

Chapter 2

Urbanization in Jiangsu Province and Zhejiang Province in China Since ca. 1930

Yukio Himiyama, Miho Ikeshita and Tetsuya Shinde

Abstract This chapter reports on the compilation and preliminary analyses of the land use datasets of the fourteen cities in Jiangsu Province and Zhejiang Province conducted as part of the series of study, and on the comparison of urbanization and its background. 1:50,000 topographic maps of China produced by Japan ca. 1930, *Atlas of Cities of China* which shows land use at ca. 1990 and Landsat ETM+ satellite images of ca. 2000 have been used as basic information sources. The study has shown that the urban expansion in the 1990s was about fourfold in 10 years, i.e., at the speed twice as fast as that during the rapid economic growth in Japan in the 1960s, that expansion was faster in medium to smaller cities than in big cities, and that the agricultural land around cities gave way to urban expansion rapidly. The datasets have been proved to be extremely useful in showing the urban area of each city in ca. 1930, ca. 1990, and ca. 2000 and the trend of change in a graph, and in comparing the fourteen cities to find out their general tendencies and the specific characteristics of each city far more accurately and easily than before. The study also revealed that the statistical areal units in China, namely built-up area, city, and urban district, do not represent “urban area” as accurately as DID, or Densely Inhabited District, used in Japan.

Keywords East China · Land use change · Urbanization · Urban area
Japanese topographic map

2.1 Introduction

China has been urbanizing very fast since the 1980s along with its modernization and economic development. The rapid urbanization, particularly the expansion of urban areas, has been causing various land use and other kinds of problems. However, our understanding in urbanization in China has not been sufficient due to

Y. Himiyama (✉) · M. Ikeshita · T. Shinde
Hokkaido University of Education, Asahikawa Campus, Asahikawa 070-8621, Japan
e-mail: himiyamay@kkd.biglobe.ne.jp

the lack of needed reliable data and the delay in related study. Bulk of research on urbanization in China relies on satellite images for spatial and quantitative information on urban expansion, and it inevitably restricts study period to the 1980s onward. Although the land use changes in China during the last two decades have been great and their environmental impacts severe, more attention should be directed to long-term changes as well as the recent ones, as without knowing the former the present situation and future prospect cannot be accurately grasped (Himiyama 2004a). For those reasons, Institute of Geography, Asahikawa Campus, Hokkaido University of Education, started a project on urbanization in China in 2003, in which 1:50,000 topographic maps of China produced by Japan ca. 1930, which are generally called *Gaiho-zu* in Japanese, *Atlas of Cities of China* (Zhou et al. 1994), and Landsat ETM+ satellite images were used as basic information sources. The present paper first reviews urbanization study on China, and then reports on the compilation and preliminary analyses of the land use datasets of the fourteen cities in Jiangsu Province and Zhejiang Province as part of the series of study, and on the comparison of urbanization and its background. An objective of the present paper is to show the value of the 1:50,000 topographic maps for LUCC study in general, and for the study of urbanization in particular.

2.2 Urbanization Study on China

Urbanization is not only a major type of land use change itself, but also a major driver of the change of other types of land use. It is often a threat to agriculture, and at the same time it affects the people's lives, society, economic activities, and the environment outside as well as inside cities. From the standpoint of LUCC, expansion of urban areas is particularly important among the land use changes related to urbanization, because of its strong effect on other land uses and the environment (Himiyama 2004b).

Ji and Torii (2000) studied the expansion of built-up area of Suzhou City in Jiangsu Province since 1980. They made land cover grid maps of 1980, 1985, 1990, 1995, and 1999 based on Landsat images, and identified major changes of land cover. They then carried out field surveys on the processes and mechanisms of urbanization, as well as analyses of available maps and statistics. They concluded that the major driving forces of urban expansion of Suzhou City west to Shanghai were industrialization backed by foreign capitals and mitigation of congestion within the built-up areas, and that the change was strongly policy-driven. Similar satellite-based studies were conducted elsewhere, such as in Su-Xi-Chang City during the 1990s (Liu et al. 2004), or Kunshan City since 1987 (Long and Li 2001).

The study of socioeconomic and political aspects is an essential part of LUCC urbanization research. The series of research on the expansion of medium to smaller cities in the Changjiang Delta area conducted by Ji offers detailed accounts of the processes and mechanisms of the conversions of rural land uses to urban land uses, not only qualitatively, but also quantitatively, fine maps of the conversions and

photographs to show what are actually taking place at each site (Ji 2003, 2004a, b). Although these studies focus only on the period since 1980, the extension of them to the other parts of the country would be an extremely meaningful challenge for LUCC.

Land Use and Land Cover Changes in Beijing 1903–1999 (Lu and Wu 2002) offers comprehensive account of the long-term land use/cover changes of Beijing Municipality. The article presents 1:650,000 land use/cover maps of ca. 1903, 1950, 1980, and 1999, land use/cover change maps between these periods, land use/cover structure tables and structure change tables, together with outline descriptions and explanations of the state, change, and background of the land use/cover during 1903–1999.

2.3 Study Areas and Method

From the discussion above, it is obvious that the study of urbanization in China should now put high priority on comparison of many cities in the country, and an extension of the time range to longer past in order to grasp much of the changes taken place during the country's modernization in the twentieth century. The present study deals with Jiangsu Province and Zhejiang Province. As mentioned above, it uses the 1:50,000 topographic maps of China produced by Japan ca. 1930, *Atlas of Cities of China* and Landsat ETM+. The cities to be chosen for the study have to have all these.

Considering these conditions concerning data availability, as well as size, location, and other features of the cities in Jiangsu Province and Zhejiang Province, the following fourteen cities have been selected as study sites (Fig. 2.1):

- Jiangsu Province: Nanjing, Changzhou, Xuzhou, Yixing, Dongtai, Nantong, and Wuxi;
- Zhejiang Province: Hangzhou, Ningbo, Huzhou, Jianxing, Shaoxing, Jinhua, and Linhai.

Basic information of Jiangsu Province and Zhejiang Province is outlined below according to *Atlas of Cities of China*. Jiangsu Province is 100,000 km² large, with much of its territory located in the fertile Chanjiang Delta. There are freshwater lakes such as Taihu Lake, and some low mountains and hills in the southwest and north. The climate is subtropical to temperate wet monsoon type. Population is about 73,549,000. Zhejiang Province is 101,800 km² large, with 70.4% of its territory in mountains and hills, 23.2% in plains and basins, and 6.4% in water surface. The climate is subtropical monsoon type, and precipitation is around 1000–2000 mm. Population is about 46,800,000. This province is not rich in natural resources or cultivable land, but its proximity to Shanghai and its coastal location attract many industries not only domestically, but also from abroad.

Fig. 2.1 Study areas

The following three types of land use map have been produced for each study site, as illustrated in Fig. 2.2:

- (1) land use map ca. 1930 based on the 1:50,000 topographic map;
- (2) land use map ca. 1990 based on the general city map in *Atlas of Cities of China*;
- (3) land use map ca. 2000 based on Landsat ETM+ image taken through Google Earth.

The area covered by the map in the *Atlas* is just large enough to contain the urban area of ca. 1990, but the urban area of ca. 2000 surpasses it in most cities, as urban expansion during the 1990s was extreme.

As is shown in Fig. 2.2a, the 1:50,000 topographic map is colored by color pencils according to land use identified by the symbols shown on the map. Thirteen types of land use, namely “settlement”, “road”, “railway”, “paddy field”, “dry field”, “orchard”, “mulberry”, “tea”, “forest”, “bamboo”, “rough land”, “water”, and “other” were identified. The colored map is then scanned and processed on the computer by using Adobe Photoshop, a popular image processing software. Figure 2.2b shows the resultant land use map of ca. 1930.

Atlas of Cities of China is the first large-scale comprehensive city atlas of China published in 1994 by the Construction Ministry of China. The atlas includes information dated from the birth of the People’s Republic of China in 1949–1989. It includes information on 450 Chinese cities, including the cities’ natural environment and human geographical features, their history, and present conditions of urban development, and presents their overall city plans. It is intended not only to

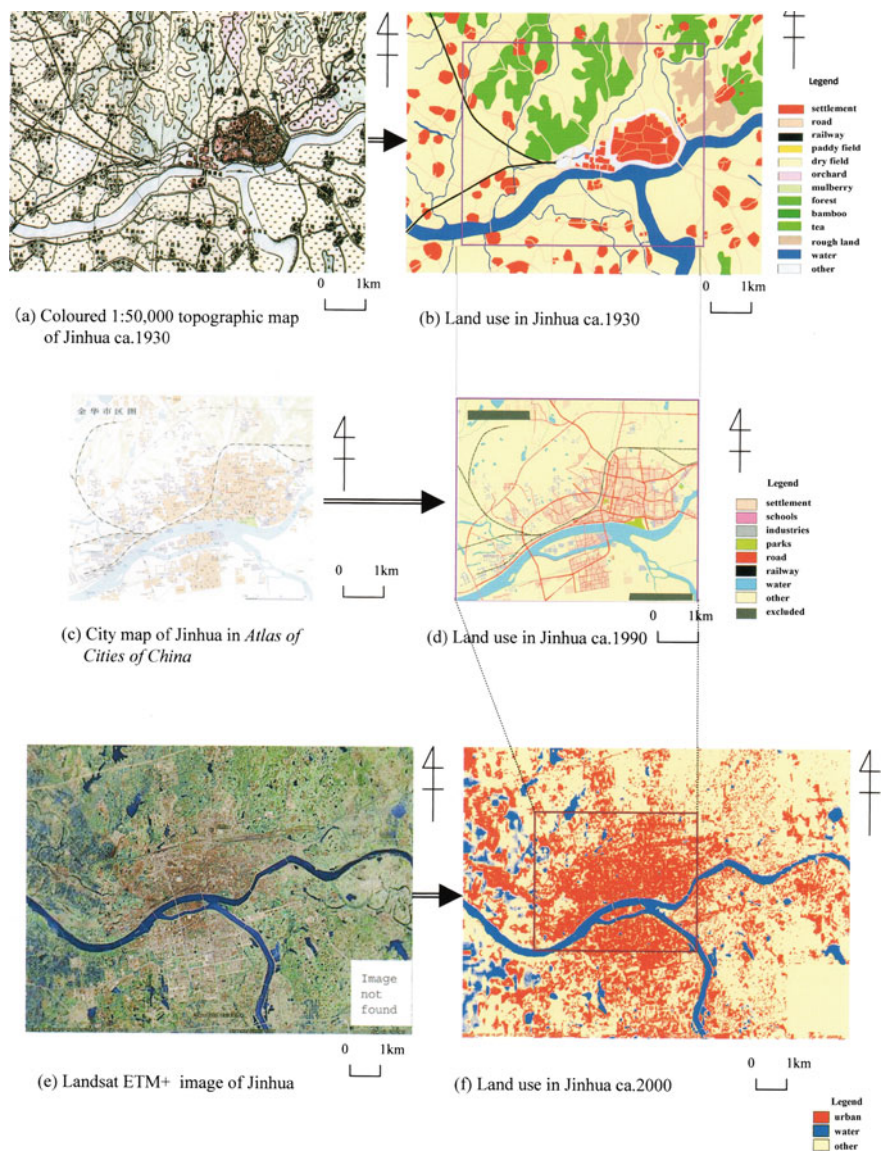


Fig. 2.2 Provision of land use maps of Jinhua representing ca. 1930, ca. 1990, and ca. 2000

provide solid fundamental materials for city planning, construction, and administration, but also to offer comprehensive information of cities to the government departments and to the general public.

The general city map in *Atlas of Cities of China* shown in Fig. 2.2c is similarly used as the information source for the digital land use map representing ca. 1990,

as shown in Fig. 2.2d. Eight types of land use, namely “urban”, “schools”, “industries”, “parks”, “road”, “railway”, “water”, and “other” have been identified and put on different layers. The land use map of ca. 2000 shown in Fig. 2.2f is made from Landsat ETM+ image (Fig. 2.2e), which is accessible through Google Earth, by using Photoshop. Overlays of the maps of different periods are also done in Photoshop, but area measurement of each land use type has been done by using a BASIC program developed by the authors.

2.4 Urbanization in the Fourteen Study Areas

2.4.1 Land Use ca. 1930

Tables 2.1 and 2.2 show land use structure of each study area in Jiangsu Province and Zhejiang Province ca. 1930, respectively. Each study area is set equal to the area covered by the general city map of the corresponding city in *Atlas of Cities of China*. Therefore, each study area contains the old settlement that later grew up to major city, adjacent rural settlements, agricultural, and marginal land uses. The cities that had larger urban land use among the fourteen cities include Hangzhou (57 km²) and Nanjing (37 km²), but the average area of urban land use in the fourteen study areas was only 12.6 km² at that time. Agricultural land use occupied 52% in average of a study area, and most of it is now in urban use, as seen later. Among agricultural land uses, dry field was by far the largest, occupying 45% of the study area in average. Hangzhou, a historical power center is unique in many ways, e.g., it is the only study area that had tea garden, and it also had orchard together with Nanjing, an another city of historical importance. Bamboo was found only in Zhejiang Province, and not in Jiangsu.

2.4.2 Expansion of Urban Areas During Ca. 1930–Ca. 2000

Figure 2.3 shows the expansion of urban areas of the fourteen study areas in Jiangsu and Zhejiang during ca. 1930–ca. 2000. The urban areas of ca. 1930 and ca. 1990 are those within the areas set by the general city maps in *Atlas of Cities of China*, while those of ca. 2000 include the contiguous urban areas beyond these boundaries. As the urban areas of ca. 2000 are quite large in most study areas and they are engulfing the adjacent settlements, precise delineation of contiguous urban areas is an important but a difficult task, and is left as a future theme of study. The urban area data for ca. 2000, which have been calculated from the land use map produced from Landsat ETM+ image, are not fully objective, and are presented here only for a reference purpose. The data of the area of ‘built-up area’, which are presented in *Urban Statistical Yearbook of China* (Statistical Bureau of China ed. 2000),

Table 2.1 Land use ca. 1930 in each study area in Jiangsu set by *Atlas of Cities of China*

Land use	km ²	%
<i>(a) Nanjing</i>		
Urban	37.23	16.73
Settlement	17.90	8.05
Road	19.33	8.69
Railway	1.38	0.62
Agricultural	62.37	28.04
Paddy field	0.02	0.01
Dry field	62.02	27.88
Orchard	0.19	0.09
Mulberry	0.14	0.06
Tea	0.00	0.00
Forest	9.30	4.18
Bamboo	0.00	0.00
Rough land	0.67	0.30
Water	25.19	11.32
Other	88.64	39.43
Total	222.49	100.00
Land use	km ²	%
<i>(b) Changzho</i>		
Urban	11.09	13.84
Settlement	6.43	8.03
Road	4.66	5.82
Railway	0.00	0.00
Agricultural	59.36	74.10
Paddy field	0.00	0.00
Dry field	59.36	74.10
Orchard	0.00	0.00
Mulberry	0.00	0.00
Tea	0.00	0.00
Forest	0.92	1.15
Bamboo	0.00	0.00
Rough land	0.00	0.00
Water	5.66	7.07
Other	3.08	3.84
Total	80.11	100.00
Land use	km ²	%
<i>(c) Xuzhou</i>		
Urban	8.94	11.60
Settlement	3.62	4.70
Road	4.10	5.32
Railway	1.22	1.59
Agricultural	34.27	44.48

(continued)

Table 2.1 (continued)

Land use	km ²	%
Paddy field	0.00	0.00
Dry field	34.27	44.48
Orchard	0.00	0.00
Mulberry	0.00	0.00
Tea	0.00	0.00
Forest	0.62	0.81
Bamboo	0.00	0.00
Rough land	0.00	0.00
Water	2.27	2.95
Other	30.94	40.16
Total	77.04	100.00
Land use	km ²	%
<i>(d) Yixing</i>		
Urban	1.36	13.42
Settlement	0.73	7.19
Road	0.63	6.24
Railway	0.00	0.00
Agricultural	5.66	55.75
Paddy field	0.00	0.00
Dry field	5.63	55.46
Orchard	0.00	0.00
Mulberry	0.03	0.29
Tea	0.00	0.00
Forest	0.00	0.00
Bamboo	0.00	0.00
Rough land	0.00	0.00
Water	2.57	25.35
Other	0.56	5.48
Total	10.15	100.00
Land use	km ²	%
<i>(e) Dongtai</i>		
Urban	3.47	13.67
Settlement	1.71	6.74
Road	1.76	6.93
Railway	0.00	0.00
Agricultural	14.45	56.93
Paddy field	0.00	0.00
Dry field	14.45	56.93
Orchard	0.00	0.00
Mulberry	0.00	0.00
Tea	0.00	0.00
Forest	0.00	0.00

(continued)

Table 2.1 (continued)

Land use	km ²	%
Bamboo	0.00	0.00
Rough land	0.00	0.00
Water	1.33	5.24
Other	6.13	24.16
Total	25.38	100.00
Land use	km ²	%
<i>(f) Nantong</i>		
Urban	7.32	10.84
Settlement	1.87	2.77
Road	5.45	8.08
Railway	0.00	0.00
Agricultural	51.23	75.90
Paddy field	0.00	0.00
Dry field	51.23	75.90
Orchard	0.00	0.00
Mulberry	0.00	0.00
Tea	0.00	0.00
Forest	0.09	0.13
Bamboo	0.00	0.00
Rough land	0.00	0.00
Water	7.70	11.41
Other	1.16	1.72
Total	67.50	100.00
Land use	km ²	%
<i>(g) Wuxi</i>		
Urban	16.09	12.23
Settlement	4.35	3.31
Road	11.73	8.92
Railway	0.00	0.00
Agricultural	83.09	63.16
Paddy field	0.00	0.00
Dry field	81.70	62.10
Orchard	0.00	0.00
Mulberry	1.39	1.06
Tea	0.00	0.00
Forest	0.08	0.06
Bamboo	0.00	0.00
Rough land	1.21	0.92
Water	18.22	13.85
Other	12.80	9.73
Total	131.56	100.00

Table 2.2 Land use ca. 1930 in each study area in Zhejiang set by *Atlas of Cities of China*

Land use	km ²	%
<i>(a) Hangzhou</i>		
Urban	57.03	21.39
Settlement	18.77	7.04
Road	36.13	13.54
Railway	2.13	0.81
Agricultural	89.97	33.73
Paddy field	0.00	0.00
Dry field	54.76	20.53
Orchard	1.47	0.56
Mulberry	33.38	12.51
Tea	0.36	0.13
Forest	16.69	6.26
Bamboo	5.30	1.99
Rough land	0.00	0.00
Water	45.57	17.07
Other	52.23	19.56
Total	266.79	100.00
Land use	km ²	%
<i>(b) Ningbo</i>		
Urban	10.86	28.19
Settlement	6.48	16.81
Road	4.11	10.68
Railway	0.27	0.70
Agricultural	19.85	51.53
Paddy field	0.00	0.00
Dry field	19.85	51.53
Orchard	0.00	0.00
Mulberry	0.00	0.00
Tea	0.00	0.00
Forest	0.04	0.12
Bamboo	0.00	0.00
Rough land	0.04	0.10
Water	5.82	15.10
Other	1.92	4.96
Total	38.53	100.00
Land use	km ²	%
<i>(c) Huzhou</i>		
Urban	4.82	21.77
Settlement	3.04	13.74
Road	1.78	8.03
Railway	0.00	0.00
Agricultural	12.59	56.84

(continued)

Table 2.2 (continued)

Land use	km ²	%
Paddy field	0.00	0.00
Dry field	11.82	53.35
Orchard	0.00	0.00
Mulberry	0.77	3.49
Tea	0.00	0.00
Forest	0.00	0.00
Bamboo	0.00	0.00
Rough land	0.00	0.00
Water	2.64	11.91
Other	2.10	9.48
Total	22.15	100.00
Land use	km ²	%
<i>(d) Jianxing</i>		
Urban	6.00	18.36
Settlement	2.98	9.12
Road	2.76	8.44
Railway	0.26	0.80
Agricultural	17.82	54.55
Paddy field	0.00	0.00
Dry field	14.01	42.88
Orchard	0.00	0.00
Mulberry	3.81	11.67
Tea	0.00	0.00
Forest	0.27	0.83
Bamboo	0.65	1.99
Rough land	0.00	0.00
Water	3.84	11.74
Other	4.09	12.53
Total	32.67	100.00
Land use	km ²	%
<i>(e) Shaoxing</i>		
Urban	6.06	20.71
Settlement	3.55	12.14
Road	2.51	8.57
Railway	0.00	0.00
Agricultural	12.44	42.55
Paddy field	0.00	0.00
Dry field	12.44	42.55
Orchard	0.00	0.00
Mulberry	0.00	0.00
Tea	0.00	0.00
Forest	0.09	0.30

(continued)

Table 2.2 (continued)

Land use	km ²	%
Bamboo	0.00	0.00
Rough land	0.00	0.00
Water	5.71	19.52
Other	4.95	16.92
Total	29.25	100.00
Land use	km ²	%
<i>(f) Jinhua</i>		
Urban	3.75	15.24
Settlement	2.37	9.61
Road	1.21	4.90
Railway	0.18	0.73
Agricultural	13.00	52.81
Paddy field	0.00	0.00
Dry field	13.00	52.81
Orchard	0.00	0.00
Mulberry	0.00	0.00
Tea	0.00	0.00
Forest	3.75	15.23
Bamboo	0.00	0.00
Rough land	0.79	3.22
Water	2.38	9.66
Other	0.95	3.84
Total	24.63	100.00
Land use	km ²	%
<i>(g) Linhai</i>		
Urban	1.88	16.18
Settlement	0.90	7.76
Road	0.98	8.42
Railway	0.00	0.00
Agricultural	4.79	41.28
Paddy field	0.00	0.00
Dry field	4.29	36.98
Orchard	0.00	0.00
Mulberry	0.50	4.31
Tea	0.00	0.00
Forest	0.23	2.00
Bamboo	0.00	0.00
Rough land	0.14	1.22
Water	1.31	11.32
Other	3.25	27.99
Total	11.60	100.00

are also presented in Fig. 2.3 for comparison. Urban growth rates for the periods ca. 1930–ca. 1990, ca. 1990–ca. 2000, and ca. 1930–ca. 2000 are also given for each study area. Figure 2.4 shows the change rates of “urban”, “water”, and “other” uses

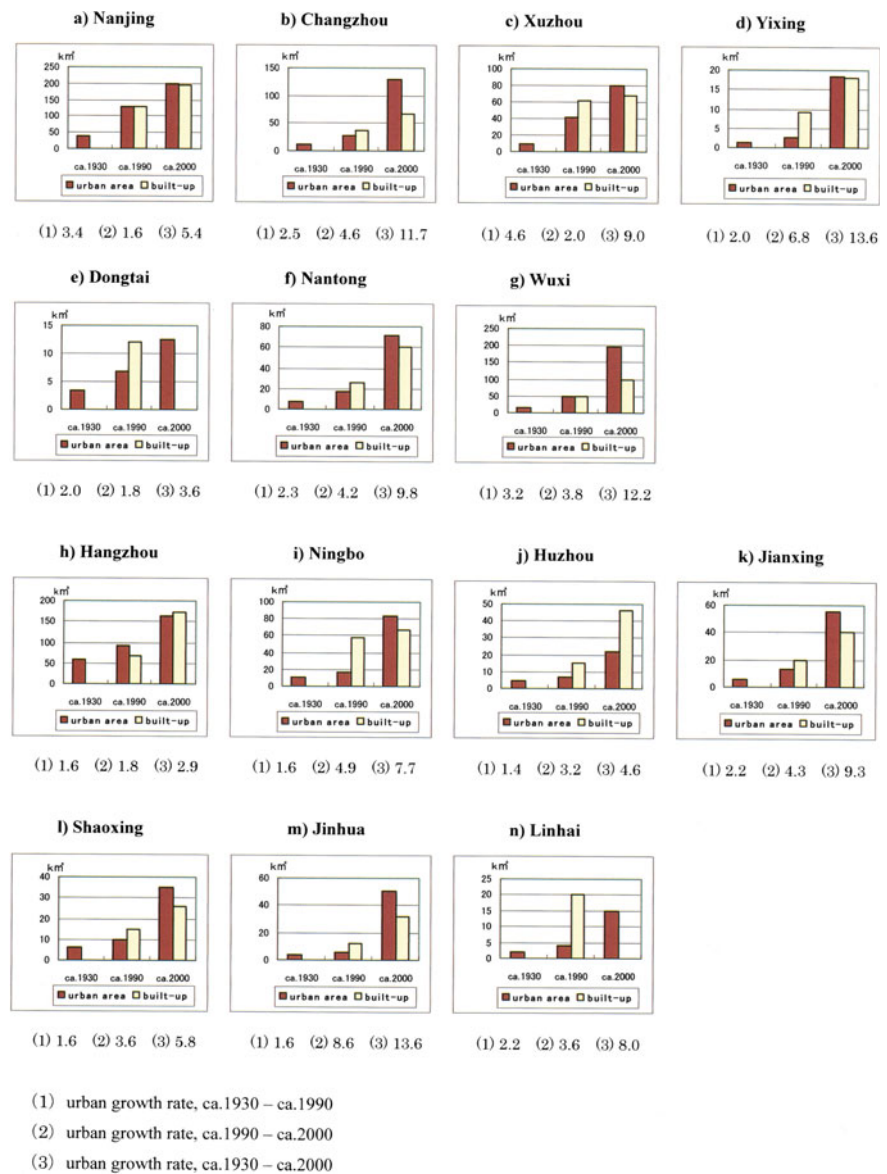


Fig. 2.3 Urban growth in the fourteen study areas in Jiangsu and Zhejiang, ca. 1930–ca. 1990–ca. 2000

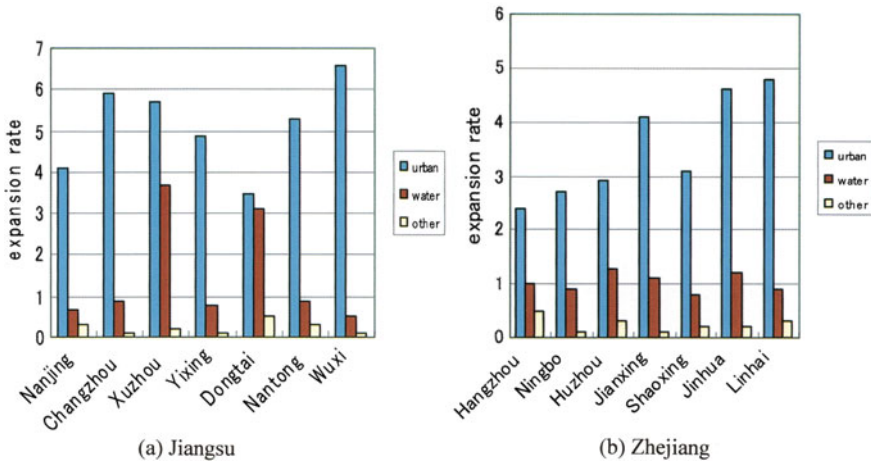


Fig. 2.4 Land use change in the fourteen study areas in Jiangsu and Zhejiang, ca. 1930–ca. 2000

in the fourteen study areas during ca. 1930–ca. 2000. It is noted that the comparison of the two periods is made within the area set by Atlas of Cities of China.

The average growth rate for the period ca. 1930–ca. 1990 for all the fourteen study areas is 2.30, while it is 2.86 for Jiangsu and 1.74 for Zhejiang. It indicates that the cities in Jiangsu Province, which occupies the Changjiang Delta and is closer to Shanghai, grew more than those in Zhejiang before ca. 1990. On the other hand, the average growth rate for the period ca. 1990–ca. 2000 for all the fourteen study areas is 3.91, while it is 3.54 for Jiangsu and 4.29 for Zhejiang, i.e., the growth rate for Zhejiang is higher than that for Jiangsu. The growth rate of 3.91 within ten years is considered to be extreme, as even Japan under the historic rapid economic growth during the 1960s–1970s experienced the growth rate of DID (Densely Inhabited District) per ten years of only 1.87, i.e., less than half of the Chinese average. It is worth noting, however, that much of the urban expansion in China was driven by local governments, and that there appear to be more dormant ‘developed’ areas in China than in Japan.

For the period ca. 1930–ca. 2000, the average growth rate for all the fourteen study areas is 8.37, while it is 9.33 for Jiangsu and 7.53 for Zhejiang. Yixing and Jinhua show the highest growth rate of 13.6 for the period of ca. 1930–ca. 2000. Dongtai on the other hand shows the lowest growth rate of 3.6 for ca. 1930–ca. 2000.

Figure 2.3 suggests that the data for ca. 1930 are extremely important when one intends to grasp the general long-term trend of urban growth of each city and to foresee its future trend.

2.4.3 Loss of Agricultural Land

The expansion of urban areas during ca. 1930–ca. 2000 was in no doubt a serious threat to the surrounding agricultural land, if not to the suburban rural community. Recent news reports from China indicate that there are many incidents of conflict between local governments and suburban rural communities. Figure 2.5 shows an example of urban expansion, which is eating up the surrounding agricultural land. According to Table 2.2, all the agricultural land of Ningbo ca. 1930 within the area set by *Atlas of Cities of China* was dry field, and it occupied 51% of the area. It was almost completely eliminated by urban expansion. As shown in Fig. 2.3, the urban growth rate of Ningbo during ca. 1930–ca. 2000 is 7.7, which is close to the average and is not particularly high. It means that the loss of agricultural land by urban expansion is substantial in most cities, if not all. It is feared that the effect of this fast expansion of urban areas is far-reaching and complicated, and much more than what mere reduction of area of cultivated land might indicate (Himiyama 2005).

2.4.4 Physical Barriers to Urban Expansion

Urbanization is constrained directly or indirectly by physical barriers, such as rivers or mountains. Figure 2.6 shows the case of Huzhou, which exemplifies how urbanization was contained within the area surrounded by rivers and canals till ca. 1990, and the sweeping advance of urbanization beyond these barriers during the

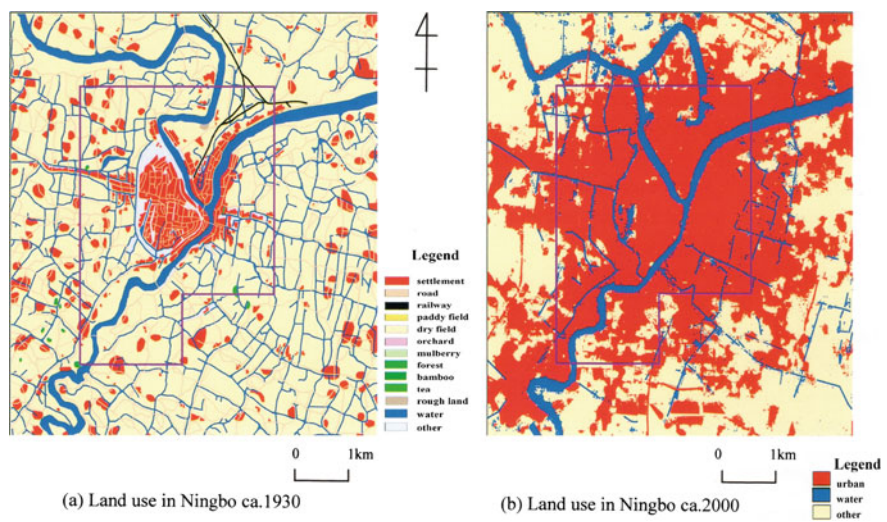


Fig. 2.5 Farmland loss by urban expansion in Ningbo ca. 2000

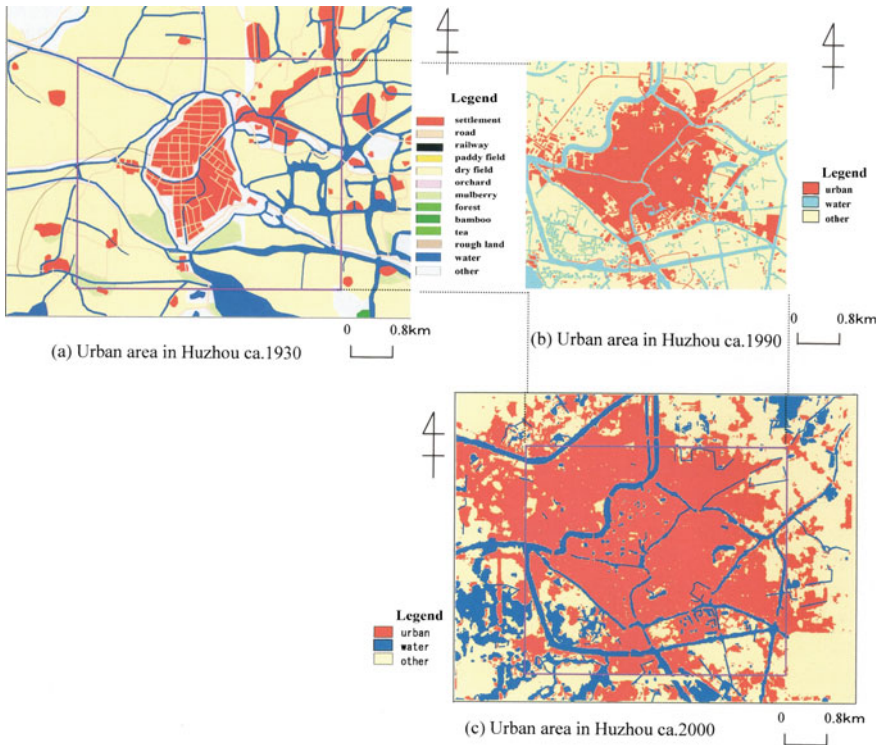


Fig. 2.6 Urbanization in Huzhou and the rivers blocking it

1990s. This advance is obviously backed by construction and improvement of bridges and roads as well as spread of cars.

Figure 2.7 shows the case of Wuxi, which shows how mountains restrict urbanization. Here mountains within and around urban area in ca. 1990 look like islands in the sea of urban area in ca. 2000. Some of these islands will remain as they are due to governmental protection or physical constraints such as steep slopes, but others will give way to further urbanization under the rapidly progressing motorization. Climbing up of urban area on less steep slopes in and around cities has been a common phenomenon in Japan since the middle of the 1960s, and it seems that it is now becoming a common phenomenon in China.

2.4.5 Identification of Urban Expansion

Delineation of an urban area is not an easy task. It is particularly so where there is no clear visible boundary in between urban area and the surrounding countryside. It is generally believed by specialists that ‘city area’ does not represent urban area

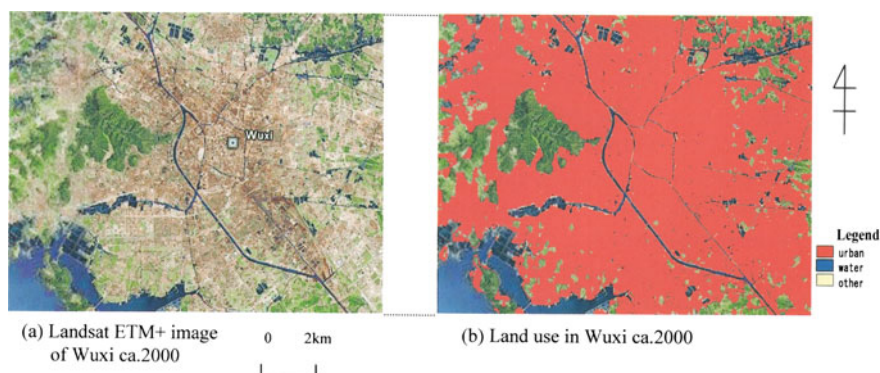


Fig. 2.7 Urbanization in Wuxi ca. 2000

well. An alternative to it may be ‘built-up area’, but again specialists are often reluctant to use it, partly because they are not convinced with its reliability, and partly because it has only a couple of decades of history. For these and other reasons, Ji (2004b) and many other specialists used satellite images, particularly night-light images, in order to identify urban areas and their changes.

As mentioned above, Fig. 2.3 shows built-up area together with urban area defined in the present study. It is shown only for ca. 1990 and ca. 2000, as it did not exist ca. 1930. Built-up area and urban area are almost identical in some cases, e.g., Nanjing ca. 1990 and ca. 2000, Yixing ca. 2000, Xuzhou ca. 2000, and Nantong ca. 2000, but large differences are also seen, e.g., Linhai ca. 1990, Changzhou ca. 2000, Wuxi ca. 2000, and Huzhou ca. 2000. Both urban area and built-up area appear to need further improvements.

In Japan, DID (Densely Inhabited District) has been defined and mapped since the 1960s in order to delineate urban area as accurately as possible based on the population census data. As Himiyama and Morishita (2003) demonstrated, it is an extremely useful tool for urban planning and the study of urbanization, although it has certain limitations. It is hoped that DID or other means equivalent to or better than DID is defined and used in China, so that urbanization is grasped more accurately and necessary planning measures are taken based on the facts.

2.5 Conclusions

Urban expansions of fourteen cities in Jiangsu Province and Zhejiang Province of China since ca. 1930 have been grasped spatially and quantitatively by producing and comparing the digital land use maps of ca. 1930, ca. 1990, and ca. 2000. The study has shown the long-term trend of urban expansion, the extreme speed of it during the 1990s, especially that of smaller cities, and the resultant farmland loss. It was argued that the existing areal unit for urban area, such as city area or built-up

area, is not as reliable as desired in some cities, and that the DID used in Japan may be useful if employed in China as a means to identify urban area.

It is hoped that systematic comparative study of long-term urbanization in China is further developed along with detailed regional studies, and helps avoiding conflicts related to urbanization.

This chapter is the revised edition of CJLUC Project Report Vol. 5 pp. 191–202 (Himiyama et al. 2006).

References

- Himiyama Y (2004a) Achievements and tasks of research on land use change in China. *Geogr Rev Jpn* 77(12):783–799
- Himiyama Y (2004b) The trend, mechanism and impact of urban expansion in Japan. Reports of the Taisetsuzan Institute of Science, no. 38, pp 53–60
- Himiyama Y (2005) Land use and its historical change of Japan—since the Meiji Era (1868–2012). In: Nakamura K, Arai T, Yonekura N (eds) *Geography of Japan—physical overview*. Asakura Shoten, Tokyo, pp 293–308
- Himiyama Y, Morishita Y (2003) Urbanization in Japan since 1960 viewed from the DID Statistics. Reports of the Taisetsuzan Institute of Science, no. 37, pp 37–52
- Himiyama Y, Ikeshita M, Shinde T (2006) Urbanization in Jiangsu Province and Zhejiang Province since ca. 1930. In: Himiyama Y (ed) *China–Japan comparative study of land use/cover changes* (V). CJLUC, Asahikawa, pp 191–202
- Ji Z, Torii K (2000) The expansion of the built-up areas of regional capital cities in the Yangtze River Delta area—a case study of Suzhou City in Jiangsu Province, China. In: Otsubo K (ed) *LUGEC project report VI*, CGER, pp 64–82
- Ji Z (2003) Rearrangement of land use in the suburbs of Wuxi City, China. In: Himiyama Y (ed) *China–Japan comparative study of land use/cover changes* (II). CJLUC, Asahikawa, pp 51–72
- Ji Z (2004a) Development of industrial estates and the response of the surrounding rural communities in Shanghai Metropolitan Area: the case of Kunshan City, Jiangsu Province. In: Himiyama Y (ed) *China–Japan comparative study of land use/cover changes* (III). CJLUC, Asahikawa, pp 25–42
- Ji Z (2004b) Changes of cities and villages in China. Ashi Shobo, Tokyo
- Liu J, Zhao T, Deng X, Zhan J (2004) Study in Su–Xi–Chang city zone. In: Himiyama Y (ed) *China–Japan comparative study of land use/cover changes* (III). CJLUC, Asahikawa, pp 67–74
- Long H, Li X (2001) Land use changes under the pressure of rapid industrialization and urbanization: the case of Kunshan, the Yangtse River Delta Economic Area. In: Shi P (ed) *Proceedings of international conference on land use/cover change dynamics*. Organizing Committee of LUCCD2001, Beijing, pp 211–222
- Lu Q, Wu Peilin (2002) Land use and land cover changes in Beijing 1903–1999. In: Himiyama Y (ed) *Land use/cover changes in selected regions in the world* (II). IGU-LUCC, Asahikawa, pp 45–62
- Statistical Bureau of China ed. (2000) *Urban statistical yearbook of China*. China Statistical Press, Beijing
- Zhou G, Chu C et al (eds) (1994) *Atlas of cities of China*. China Map Publishers, Beijing

Exploring Sustainable Land Use in Monsoon Asia

Himiyama, Y. (Ed.)

2018, VIII, 296 p. 189 illus., 119 illus. in color.,

Hardcover

ISBN: 978-981-10-5926-1