Investigation of City Living Environment and Energy Consumption in Yangtze Delta Area

Xingtian Wang *1, Weijun Gao2, Haifeng Li 3, Penglin Zhao4, Jianxing Ren 5 and Toshio6 Ojima

1 Architect, Shanghai Nikko Architectural Consultation Co., LTD, China
2 Associate Professor, Faculty of Environment Engineering, The University of Kitakyushu, Japan
3 Researcher, Building Research Institute, China
4 Chief Engineer, Shenzhen Municipal Planning & Land Bureau, China
5 Professor, Department of Power Engineering, Shanghai Institute of Electric Power, China
6 Professor, Department of Architecture, Waseda University, Japan

Abstract
Yangtze Delta Area is most developed area in China, the center of which is Shanghai, a largest economical city and largest harbor for industry and trade. Besides Shanghai, this area has many cities with a high economical power and highly developed urbanization. The GDP is about 195 billion USD about 20% of the all cities in China. GDP for person is twice than average value of all the cities. The development of economy and living condition in this area will give a significant impact on other cities in China. In this paper, we have an investigation on situation relating with living environment and energy consumption in cities of Yangtze Delta Area by using China statistical data.

Keywords: living environment, energy consumption, city, China

Introduction
Yangtze Delta Area is most developed area in China, the center of which is Shanghai, a largest economical city and largest harbor for industry and trade. Besides Shanghai, this area has many cities with a high economical power and highly developed urbanization. The GDP is about 195 billion USD about 20% of the all cities in China. GDP for person is twice than average value of all the cities.

Yangtze Delta Area includes Shanghai, Nanjing, Suzhou, Wuxi, Changzhou, Zhenjian, Yangzhou in Jiangshu province, Hangzhou, Jiaxing, Huzhou, Ningbo in Zhejiang province, and so on. The area is about 9.95 ten thousand km², which is about 1.04% of the total area in China. Population is about 73 million people, which is about 6% of the total population in China. The urban population (not include agricultural population) is about 2.5 million people with about 11% of the total urban population in cities of China. About 3% is living population is about 44.4 million people, about 10.4% of that of China cities. Among this population, about 10.5 million people, 23.7% serve for service industry, which is about 11% of that of China cities. It is obvious that this are have a higher level for urbanization.

Therefore, the development of economy and living condition in this area will give a significant impact on other cities in China. In this paper, we have an
Table 1. Outline of the cities in Yangtze Delta Area

| Classification of city scale | City Name | Total Population (Ten thousand persons) | Non-agricultural population (Ten thousand persons) | Land area (sqkm) | Population density of urban districts (person/sqkm) | GDP (Billion US Dollar) |
|-----------------------------|-----------|----------------------------------------|-----------------------------------------------|----------------|-----------------------------------------------|------------------------|
|                             | National Total | 97427 | 26018 | 26961 | 15965 | 3142726 | 385661 | 19407 | 310 | 675 | 1022.10 | 500.73 |
|                             | Gigantic cities total | 13027 | 7697 | 6048 | 5021 | 258646 | 52209 | 3489 | 501 | 1159 |                       |           |
|                             | Mega cities total | 12097 | 6149 | 4277 | 3153 | 333778 | 34837 | 2963 | 362 | 1191 |                       |           |
|                             | Big cities total | 18740 | 4824 | 5673 | 3289 | 558429 | 74462 | 3342 | 336 | 648 |                       |           |
|                             | Middel cities total | 47361 | 88612 | 9781 | 4111 | 1615104 | 164676 | 4594 | 294 | 538 |                       |           |
|                             | Small cities total | 6203 | 1087 | 1214 | 390 | 379169 | 59477 | 5567 | 164 | 183 |                       |           |

Note: 1 US Dollar = 8 RMB (China current)

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### Location, Population and Economy

Figure 1 showed the map of Yangtze Delta Area, which is located in the east middle part of China. There are three main economic zones, which is Shanghai economic zone, Nanjing economic zone and Hangzhou economic zone. Many functions, economical and cultural activities, have concentrated in Shanghai. Shanghai has taken up rapidly growing international functions, such as international finance which is brought to China as it has become more oriented toward an international and information intensive society. The city’s function as node of information conveyance of the nation as well as of the world has increased its importance. Such functional concentration on the other hand has been a major contributing factor of abnormal upsurge in land price, traffic congestion, and deteriorating environment.

In order to keep the development of Yangtze Delta Area, it has to adjust the relationship between Shanghai and other cities. There are significant differences in population scale as shown in table 1. The population of Shanghai is over 900 ten thousand. However, the second center of cities in this area, Nanjin, has only about 250 ten thousand population. Therefore, it may be necessary to control the scale of population in Shanghai. About 63% of non-agricultural population lives in three economic centers, Shanghai, Nanjin and Hangzhou.

The figure 2 shows the yearly change of the density of population in urban districts (resident population). From the figure, the density of population in Shanghai has a significant change. About 10,000 people per 1km² in 1992 decreased to about 2,900 people per 1km² in 1999. The reason is that although the urban area expanded from 750km² in 1992 to 3,900km² in 1999, the population changed only from 750 Ten thousand in 1992 to 950 Ten thousand in 1999. Hangzhou and big cities in this area also have this tendency. However, the change is smaller than Shanghai. Nanjing and middle cities are almost no change in the population density. The population density of cities in Yangtze Delta Area is about 3-4 times higher than that of national total.

### Greenery

Recently, public interest in accessibility to nature has become much keener than before. The citizens of Yangtze Delta Area have also come to fully recognize that green and waterside areas are indispensable to their daily life, which should be comfortable and pleasant, and that nature enhances the beauty of the city and provides them with places for enjoying sports and recreational activities.
The government has made steady efforts to construct and improve parks and to conserve other natural resources in order to recover greenery in the cities. However, woodlands in the cities are still being devastated, and the average park area per citizen in Yangtze Delta Area is only 5.4 m². Shanghai is only about 2.4 m² per person, quite a low level for an international city, compared with 30.4 m²/person of London, 19.2 m²/person of New York and 12.2 m²/person of Paris.

Figure 3 gave a yearly change of ratio of urban gardens and green areas to total city area. Nanjing has a stable change with about 16% green area in city. Green area of Hangzhou increased with year. However, between 1995 and 1996, there has a decline in the ratio of green area to whole land area. The reason is that in 1996, Hangzhou expanded its city boundary from 430km² to 683km². Big cities and middle cities have tendency with an increase of green area although they have a low level in green area with about 10% of total city area. The ratio of green area in city land use for Shanghai is lowest in Yangtze Delta Area, which is only about 5%.

Water Supply and Treatment

Although Yangtze Delta Area has many river and lake, the quality of major water source, tended to deteriorate chiefly due to industrialization and urbanization. The cities of Yangtze Delta Area have many small-scale factories with a lower quality of equipments and technologies. In addition, with a lack of control, about 70% sewage is directly discarded to rivers. The construction of sewerage facilities cannot catch up the step of economical development. Rate of penetration of sewerage (percentage of urban population with access to sewerage facilities is very low. The efficiency of the treatment facilities is also low. For Mega cities, the rate of penetration of sewerage is lower than 20%. For large cities, it is only about 10% and many small cities have no treatment facilities.

Water is a valuable resource whose supply is limited. The supply power in Yangtze Delta Area cannot satisfy the demand of the economical development. The quality of tap water is also a problem, which even cannot to satisfy the standard of national regulation. Some water resources have been deteriorated so the city has to find another water resource. For example, Shanghai city has to move her water resource to a far place because the Wangpu River near the city has been seriously deteriorated.

Figure 4 showed per capita yearly consumption of tap water. Before 1995, an increase of water use has been observed except for Shanhai. The use of tap water represents the living level of a city. Shanghai used to reach a higher use of tap water than the other cities. However, Shanghai is lack of water resource. From 90’s, the government encouraged water saving. The statistics data may represent this effort. After 1995, there is a tendency in the decrease of per capita yearly consumption of tap water.

Energy Consumption

Figure 5 showed per capita annual electricity consumption for home use. The electricity consumption increased quickly with the year. In 1999, Shanghai is about 400 KWh/person; Nanjing is about 350 KWh/person and Hangzhou is about 450 KWh/person, which is about 1.2-1.6 times as the same as that of national
total. Big cities are about 371 KWh/person and middle cities are about 310 KWh/person.

Per capita annual consumption of coal gas was shown in figure 6. For the cities with over 100 ten thousand people, the utilization of coal gas with a pipeline has been dramatically increased, which showed the construction of coal gas pipeline increase quickly. However, for big and middle cities, the rate of increase in coal gas use is not high. In those cities, people mainly use the liquefied petroleum gas (LPG), which was shown in figure 7. For the use of LPG, the big and middle cities have quick increase with the year. In Shanghai, the consumption of LPG reached a stable level, which is about 17kg/person.

Figure 8 is a sum of energy consumption of electricity, coal gas and liquefied petroleum gas for home use.

Road Transportation Network

Roads are the facilities of urban structures, which support citizens’ life as spaces that meet the diversified traffic needs of automobiles, bicycles and pedestrians. In the process of the economy development and urbanization, the amount of automobiles increases every year. For example, in Shanghai, as shown in figure 9, the increase of the amount of automobiles reaches about 0.45 million in 1996. On the other hand, as far as the pace of road construction is concerned, it is very fast in Shanghai. The road length is 1,653 km in 1990 and it reached 3,118 km in 1996. Nevertheless, with the rapid increase of the amount of automobiles, the road length each automobile occupied has been continuously decreasing from 1990 to 1996. That is to say the pace of road construction is lower than that of the increase of the amount of automobiles. As is shown in figure 10, the road length each automobile occupied has been coming down from 1990 and it reaches the bottom 6 m per automobile in 1992. In the same year, because the pace of road construction accelerates, which is higher than that of the increase of automobiles, the road length each automobile occupied enhances 9 m per automobile in 1993. After 1993, as the pace of road construction is lower than that of the increase of automobiles, the road length each automobile occupied keeps about 7 m per automobile. Due to the constraint of the pace of road construction, it will certainly result in traffic jam with the increase of the amount of automobiles. Especially in the center of the city where automobiles move slowly and traffic jam comes forth frequently.

Figure 11 showed the per capita area of paved road in cities. For national total, this value increased from 2.5 m²/person to 4.9 m²/person, nearly twice between eight years. For Shanghai, per captial area of paved road in 1999 is as three times as that in 1991. The other cities were also developed in a speed of 2 times for road construction. As mentioned above, however, the road construction seem still not to catch up the need of increase of automobiles.
The state of the housing and neighborhood living environment are prime factors for all citizens. Entering 1990s, the real estate developed dramatically. The investment in Shanghai, for example, increases by a increase rate of year at 44%. The living condition has been improved. Figure 12 showed the floor area for one person. The increased tendency can be seen obvirously. Big cities and middle cities have a higher floor area than the mage cities, Shanghai, Nanjing and Hangzhou. Growth rate of per capita floor area for all cities is about 1.8-2.1.

Now some problems in housing development were faced in Yangtze Delta Area as follows. Excess and no-planned investment causes many houses cannot find a buyer. Many houses are still no people living. For example in Shanghai, empty new built house share about 84% in all types of buildings. This results the developer cannot get the profits back and disturb the health development of housing industry.

The cost of houses is very higher. The developers have not considered the citizens' purchase abilities. The price of a new house surpassed the payment capability of people.

The infrastructure construction cannot catch up the high-speed housing development. The residents have many inconvenience for their new houses.

**Conclusion**

Here we used the statistic data to investigate the basic condition of living environment and energy consumption for Yangtze Delta Area.

This area is one of the most developed area in China, which has a high population density. However, the increase of population has some unbalance factor. The scale of population in Shanghai should be controlled to adjust the population structure in this area.

Although Yangtze Delta Area is rich for water, the urbanization and industrialization deteriorate the quality of water resource. The new development should consider to conserve natural environment, especially for Shanghai, big cities and middle cities. This area needs effort to promote water quality control, construction of sewerage systems and measures for drainage according to an environment control to preserve water quality in water supply source areas.

Home energy use increase very fast in this area especially for pipeline coal gas use. It is necessary to pay more attention to decrease energy consumption.

Reflecting the dense population and an active economy, the density of automobile traffic in this area is exceedingly high and congestion, particularly in mega cities. With the construction of road, it should be to adjust the balance between the cities and in a city, some road for the use of automobiles separated in grad from ordinary level roads should be developed to increase the convenience for people.

The living condition for resident has improved gradually. Housing development should consider the economical condition of people and planned carefully.

**References**

1) Urban Statistical Yearbook of China 1992-2000, China Statistics Press
2) Shanghai Statistical Homepage, http://www.stats-sh.gov.cn/