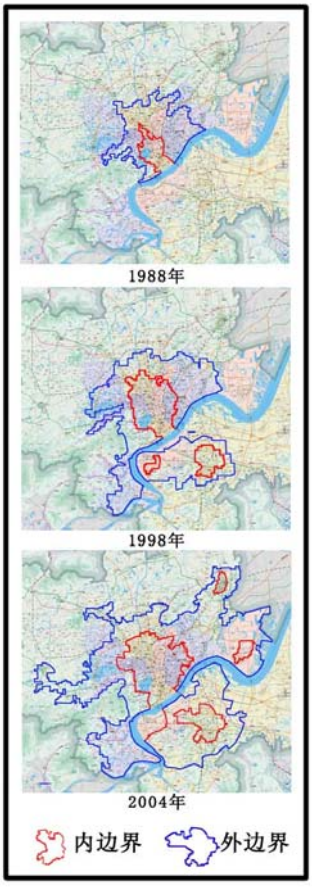


Figure A5 Entropy change curve in different directions



From the center to the periphery, the first turning point, i.e., from low to high entropy value, appeared at an entropy value of appr. 60. This value indicates the change from the urban area with predominantly built land to the co-existence of various land-cover types in the peri-urban area,(see Figure A6).

In 1988, the inner boundary followed Daguan Road in the north and Beijing-Hangzhou Canal in the east, connected by the North Ring Road to Shanghai-Hangzhou Railway and then continuing to the north bank of Qiantang River across Qingjiang Road; Wan Songling and Xishan Road in the west, where it followed Shuguang Road and Moganshan Road to the north of the city.

The inner boundary in 1998 followed Gongchen Bridge in the north, and then continued to Shanghai-Hangzhou Railway and Xintang Road along Xuancheng-Hangzhou Railway, connected by Qingjiang Road to the north bank of Qiantang

River in the south; the West Lake hills and Laohe Hill in the west and then to Gucui Road, connected by Hemu Road, Moganshan Road and Shixiang Road in succession to the north of the city.

In Bingjiang District and Shaoshan District located at the south bank of Qiantang River, the inner boundary was basically the border of built-up areas of Puyan Town and Chengxiang Town.

The inner boundary in 2004 followed Shixiang Road in the north; Shanghai-Hangzhou Expressway in the east, connected by Xianqiao Town and Pengbu Town to Hanghai Road and then it continued to the north bank of Qiantang River in the south; Yuhuang Hill in the west, along the west of the West Lake and Tianmushan Road to Gudun Road and then to Shixiang Road.

In Bingjiang District and Xiaoshan District the inner boundary was basically the border of the built-up areas of Puyan Town, Chengxiang Town and Xixing Town in 2004. In Xiasha Sub-city, the inner boundary followed the Ring Road in the north, the 12th Street in the south, the 11th Street in the east and the 1st Street in the west. The inner boundary of Linping District followed Linping Street, Nanyuan Street and the built-up areas of Yuhang Economic Development Zone.

(2) Delimitation of the outer boundary

It can be seen from Figure A4 that the second turning point, i.e., from high entropy to low entropy values, occurred at a value of appr. 30. This value indicated the change from the peri-urban area to the rural zone with predominantly farmland. When overlayed with a map of Administrative Divisions, the outer boundaries of the peri-urban areas in different periods was delimited as follows:

The outer boundary in 1988 followed Shixiang Road in the north; Dingqiao Town, Xianqiao Airport and Hanghai Road in the east; the north bank of Qiantang River in the south; and Yuhuang Hill, Nan Gaofeng, Laohe Shan, the west side of Gudang Town, Fengtan Road and the border of Gongshu District in the west.

The outer boundary in 1998 followed Xuancheng-Hangzhou Railway and the south side of Ban Hill in the north; Yueya River at the east side of Jiubao Town in the east; the north bank of Qiantang River in the south; and Jiuxi, Bei Gaofeng, the west section of Ring Road and the outer border of Sandun Town in the west. In the southwest, the outer boundary followed Zhijian Road and Ring Road to Zhuantang Town, Zhoupu Village and Yuanpu Town. The peri-urban area located at the south bank of Qiantang River followed the east bank of Qiantang River in the west, State Road 104 in the east, Zhongxing Road and Airport Road in the north, and Wenyan Town, Shushan Street and the north side of Xintang Street.

The outer boundary in 2004 followed the Ring Road in the north; the west bank of Qiantang River in the east; the north bank of Qiantang River in the west; and Jiuxi, the west to Ring Road and Xuancheng-Hangzhou Railway in the south. The southwest extended to the outer border area of Zhuantang District. The peri-urban area located at the south bank of Qiantang River extended to the border of Bingjiang District in the west, State Road 104 and Hangzhou-Jinhua-Quzhou Expressway in the east, the south bank of Qiantang River in the north, and the south section of Ring Road in the south. In addition, in line with the overall urban pattern of Hangzhou City which has been characterized as "a city core with three sub-cities and six city clusters", linear sprawl has occurred correspondingly in peri-urban areas, mainly including:

In the northern direction: Sandun Town – the extending section of Moganshan Road - Liangzhu Town; Shenban Road- the north side of Ban Hill - Chongxian town.

In the western direction: Tianmushan Road - Xixi Wetland – Jiang Village – Liuxia Town – Provincial Road 02 - Xianlin Town - Yuhang Town.

In the northeastern direction: Shiqiao Town - Shanghai-Hangzhou Railway - Xianqiao Town – Dingqiao Town - Xingqiao Town – linping Town.

In the eastern direction: Pengbu Town – Hanghai Road – Qiaosi Town - Xiasha Road - Sanbao - Wubao - Qibao - Jiubao - Xiasha Sub-city.

From the above analysis the extension of peri-urban areas of Hangzhou can be seen for different periods in time (Figure A5,Figure A6,Figure A7) (2).

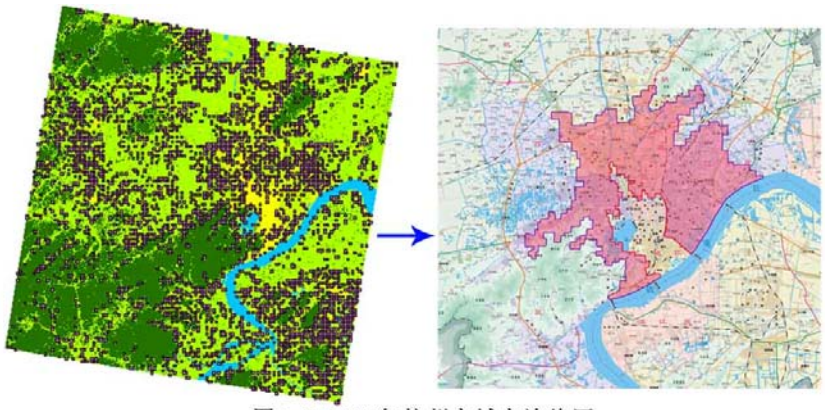


图3-7:1988年杭州市城市边缘区

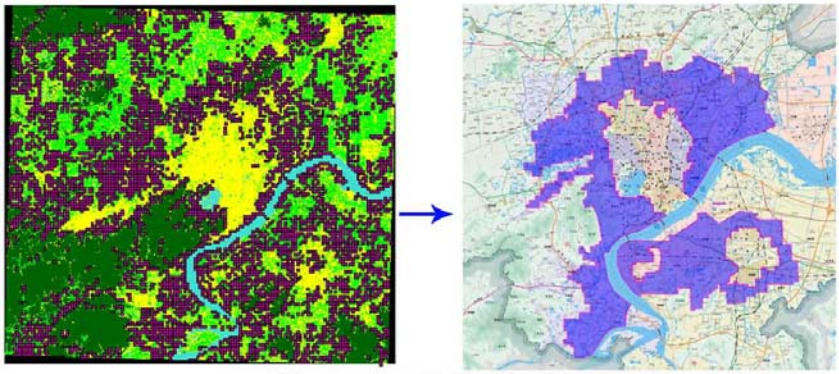


图3-8:1998年杭州市城市边缘区
Urban fringe of Hangzhou city,1998

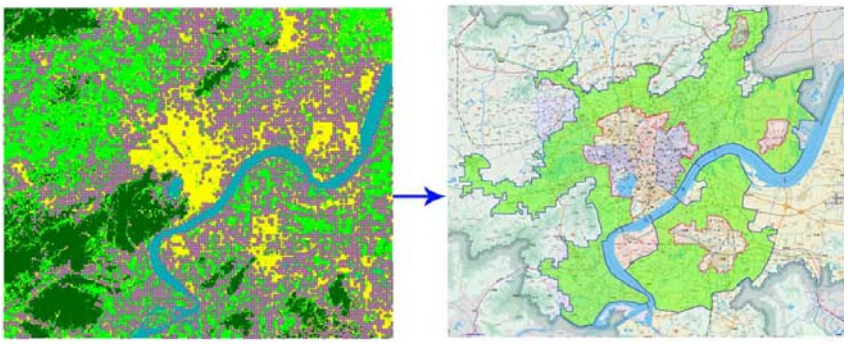


图3-9:2004年杭州市城市边缘区
Urban fringe of Hangzhou city,2004

3 Discussion

3.1 Research Methodology

Peri-urban areas are characterised by the penetration and diffusion of non-farming social and economic activities of urban areas into the neighboring rural areas, and they are also the geographical entity formed through the mutual integration of agricultural and partly-agricultural social and economic activities. The proper definition and spatial delimitation of peri-urban areas based in an understanding of underlying trends and determinants is of great significance for land use management. This is particularly important for Hangzhou, as a big, and strongly developing city where land resources are relatively scarce and the land reserves for urban expansion are increasingly limited.

Remote sensing and GIS were useful tools for the spatial delimitation of the peri-urban areas in Hangzhou.

The application of information theory proved a possibility to distinguish urban, from peri-urban and rural areas in Hangzhou. A limitation of this approach is that it is based on land cover features whereas functional features such as commuter patterns and process-based features (i.e. rates of change) could not yet be taken into account. However, the results precisely show for the first time the peri-urban areas of Hangzhou. This is a great advance in comparison to delimitations which are based on administrative boundaries.

3.2 Results

The study employed remote sensing and GIS technologies to make empirical research with peri-urban areas of Hangzhou as the case. Through analysis, the main conclusions were as follows.

(1) The research found that in the initial stage of urbanization, the density of the built-up areas weakened with the increase in distance from the city core; With ongoing urbanization, the available undeveloped land more close to the city core became less and the density of the built-up areas increased at greater distance from the city core.

(2) In the 15 years from 1988 to 1998 and then to 2004, the land use in peri-urban areas of Hangzhou had changed dramatically. This mainly manifested in the increasing growth of built land and the continual decrease of farmland area. In the study area, areas with a low density of

urban land cover were negatively correlated with unused land because rural settlements were demolished to prepare the land for dense urban development.

(3) The comparative analysis of the three periods, clearly showed continuous expansion of the inner boundary of the peri-urban areas have, which indicates the border of urbanization continues to expand outward. The urbanization border expanded to 3.4 km from Wulin Square in the city center in 1988 to 4.2 km in 1998 and then further to 5 km in 2004.

(4) This study identified the general pattern of urban development and peri-urbanisation in Hangzhou. A more detailed analysis is required to better understand the driving forces of observed peri-urbanisation and assess its social, ecological and economic impacts. Which land use strategies have been applied and successful were these in terms of intended and unintended outcomes? A more detailed level of analysis is required to give an answer to these questions. Therefore, three embedded case studies have been chosen for the further study.