Chapter 2
Current Situation in the Study Area

Abstract Beijing is the capital of the People's Republic of China. It is a typical city in which huge amount of sewage sludge discharged without treatment. Water shortage and water pollution has become key factors which limits Beijing socio-economic and environmental sustainability. In this chapter, the economic and environmental characteristics and the capacity of sewage and sewage sludge treatment in Beijing are presented. Based on the analysis of Beijing situation, it is necessary using a comprehensive simulation method to evaluate the environmental and economic impact of sewage sludge treatment.

Keywords Beijing · Economic development · Water environment · Sewage sludge treatment capacity

Beijing, the capital of the People's Republic of China, is the center of the nation's politics, culture, and international exchanges and a modern metropolis full of vitality.

2.1 History and Relics

Beijing is home to the well-known "Peking Man (Sinanthropus pekinensis)" relic that dated back 200,000–700,000 years ago. Evidence of historical record and excavated relics has proved that the city has stood on its current site for well over 3,000 years. It was the capital city for Liao, Jin, Yuan, Ming, and Qing dynasties in ancient and contemporary Chinese history.

With the founding of People's Republic of China on October 1, 1949, Beijing became the capital of the new republic and has since developed itself into a political and cultural center of China and international exchange hub. Cultural relics in Beijing like the Forbidden City, the Great Wall, Zhoukoudian Peking Man Relics, the Temple of Heaven, the Summer Palace, and the Ming Tombs are world cultural and natural heritage approved by the United Nations. There are a total of 7,309 historical and relic sites in Beijing among which 60 are classified as national cultural heritages and another 234 are Beijing cultural heritages.

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2.2 Natural Geography

Beijing Municipality is located between 116°20′ east longitude and 39°56′ north latitude, with Tianjin City on its eastern border and Hebei province on the other three sides.

Lying in the northern part of North China Plain, Beijing is surrounded by mountains on the west, north and northeast. The northeastern part of the city is high while the southwestern part is low topographically, with a southeastern plain tilted gradually downward to the Bohai Sea. Major rivers flowing through Beijing include Yongding River, Chaobai River, North Canal, and Juma River that mostly originated in the northeastern mountainous areas of Beijing. These rivers flow through rugged mountains towards southeastern plain of Beijing and in the end join the Bohai Sea.

Beijing has a continental monsoon climate with four distinct seasons. Spring and autumn are short while winter and summer are long. The average temperature of Beijing in year 2002 was 13.2 °C. December was the coldest month with an average temperature of –2.9 °C while July was the hottest month with an average temperature of 27.5 °C. Average annual rainfall in 2002 equaled 370.4 mm, which was relatively low. The frost-free period of Beijing for 2002 was 199 days.

Beijing occupies a total area of 16,807.8 km^2. Around 10,417.5 km^2 are mountainous areas, which constitute 62 % of the total space of Beijing. The plain area of Beijing covers 6,390.3 km^2, which accounts for 38 % of the city's total area. Beijing municipality has 14 subordinate districts and 2 counties.

2.3 Population and Nationalities

By the end of 2010, Beijing has a total of 19.61 million residents among which 12.58 million people are registered permanent ones. Over the past decade (2001–2010), the average annual population growth rate is 3.8 % (Fig. 2.1). The population density of Beijing is 1,166 people per square kilometer.

According to the Sixth Census conducted in year 2010, average life expectancy of Beijing residents reached 80.2 years. Beijing boasts all 56 ethnic nationalities of the country, with nationality of Hui, Manchu, Mongolia, and Korea exceeding 10,000 people.

In term of population distribution, the areas of Central City and other districts have similar size, but the population of the Central City accounted for about 60 % of the total population in Beijing. The population of every subregion in 2010 is shown in Table 2.1.

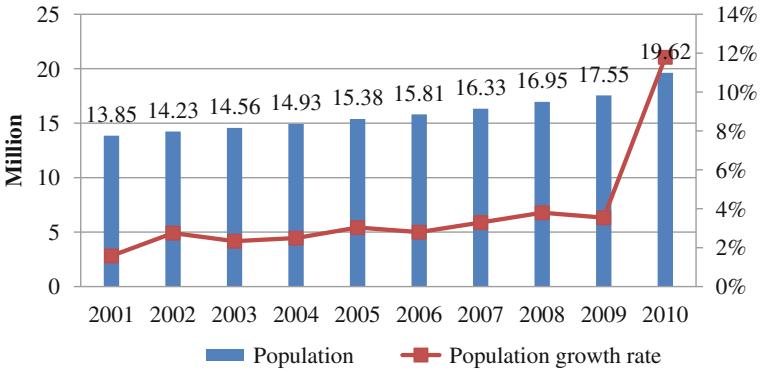

Fig. 2.1 Population growth for Beijing

Table 2.1 Population of each subregion in thousands

Subregion	Population	Percentage (%)
Central City	11,716	60
Fangshan	945	5
Tongzhou	1,184	6
Shunyi	877	4
Changping	1,661	8
Daxing	1,365	7
Mentougou	290	1
Huairou	373	2
Pinggu	416	2
Miyun	468	2
Yanqing	317	2
Total	19,612	100

2.4 Economic Development

Through more than 50 years of construction, Beijing has changed from a consumer city to a major city with various industries. Beijing ranks second among the top 50 cities in China in terms of comprehensive power, and is the first among the 40 best cities in China in terms of investment environment.

As a dynamic city, Beijing has a wide range of industries. During the years after China adopted reform and open-up policies and especially in the Eleventh Five-year period (year 2005–2010), CPC Beijing Committee and Beijing Municipal Government has made adjustments to the city's economic structure and layout to

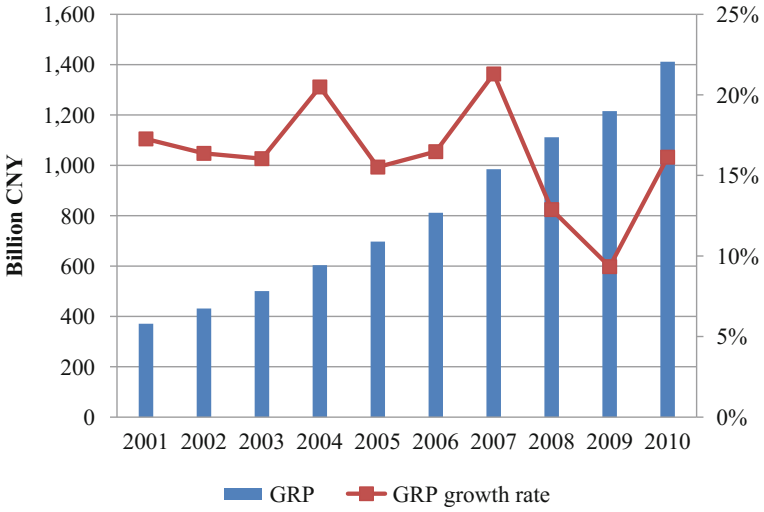

Fig. 2.2 GRP growth trend from 2001 to 2010 for Beijing

ensure a healthy, sustained economic development for the city. In 2010, Beijing's gross domestic production (GDP) increased 16 % from previous year to reach 1,411 billion CNY (Fig. 2.2).

In the year of 2010, Beijing saw the establishment of a modern agriculture structure highlighting cash crops and fruit tree plantation, livestock breeding and eco-tourism. Livestock breeding occupies 55 % of the gross agricultural output. Cash crops accounted for 45.4 % of the total crops. Beijing has a fully integrated industrial structure. It has to date nearly 31,547 industrial enterprises, covering fields of electronics, machinery, chemicals, light industry, and textile and car manufacturing. High tech and modern manufacturing industries have become the leading forces of Beijing's industrial growth. Total value added of the industrial sector of Beijing achieved 339 billion Yuan in 2010. Beijing is also a major city with the greatest development of the tertiary industry with 75 % of the total GDP devoting to the tertiary industry in 2010. Over the past decade, the proportion of three industries structure shown in Fig. 2.3.

The regional economic development is imbalance in Beijing. In terms of GRP, Central City is 1,056 billion CNY in 2010, which accounts for 74.59 % of total GRP in Beijing (Table 2.2).

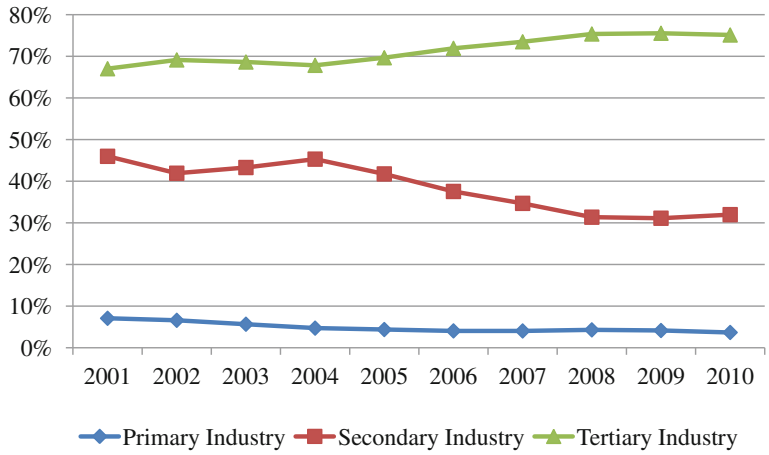

Fig. 2.3 GRP structure trend from 2001 to 2010 in Beijing

Table 2.2 GRP of every subregion in billions

Subregion	GRP	Percentage (%)
Central City	1,056	74.59
Fangshan	37	2.62
Tongzhou	34	2.44
Shunyi	87	6.13
Changping	40	2.83
Daxing	101	7.14
Mentougou	9	0.61
Huairou	15	1.05
Pinggu	12	0.83
Miyun	14	1.00
Yanqing	11	0.76
Total	1,415	100

2.5 Finance Revenue and Expenditure

Local financial revenue of the city totaled 381 billion CNY and saw an increase of 42 % over 2009 and an average of over 25 % increase for a consecutive of 10 years. Beijing's local expenditure was 406 billion CNY, which equaled to an increase of 6 % over the previous year. Over the past decade (2001–2010), Beijing fiscal revenue and expenditure are shown in Fig. 2.4.

In term of districts and counties financial revenue, Central City is 81 billion in 2010, which is also the highest amount of all subregions. Finance revenue and expenditure of every subregion is show in Table 2.3.

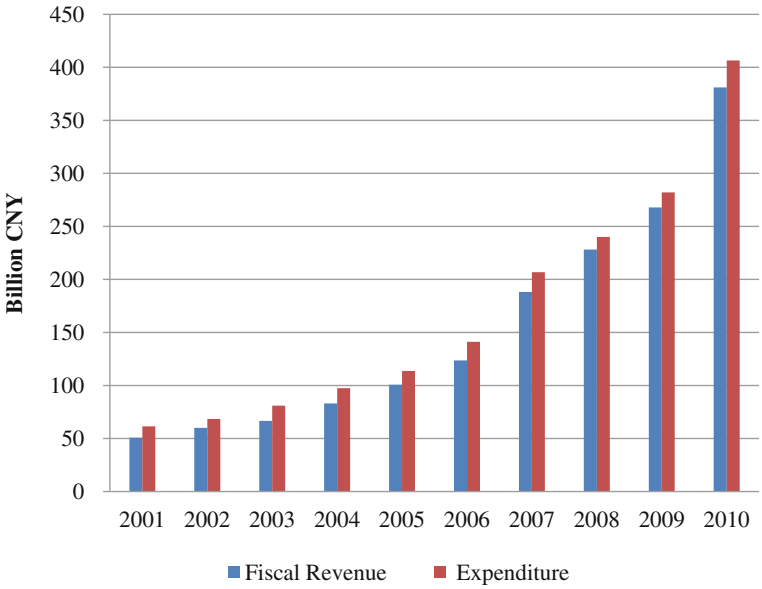

Fig. 2.4 Beijing fiscal revenue and expenditure trend from 2001 to 2010

Table 2.3 Finance revenue and expenditure of every subregion in 2010 in billions

Subregion	Finance revenue	Expenditure
Central City	81	103
Fangshan	17	22
Tongzhou	17	18
Shunyi	15	16
Changping	14	14
Daxing	26	30
Mentougou	3	6
	2	8
Huairou Pinggu	4	8
Miyun	2	8
Yanqing	1	6

2.6 Sewage Generation and Treatment

Due to its rapid economic and population growth, Beijing's municipal sewage generations are increasing each year. In 2010, the city produced more than 1.4 billion tons of sewage emissions (Beijing Environmental Protection Bureau 2011). Many sewage treatment plants that have been constructed by the Beijing municipal government have adopted advanced technologies, and the sewage treatment rate

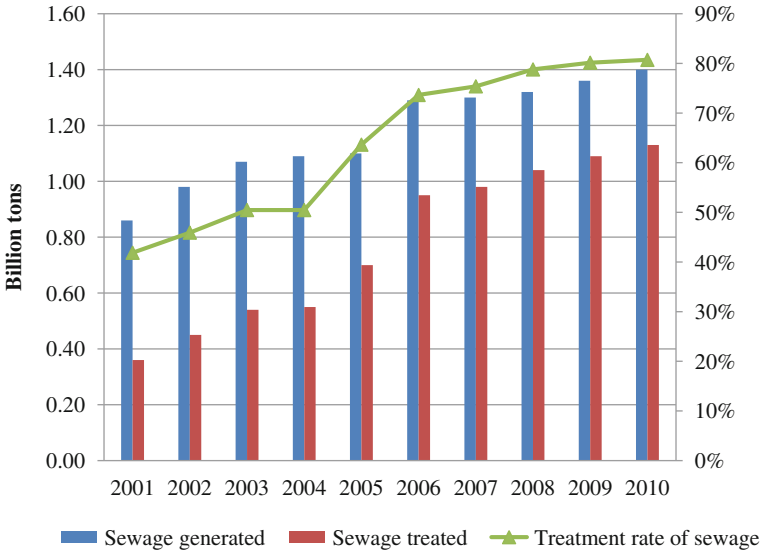

Fig. 2.5 Sewage generated and treated situation for Beijing

Table 2.4 Information of sewage generation and treatment of every subregion in 2010

Subregion	Sewage generation (million tons)	Sewage treatment (million tons)	Rate of sewage treatment (%)
Central City	810	779	96
Fangshan	52	36	69
Tongzhou	84	51	61
Shunyi	79	40	51
Changping	120	90	75
Daxing	95	68	72
Mentougou	40	14	35
Huairou	22	9	41
Pinggu	32	19	59
Miyun	46	16	35
Yanqing	45	11	24
Beijing	1,425	1,133	80

increased to 80 % in 2010 (Appendix 1; Beijing Water Authority 2011). Recent years, sewage generation and treatment conditions are shown in Fig. 2.5.

In term of subregion, the amount of sewage is 784 million tons in Central City, which account for 55 % of total sewage generate in Beijing. And the rate of sewage treatment is 96 %, which is much higher than other subregions. The detail information of sewage generation and treatment is shown in Table 2.4.

2.7 Sewage Sludge Generation and Treatment Capacity

As the byproduct of sewage treatment, the amount of sewage sludge also increases every year (Fig. 2.6). In 2010, the amount of sewage sludge is 1.13 million tons. However, the capacity of sewage treatment is only 0.48 million tons (Tables 2.5 and 2.6). In fact the rate of sewage treatment is less than 30 %. Therefore, there is amount of sewage untreated generated every year. If this sewage sludge cannot be treated, 50 % of the water pollutants removed by sewage treatment will return to the environment (Yang 2010). However, the need for sewage sludge treatment has not been addressed by the government.

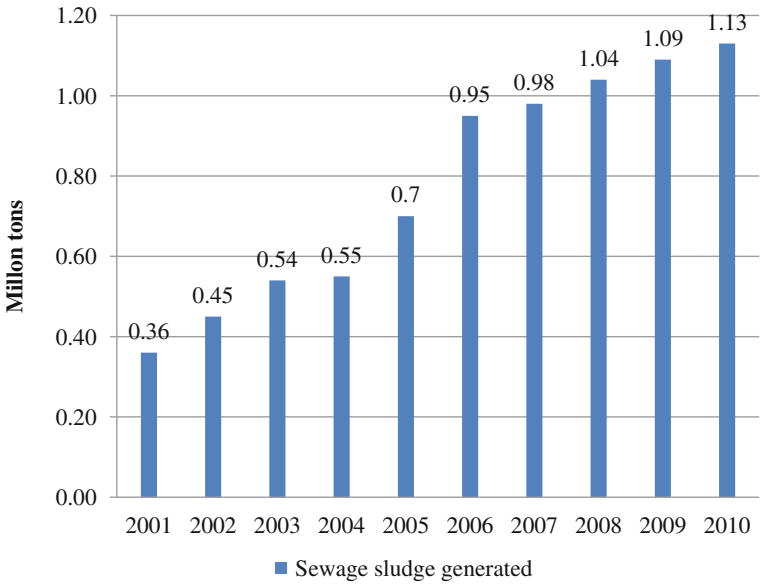

Fig. 2.6 Sewage sludge generated in Beijing

Table 2.5 The capacity of sewage treatment of Beijing in 2010 (thousand tons/year)

No	District	Name of Sludge Plant	Capacity
1	Daxing	Pang Ge Zhuang Composting Plant	110
2	Chang Ping	Chang Ping Composting Plant	29
3	Feng Tai	Fang Zhuang Limestone Drying Plant	11
4	Haidian	Qing He Sludge Heat Drying Plant	146
5	Changping	Beijing Cement Plant	184

Sources Tan et al. (2011), pp.105–109

Table 2.6 Sewage sludge generation and treatment capacity of every subregion in 2010

Subregion	Sewage sludge generation (thousand tons)	Capacity of sewage sludge treatment (thousand tons)
Central City	737	157
Fangshan	41	0
Tongzhou	51	0
Shunyi	40	0
Changping	104	213
Daxing	68	110
Mentougou	15	0
Huairou	21	0
Pinggu	29	0
Miyun	16	0
Yanqing	11	0
Beijing	1,133	480

2.8 Water Quality

In 2010, water shortages (Fig. 2.7) and water pollution in urban river downstream represent a serious situation that still has not been fundamentally reversed. The river water quality in Beijing is bad compared with other types of water class; 43.2 % of the river water is considered to be "inferior V" class, which is the worst level in China. 6.3 % of lake water is considered to be "inferior V" class. The water quality class proportion of rivers, lakes and reservoir is shown in Table 2.8. The surface water quality classification standard is shown in Table 2.7.

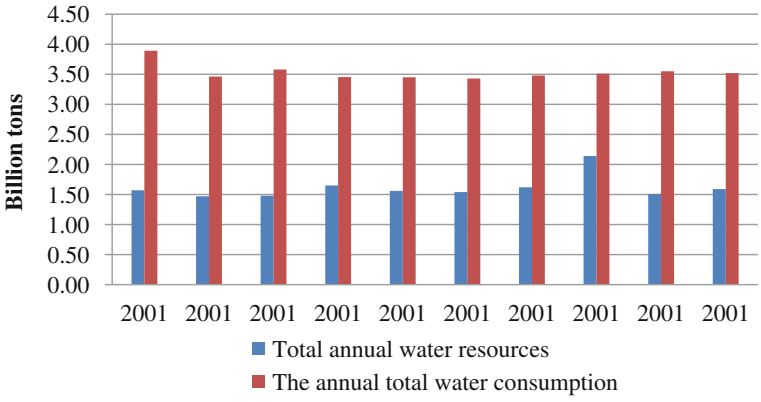

Fig. 2.7 The amount of water resource and water consumption trend in Beijing

Table 2.7 Surface water quality classification standards in China (mg/L)

	I	II	III	IV	V
COD	≤15	≤15	≤20	≤30	≤40
NH_3–N	≤0.15	≤0.5	≤1.0	≤1.5	≤2.0
T–P	≤0.02	≤0.1	≤0.2	≤0.3	≤0.4
T–N	≤0.2	≤0.5	≤0.1	≤1.5	≤2.0

Source Ministry of Environmental Protection of PRC's National Environmental Quality Standers for Surface Water (GB3838-2002), 2002, Beijing, China

Table 2.8 The water quality class proportion of rivers, lakes, and reservoir (%)

	II	III	IV	V	inferior V
River	49.1	6.4	0.2	1.1	43.2
Lake	31.0	45.2	14.2	3.3	6.3
Reservoir	85.8	3.7	10.5	–	–

Fig. 2.8 Load of COD in Beijing from 2001 to 2010

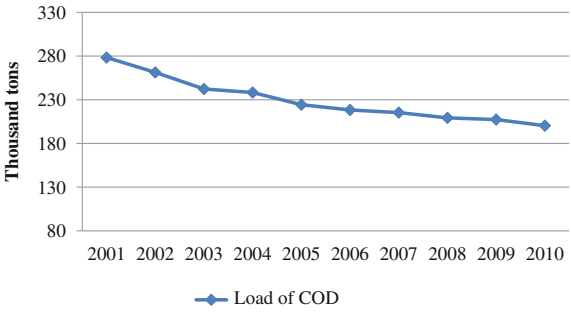

Figure 2.8 Shows load of COD in Beijing from 2001 to 2010. It is declining since the government has put forward proposals to improve water quality. However, COD is still the most important water pollutant which is to be reduced to improve water quality. The government has planned that COD should be reduced 8.7 % in 2015 compared with in 2010.

2.9 Energy Consumption and GHG Emission

Figure 2.9 shows total energy consumption and energy consumption intensity from 2001 to 2020. The trend of energy consumption is increasing, but the energy consumption intensity is decreasing. According to Beijing government's plan, energy consumption intensity should be reduced 17 % in 2015 compared to in 2010 to achieve the GHG reduction target in 2015.

GHG emission by energy consumption is about 110 million tons in 2010. GHG emission intensity is about 78,052 tons/billion CNY. According to *The Twelfth Five-Year Plan of Economic and Social Development* (Beijing Municipal

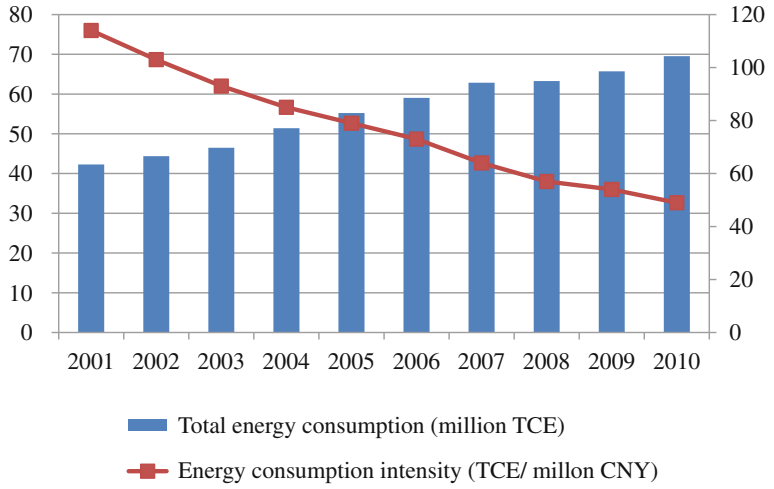

Fig. 2.9 Energy consumption and energy intensity from 2001 to 2020

Development and Reform Commission 2011), GHG emission intensity should be reduced 18 % in 2015 compared to in 2010. And in order to achieve the reduction target of GHG emission in 2020 of China, GHG emission intensity of Beijing must be reduced 36 % in 2020 compared to in 2010, while energy consumption intensity must be reduced 34 % in 2020 compared to in 2010.

2.10 Implications and Conclusions

Based on the current analysis of Beijing city, we can get the conclusion that, due to its rapid economic and population growth, water pollution, greenhouse gas emissions, energy demand increase is the key problems which is constraining economic and environmental sustainable development of Beijing.

Recently, the government has realized the importance of environmental protection. Accordingly, The Twelfth Five-Year Plan of Economic and Social Development (Beijing Municipal Development and Reform Commission 2011) requires that all sewage sludge be treated by 2015 and load of COD be reduced by 8.7 % in 2015 compared with 2010. In addition, in order to achieve the reduction target of GHG emission in 2020 of China, GHG emission intensity of Beijing must reduce 36 % in 2020 compared to in 2010, while energy consumption intensity reduced 34 % in 2020 compared to in 2010.

However, there is a big gap between the current situation and the future target. In order to realize these targets, Beijing government has adopted an integrated policy that are forestation for water conservation, reduction of working capital, and the introduction of advanced sewage sludge treatment technologies. However, how to

evaluate the economic and environmental impact of the integrated policy is an urgent issue for Beijing government. To determine the optimal development plan for Beijing, it is beneficial to use a simulation method to evaluate the regional environmental and economic impacts.

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