Water Resources in China

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Water resources in China

- **Water resources: surface water**
- **Water resources: ground water**
- **Mobilization of water resource**
- **Water use by sectors and trends**
- **Competition between sectors in future China**

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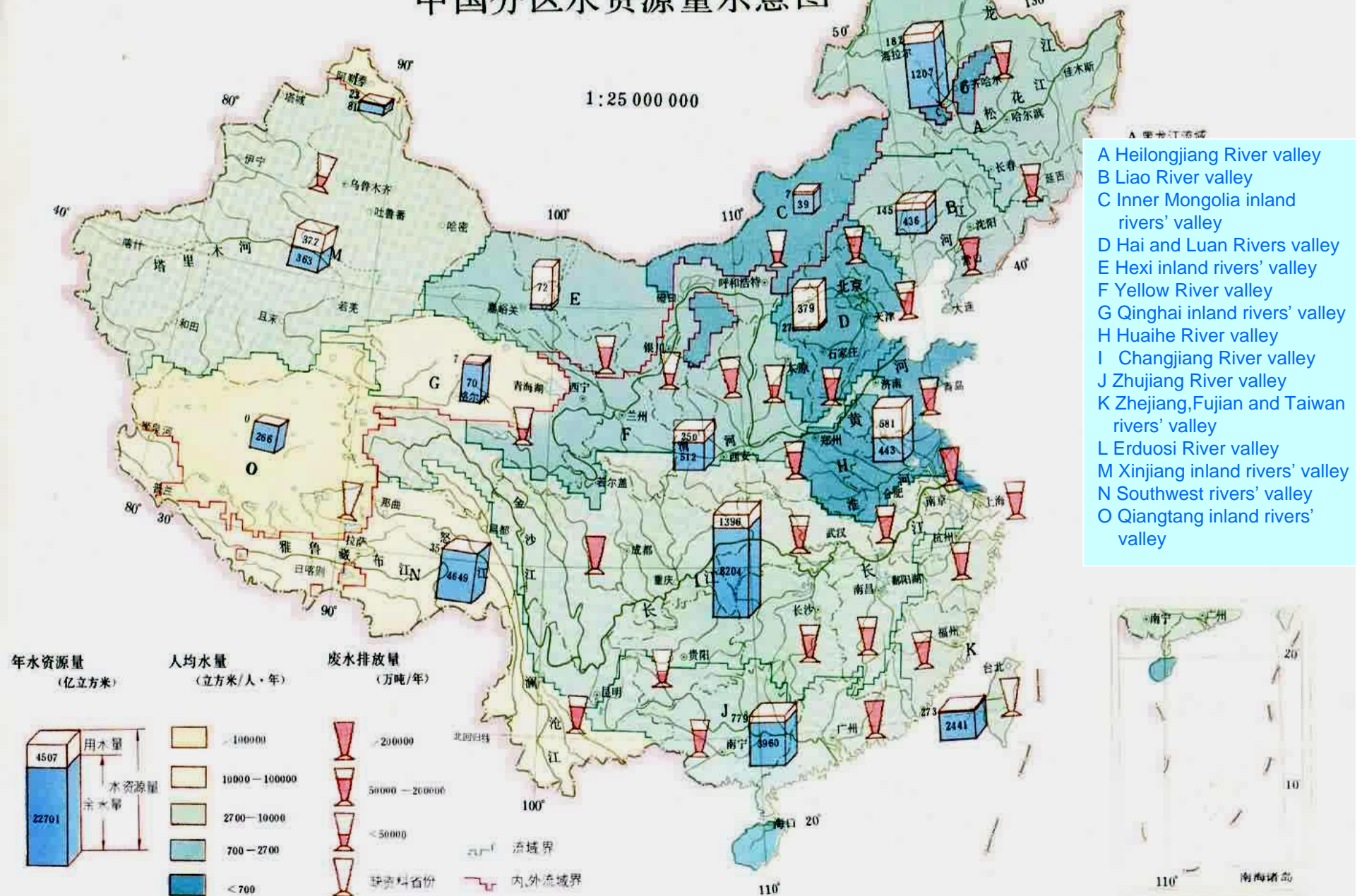# Water resources: surface water

Volume of water resource

¡ Total volume of water resources : 2812.4 ($\times 10^9$) billion m^3 ,about 96 % of it is surface water resources

¡ Average annual fluvial runoff : 2711.5 ($\times 10^9$) billion m^3

¡ The average annual ground water: 828.8 ($\times 10^9$) billion m^3

¡ Overlap between above two parts: 727.9 ($\times 10^9$) billion.

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Sketch map of distribution of water resource volume in China

中国分区水资源量示意图

1:25 000 000

A Heilongjiang River valley
B Liao River valley
C Inner Mongolia inland rivers' valley
D Hai and Luan Rivers valley
E Hexi inland rivers' valley
F Yellow River valley
G Qinghai inland rivers' valley
H Huaihe River valley
I Changjiang River valley
J Zhujiang River valley
K Zhejiang,Fujian and Taiwan rivers' valley
L Erduosi River valley
M Xinjiang inland rivers' valley
N Southwest rivers' valley
O Qiangtang inland rivers' valley

年水资源量
（亿立方米）

人均水量
（立方米/人·年）

废水排放量
（万吨/年）

The Total Volume of Water Resources in the Provinces, Autonomous Regions and Municipalities of China (2-1)

Provinces, Municipalities and Autonomous Regions	Annual total volume of precipitation	The overlap volume between surface and ground water 10^8m^3	Annual total volume of water resources	Annual water-yielding modulus $10^4m^3/km^2$
Beijing	105	10.7	40.8	24.29
Tianjin	68.3	2.0	14.6	12.91
Hebei	1034	75.9	236.9	12.62
Shanxi	831	66.1	143.5	9.18
Inner Mongolia	3183	112.6	506.7	4.39
Liaoning	1000	67.3	363.2	24.96
Jilin	1140	65.1	390	20.69
Heilongjiang	2481	140.5	775.8	16.62
Shanghai	65.1	3.7	26.9	43.49
Jiangsu	1017	38.9	325.4	31.88
Zhejiang	1597	201.2	897.1	88.12
Anhui	1591	106.8	676.88	48.49
Fujian	2023	305.7	1168.7	96.28
Jiangxi	2660	316.2	1422.4	85.08
Shandong	1110	83.2	335	21.85
Henan	1290	102.2	407.7	24.41

The Total Volume of Water Resources in the Provinces, Autonomous Regions and Municipalities of China (2-2)

Provinces, Municipalities and Autonomous Regions	Annual total volume of precipitation	The overlap volume between surface and ground water $10^8 m^3$	Annual total volume of water resources	Annual water-yielding modulus $10^4 m^3/km^2$
Hubei	2166	256.1	981.2	52.78
Hunan	3020	368.2	1626.6	76.79
Guangdong(Hainan included)	3757	522.8	2134.1	100.66
Guangxi	3621	397.7	1880	79.05
Sichuan	5889	798.8	3133.8	55.21
Guizhou	2094	258.9	1035	58.76
Yunnan	4824	738.0	2221	57.86
Tibet	7132	1094.3	4482	37.31
Shaanxi	1371	143.2	441.9	21.5
Gansu	1297	131.4	274.3	6.93
Qinghai	2064	254.9	626.2	8.66
Ningxia	157	14.8	9.9	1.92
Xinjiang	2429	489.7	882.8	5.36
Taiwan	874	111.6	664.1	184.57
National total	61889	7278.5	28124.4	29.46

Water resources: surface water

River systems

- The total length of all rivers in China amounts to about 420000 km
- More than 50000 rivers have a drainage area of more than 100 km^2. The annual discharge of all rivers totals more than 2600 billion m^3.
- Two large systems of rivers: oceanic and inland .The oceanic system—— can be again subdivided into Pacific, Indian and Arctic drainage basins——occupying about 64 per cent of the total land area in China.

Water resources: surface water

River systems

- All the major river systems of China flow in a generally western to eastern direction to the Pacific Ocean.

- About 50 percent of the total land area drains to the Pacific ocean

- About 10 percent drains to the Indian and Arctic ocean

- About 40 percent drains to the arid basins of the west and north (without outlet to the sea)，where the streams evaporate or percolate to form deep underground water reserves .

Major rivers in China

River	Drainage Area (km^2)	Length (km)	Annual Flow (10^8 m^3)
Changjiang River (Yangtze River)	1808500	6300	9513
Huanghe River (Yellow River)	752443	5464	661
Songhuajing River	557180	2308	762
Liaohe River	228960	1390	148
Zhujiang River (Pear River)	453690	2214	3338
Haihe River	263631	1090	228
Huaihe River	269283	1000	622

Source：State Statistical Bureau of PRC，1998，China Statistical Yearbook 1998

Drainage Area of Rivers in China

River	Drainage Area (km^2)	Percentage to Total (%)
Total Exotic Streams and Inland Rivers	9559370	100.00
Out-flowing Rivers	6114728	63.97
Heilongjiang River and Suifenhe River	875342	9.16
Liaohe,Yalujiang and Related Coastal Rivers	345207	3.61
Haihe River and luanhe River	318161	3.33
Huanghe River (Yellow River)	752443	7.87
Huaihe and Related Coastal Rivers in Shandong Province	329211	3.44
Changjiang River (Yangtze River)	1808500	18.92
Rivers in Zhejiang, Fujian and Taiwan Provinces	239803	2.51
Zhujiang River (Pear Rive) and Related Coastal River	580640	6.07
Yuanjiang River and Lancang River	240652	2.52
Nujiang River and West Yunnan Rivers	157156	1.64
Yarlung Zangbo River and Southern Tibet Rivers	396258	4.15
Western Tibet Rivers	57340	0.60
Ertix River	50000	0.52
Inland Rivers	3408659	35.66
Rivers in Inner Mongolia	300067	3.14
Huanghe Upper Reach Area	488301	5.11
Rivers in zhunger Basin	316530	3.31
Rivers Central Asia	93130	0.97
Rivers in Tarim Basin	1074810	11.24
Rivers in Qinghai Province	316285	3.31
Rivers in Qiangtang	721182	7.54
Blind Drainage Areas of Songhua River, Huanghe River and Southern Tibet	90353	0.95

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Source: State Statistical Bureau of PRC，1998，China Statistical Yearbook 1998，

Water resources: surface water

Lakes in China

- There are approximately **2800 natural lakes**, each with an area greater than 1 km^2, and with total area more than 80000 km^2.

- There are many artificial lakes-reservoirs, mainly constructed since 1949.

- The distribution of lake basins in China depends heavily on the feeding conditions of lake water.

- Major lake regions can be classified into **5 lake regions**: the Northeast Lake region, the Northwest Lake Region, the Qinghai-Xizang Lake Region, the Eastern Lake Region and the Southwest Lake Region.

Chief Features of Major Lakes in China（2-1）

type	Lake name	Basin area (km²)	Elevation of lake surface (m)	Maximum depth (m)	Total volume (10⁸m³)
Fresh lakes	Xingkai lake	4380	69	6	27.1
	Poyang lake	3583	21	16	248.9
	Dongting lake	2740	33.5	30.8	178
	Taihu lake	2420	3.1	4.8	48.7
	Hongze lake	2069	12.5	5.5	31.3
	Nansi lake	1268	35.5	6	25.3
	Chaohu lake	820	10	5	36
	Gaoyouhu lake	663	5.7	1.7	8.9
	Elinghu lake	610.7	4268.7	30.7	107.6
	Zhalinghu lake	526	4293.2	13.1	46.7
	Honghu lake	402	25	1.5	7.5
	Dianchi lake	330	1885	8	15.7
	Wudalianchi lake	276.2	139	4.6	6.1
	Erhai lake	246	1965.5	21	30
	Fuxianhu lake	217	1875	151.5	173.5
	Jingpohu lake	95	350	62	16.3
	Baitoushantianchi lake	9.8	2194	373	20
	Riyuetan lake	7.7	760	21	1.4

Chief Features of Major Lakes in China（2-2）

types	Lake name	Basin area (km^2)	Elevation of lake surface (m)	Maximum depth (m)	Total volume (10^{8}m^3)
Saltwater lakes	Qinghaihu lake	4635	3196	28.7	854.4
	Hulunhu lake	2315	545.5	8	131.3
	Namucuo lake	1940	4718	35	
	Qilincuo lake	1640	4530	33	
	Bositenghu lake	1019	1048	15.7	99
	Zharinanmucuo	985	4613		
	Dangreyongcuo	825	4535		
	Wulunguhu lake	745	4854	12	59
	Yangzhuoyonghu lake	730	4441	59	160
	Wulanwulahu lake	610	4854		
	Halahu lake	602	4078	65	160
	Sailimuhu lake	464	2071		232
	Mapangyongcuo lake	412	4587		202.7
	Daihai	165	1200	18	13.3
Salt lakes	Aibihu lake	1070	189		
	Aidinghu lake	124	-154		

Water resources: surface water

Difference between North and South China

- South China , which includes 4 basin regions, has an average water yielding modulus (the volume of water yielding on per unit area) of 6.54×10^5 m³/km² ·a, 7.4 times that of the North China.

- Among 10 basin regions, Zhejiang-Fujian-Taiwan basin region, which locates at the southeast of China, has a top water yielding modulus of 10.81×10^5 m³/km² ·a.

- Inland-river basin region has a smallest modulus of only 0.36×10^5 m³/km² ·a, one thirtieth of that of the former.

Water resources: ground water

¡ China has a total fresh ground water resource (renewable) of about 870 billion m³ annually, and slightly salty ground water resource amounts to 20 billion m³ annually.

¡ The exploited volume of the fresh ground water is about 290 billion m³ and the slightly salty ground water is about 12 billion m³ in one year.

¡ Ground water distributes and concentrates mostly in several large-scale alluvial plains (the Northeast China plain, the North China plain, the Middle and Lower Changjiang Valley) and structural basins (the Talimu, Junggar, and Sichuan basins).

¡ In arid and semiarid Northwest China, exploitation of ground water resource is of great use. In humid and subhumid Eastern Monsoon China , ground water resources is also important supplement to irrigation during the dry season.

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Natural Ground Water Resource of China

Regions	Natural ground water resource		
	Total volume （$10^8 m^3/a$）	Percentage （%）	Water yield modulus （$10^4 m^3/km^2/a$)
Heisong basins region	525.03	5.97	5.67
Liaohe basin region	281.11	3.19	8.01
Huanghuaihai region	754.14	8.57	11.91
Luanhe basin region	62.20	0.71	9.84
Haihe basin region	272.46	3.09	12.28
Huanghe basin region	440.30	5.00	5.55
Northwest inland region	660.98	7.51	3.15
Changjiang Valley region	2666.72	30.32	15.55
Hilly region of Fujian and Zhejiang Provinces	419.60	4.77	20.65
Zhujiang basin region	1331.59	15.41	27.18
Nujiang and Lancangjiang basins region	618.24	7.02	15.41

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Major Plains and Basins with Ground Water Resource ($10^8 m^3$)

Plains or basins	Natural ground water resource	Exploited volume of ground water	The overlap between surface and ground waters	Total volume of water resource
Sanjiang plain	89.64	127.88	15.44	130.88
Songliao plain	297.81	234.53		
Huang-huai-hai plain	462.53	460.39		
Hetao plain	41.42	26.79	20.06	26.69
Yinchuan plain	18.20	16.62		
Corridor west Huanghe River	44.76	26.85	39.82	12.36
Caidamu basin	30.83	12.11	22.75	53.19
Zhungeer basin	296.46	260.19	245.10	531.75
Talimu basin	262.01		196.15	427.93
Sichuan basin	358.57	125.08	327.02	1524.82
Jianghan plain	189.41	149.81		324.16
Dongtinghu plain	44.26	37.18		

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Water resources: ground water

Difference between North and South China

North China

¡ Including 15 provinces or autonomous regions, accounts for 60% of the total area of China

¡ Ground water resources only 30% of that of national total

¡ The exploited ground water volume accounts for 49% of that of national total, and 61% well-suited ground water resource distributes in North China

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# Mobilization of water resource

¡ China is highly uneven in the distribution of water resources as well as land resources.

¡ Water shortage has become a major restriction to economic development in the regions such as Huanghe River Plain, Huaihe River Plain, Haihe River Plain and the Jiaodong Peninsula.

¡ Water scarcity has caused the deterioration of ecological environment within the above regions.

¡ The Project of Transferring Water from South to North in China (PTWSN) is one of key works to tackle the problem in China.

¡ Three major lines for PTWSN has been made.

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Per Capita and Per Hectare Water Resources Volume in Various Basin Regions of China								
The name of basin region			Area Percentage (%)	Total volume of water Resource ($10^8 m^3$)	Percentage of water volume （%）	Percentage of population （%）	Percentage of arable land (%)	Water volume per capita (m^3)	Water volume per hectare land(m^3/hm^2)
Inland rivers area			35.3	1303.9	4.6	2.1	5.8	6290	1470
Oceanic Rivers area	Five basin Regions North China	Heirongjiang River region	9.5	1351.8	4.8	5.1	13.0	2630	679
		Liaohe river region	3.6	576.7	2.1	4.7	6.7	1230	558
		Haihe and luanghe Rivers region	3.3	421.1	1.5	9.8	10.9	430	251
		Huanghe River region	8.3	743.6	2.6	8.2	12.7	912	382
		Huaihe River region	3.5	961.0	3.4	15.7	14.9	623	421
		Total	28.2	4054.2	14.4	43.5	58.2	938	454
	Four basin regions South China	Changjiang River region	19.0	9613.4	34.2	34.8	24.6	2760	2620
		Zhujiang River region	6.1	4708.1	16.8	10.9	6.8	4300	4530
		Basins region of Fujian-Zhejiang Taiwan Provinces	2.5	2591.7	9.2	7.2	3.4	3590	4920
		Rivers region Southwest China	8.9	5853.1	20.8	1.5	1.8	38400	21800
		Total	36.5	22766.3	81.0	54.4	36.0	4180	4130
		Oceanic basins total	64.7	26820.5	95.4	97.9	94.2	2750	2600
National total			100	28124.4	100	100	100	2730	1870

Uneven resources distributions among inland river area, five basin regions North China and four basin regions South China
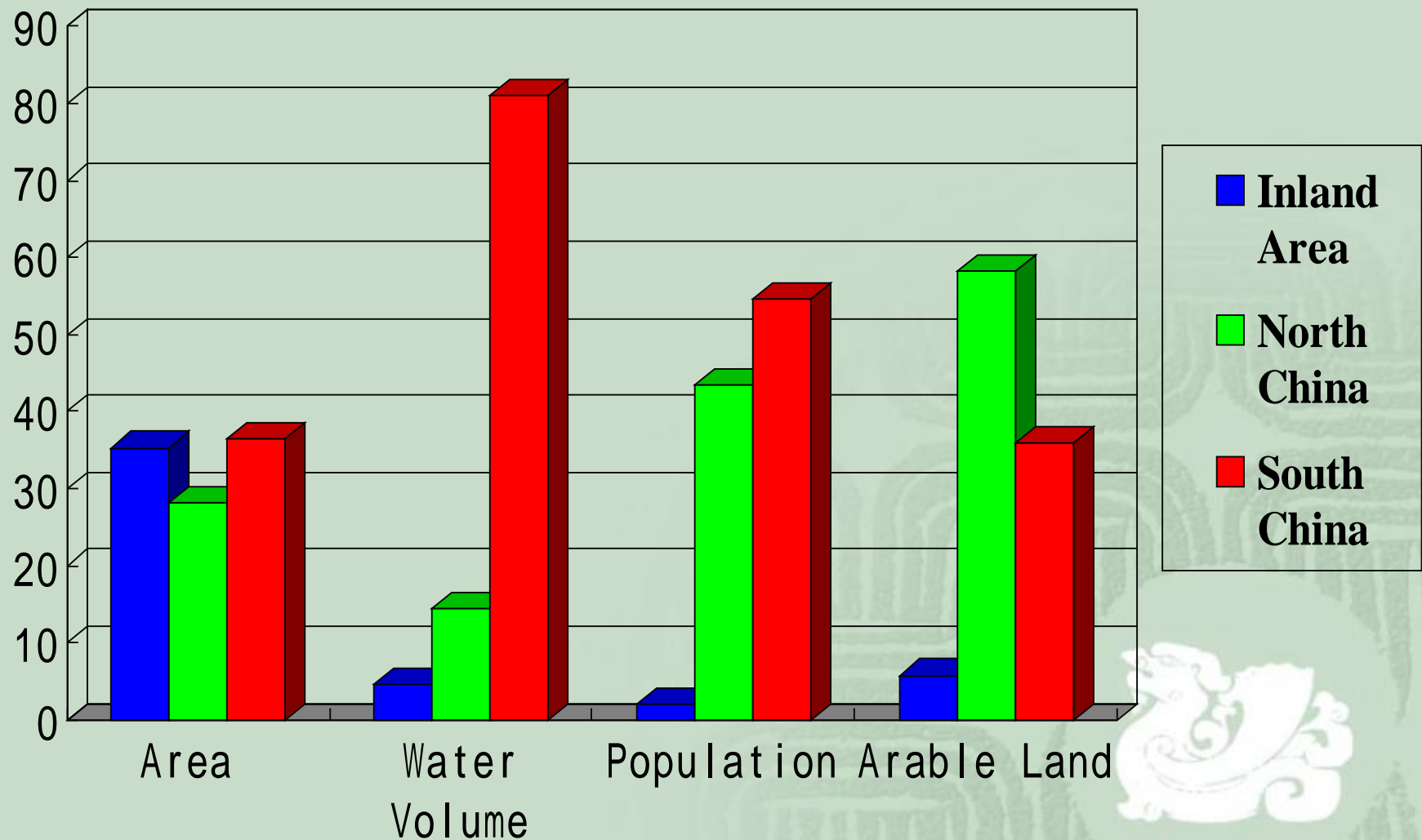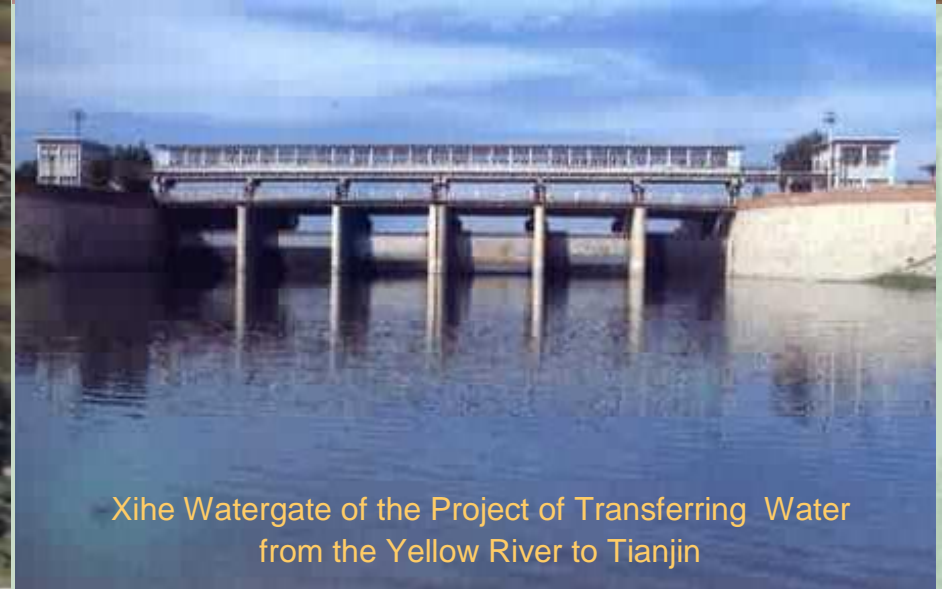
Sketch Map of the Great Canal
Exchange of cultures and economies between North and South China

A Photo of transferring water from Huairou Reservoir to Beijing through Jingmi Canal

Xihe Watergate of the Project of Transferring Water from the Yellow River to Tianjin

Songzhuan Watergate of the Project of Transferring Water From the Yellow River to Qindao

Shenzhen Reservoir Supplying Water for Hong Kong

Sketch map of Three Lines of PTWSN in China

附图5 南水北调线路示意图

附图6 南水北调 东线工程线路图
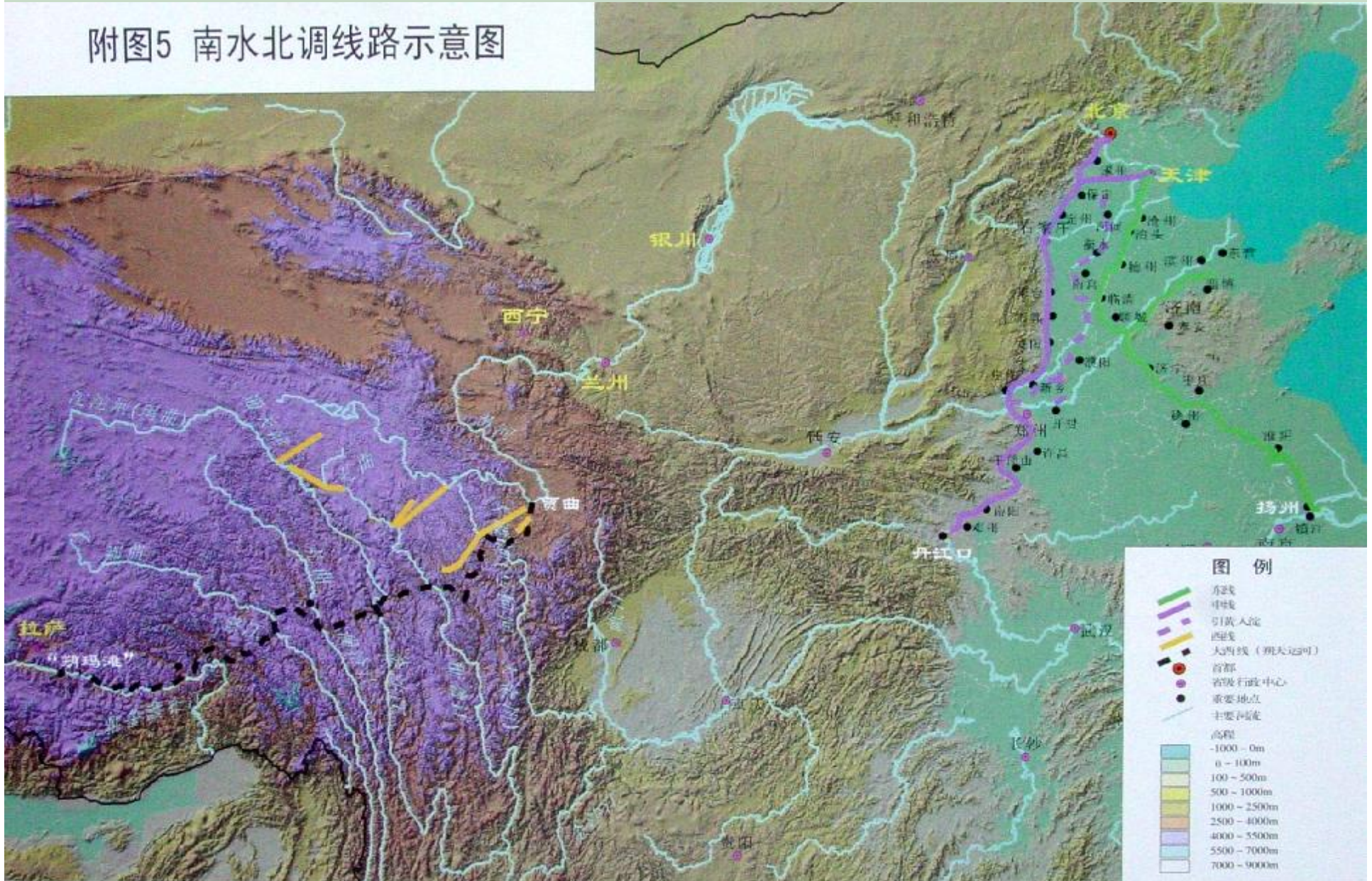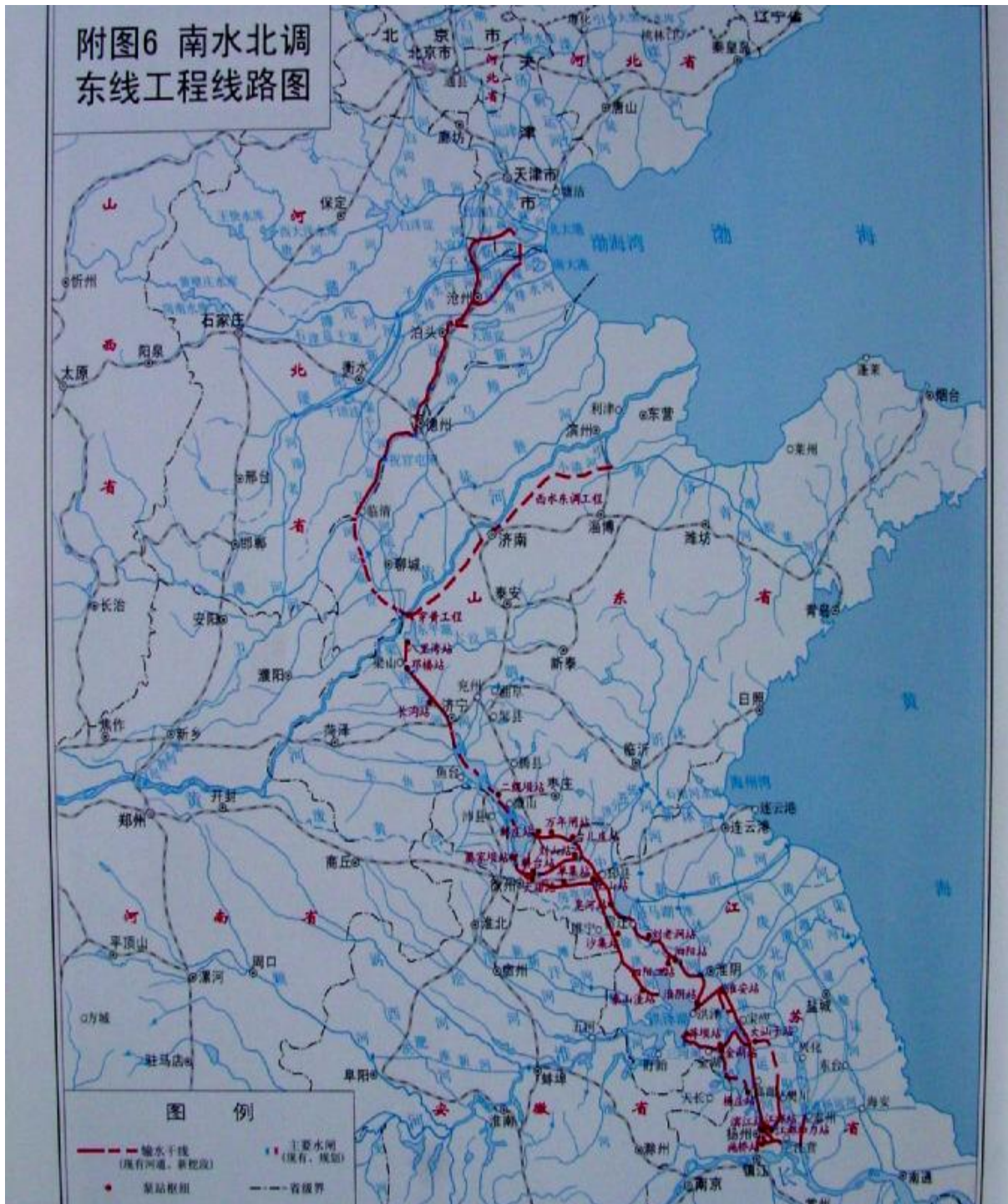
The Eastern line of PTWSN

The project is to transfer water from the lower reach of Changjiang River through lifting water step by step along the Great Jinghang Canal to provide water for the eastern part of the Huang-huai-hai plain and end in Tianjin.

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The Middle line of PTWSN

In near future, the project has been planned to transfer water from Danjiangkou reservoir on Hanjiang River, a branch of Changjiang River, through the channel along the plains before Funiu and Taihang Mountains to Beijing. In the long term, to transfer water from the Three Gorges Reservoir or the trunk river down thus to increase the water transferred. Due to good water quality and automatic flow means, the Middle Project will be an extremely important infrastructure to resolve the water crisis in North China.

附图7 南水北调中线工程线路图
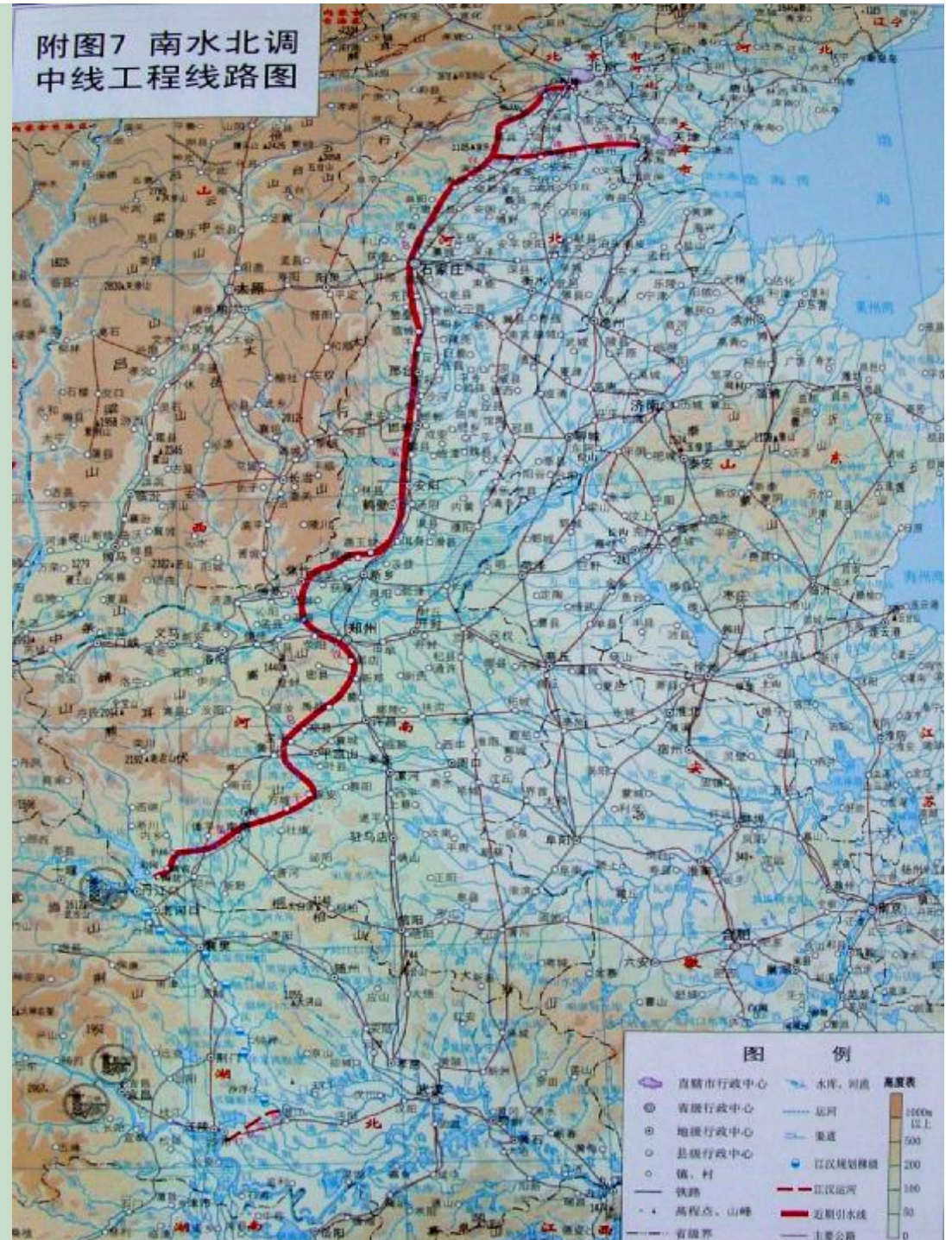
The Eastern line of PTWSN   It's a strategic project of transferring water from the upper reach of Changjiang River to the Yellow River so as to resolve the problem of drought in Northwest and North China. According to a done research, the total possible transferring water from Tongtian River, Yalong River and Dadu River amounts to 20 billion cubic meters, of which 10 billion from the upper reach of Tongtian River and 5 billion from Yalong River which is a tributary of Changjing River and the rest from Dadu River. The object range initially falls in Qinghai Gangsu,Shanxi, Shaanxi provinces and Inner Mongolia Autonomous Regions.
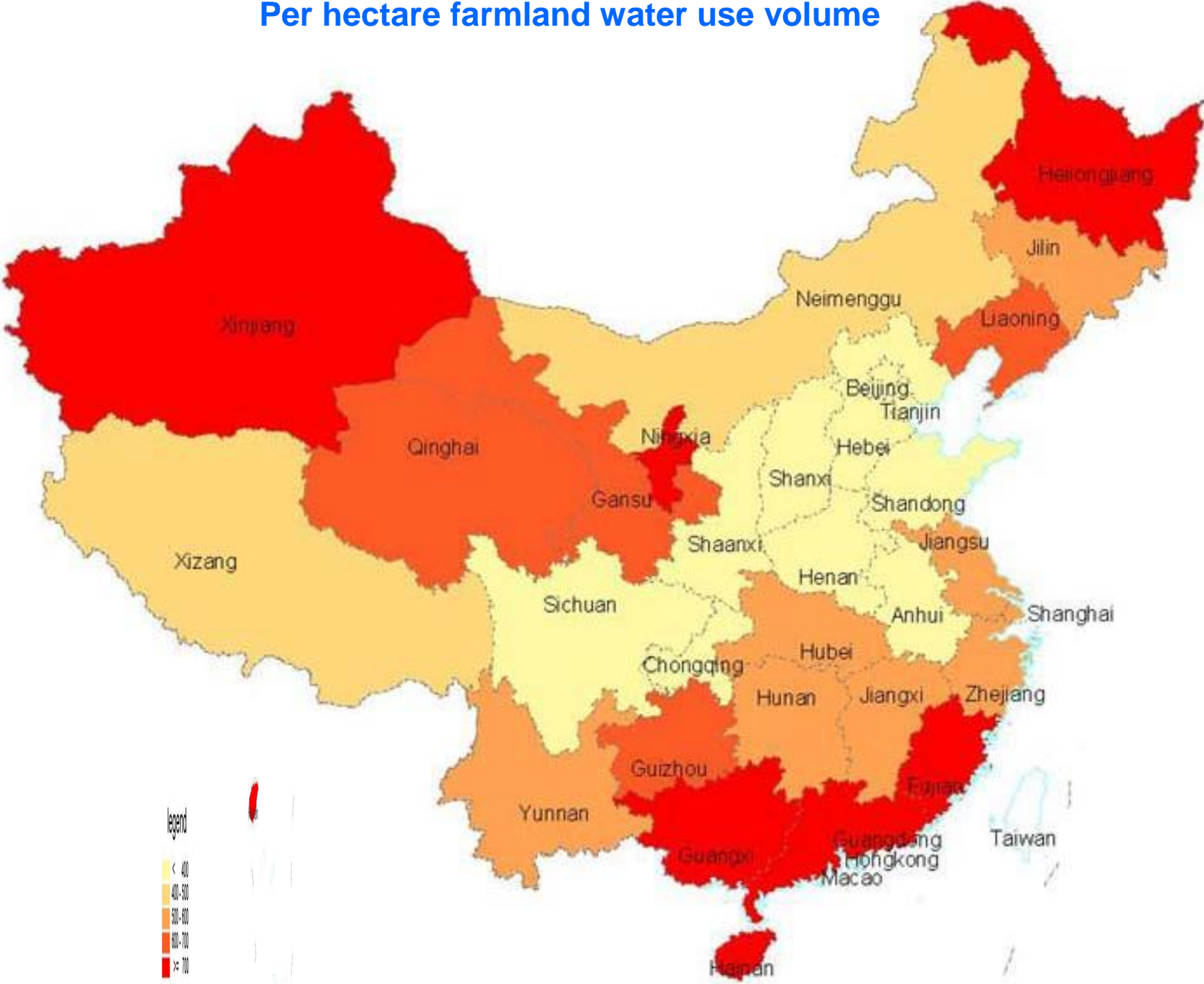

附图8 南水北调西线工程
代表性方案引水线路图

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Water use by sector and trends in China

- Water consumer mainly includes industry, cities, rural residents and agriculture.

- A close relationship exists between the increase of industrial water use volume and the growth of industry. It is predicted that industry in China will grow at an increasing rate of 6% continually up to the year 2020.

- The water use volume in a city mainly depends on total urban population. During 90's and the first ten years of 21th century, the increasing rate of Chinese urban population is forecast to amount to 4% and 3% respectively.

- The rural residents' water use volume predicts to remain stable, since the minute increase of per capita water use volume will be cancelled out by decrease of rural population.

- Irrigation water requirements depend on effective irrigated area, irrigation technique, sequential cropping and water use volume of all kinds of crops. However, because agricultural sector is the least noticeable consumer, agricultural irrigation can only use the water left by the other sectors and its water requirement is often insatiable.

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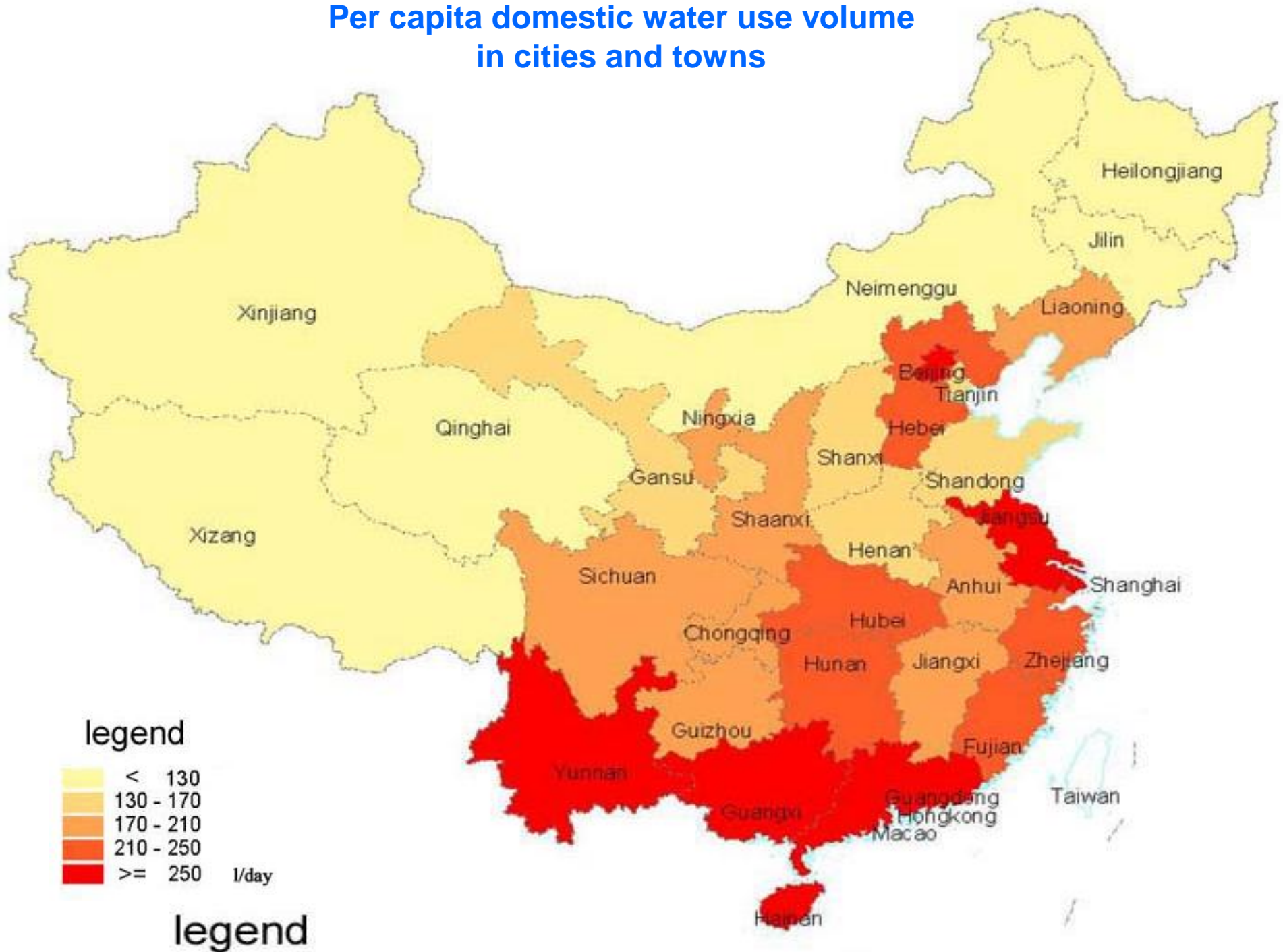
Analysis on Water Utilization Situation of China (1993)

Region		water volume （10^8m³）	Utilized volume （10^8m³）	Utilization Ratio (per cent)		Used by Agriculture	Used by Agriculture					Used by Industry		Used by Urban and Rural Citizens
				To total water volume	To runoff water volume	Irrigated area (10^8hm²)	Irrigated area (10^8hm²)	Irrigation ratio（%）	Irrigated quota m³/hm²	Used volume (10^8m³)	Used volume (10^8m³)	To total water volume	Used volume	To total water volume
North China	River of Northeast	1928	498.2	25.84	30.14	0.032	0.476	16.6	772	367.7	96.7	19.4	33.9	6.8
	Basins of Haihe and Luanhe River	421	409.6	97.29	142.22	0.064	0.96	60.4	323	310.5	64.4	15.7	34.7	8.4
	Huanghe River basin	744	387.7	52.11	58.65	0.045	0.68	37.5	457	312.0	48.9	12.6	26.8	6.9
	Huaihe and Related Coastal Rivers in Shandong Province	961	569.0	59.21	76.79	0.088	1.32	60.8	343	453.1	63.7	11.1	52.3	9.1
	Inland Rivers of Northwest China	1300	582.0	44.77	50.00	0.049	0.73	91.3	766	559.4	14.6	25.0	8.1	1.3
	Total	5354	2446.5	45.69	55.77	0.277	4.16	45.1	480	2002.7	288.2	11.7	155.8	6.3
South China	Changjiang River Valley	9613	1659.4	17.26	17.44	0.185	2.77	64.8	504	1093.0	418.8	25.2	147.5	8.8
	Southeastern China Coastal Area	2592	286.1	11.04	14.90	0.019	0.28	80.0	740	207.2	49.9	17.4	29.0	10.1
	Zhujiang River and Related Coastal Area	4710	794.7	16.87	16.96	0.047	0.71	69.8	761	542.0	165.3	20.8	87.4	11.0
	Rivers of Southwest China	5850	68.0	1.16	1.16	0.011	0.16	66.7	385	61.5	3.3	4.8	3.2	4.6
	Total	22765	2808.2	12.34	12.78	0.221	3.32	67.0	573	1903.7	637.3	22.6	267.1	9.5
	National total	28124	5254.7	18.69	19.85	0.499	7.49	52.7	522	3906.4	925.5	17.6	422.9	8.0

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Per hectare farmland water use volume

legend
- < 400
- 400-500
- 500-600
- 600-700
- >= 700

Per capita domestic water use volume in cities and towns

legend

	< 130
	130 - 170
	170 - 210
	210 - 250
	>= 250 l/day

legend

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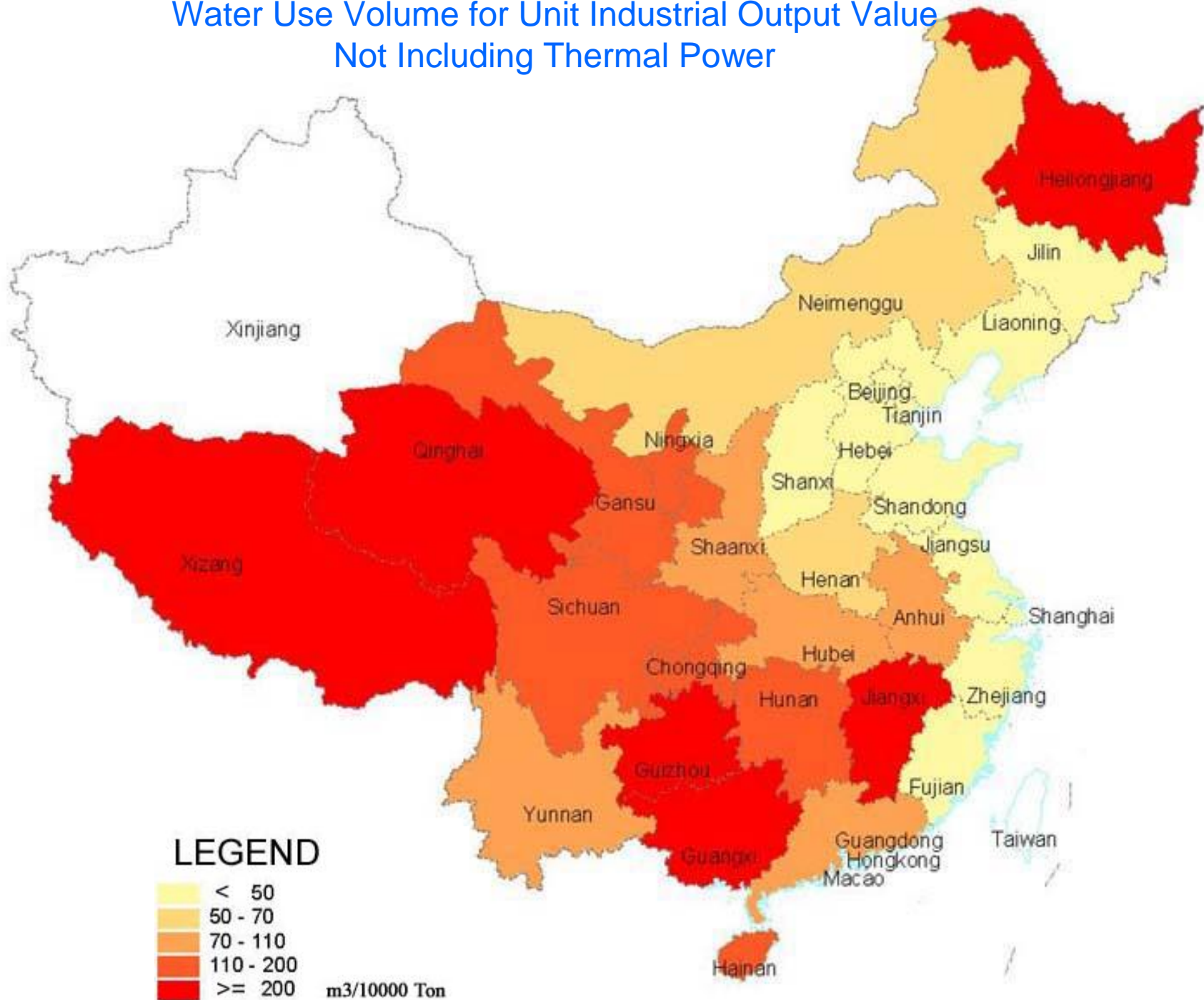
Per Capita Domestic Water Use Volume In Rural Areas

legend

< 50
50 - 65
65 - 90
90 - 110
>= 110 l/day

Water Use Volume for Unit Industrial Output Value Including Thermal Power

LEGEND

	< 60
	60 - 90
	90 - 130
	130 - 180
	>= 180 m3/10000 Yan

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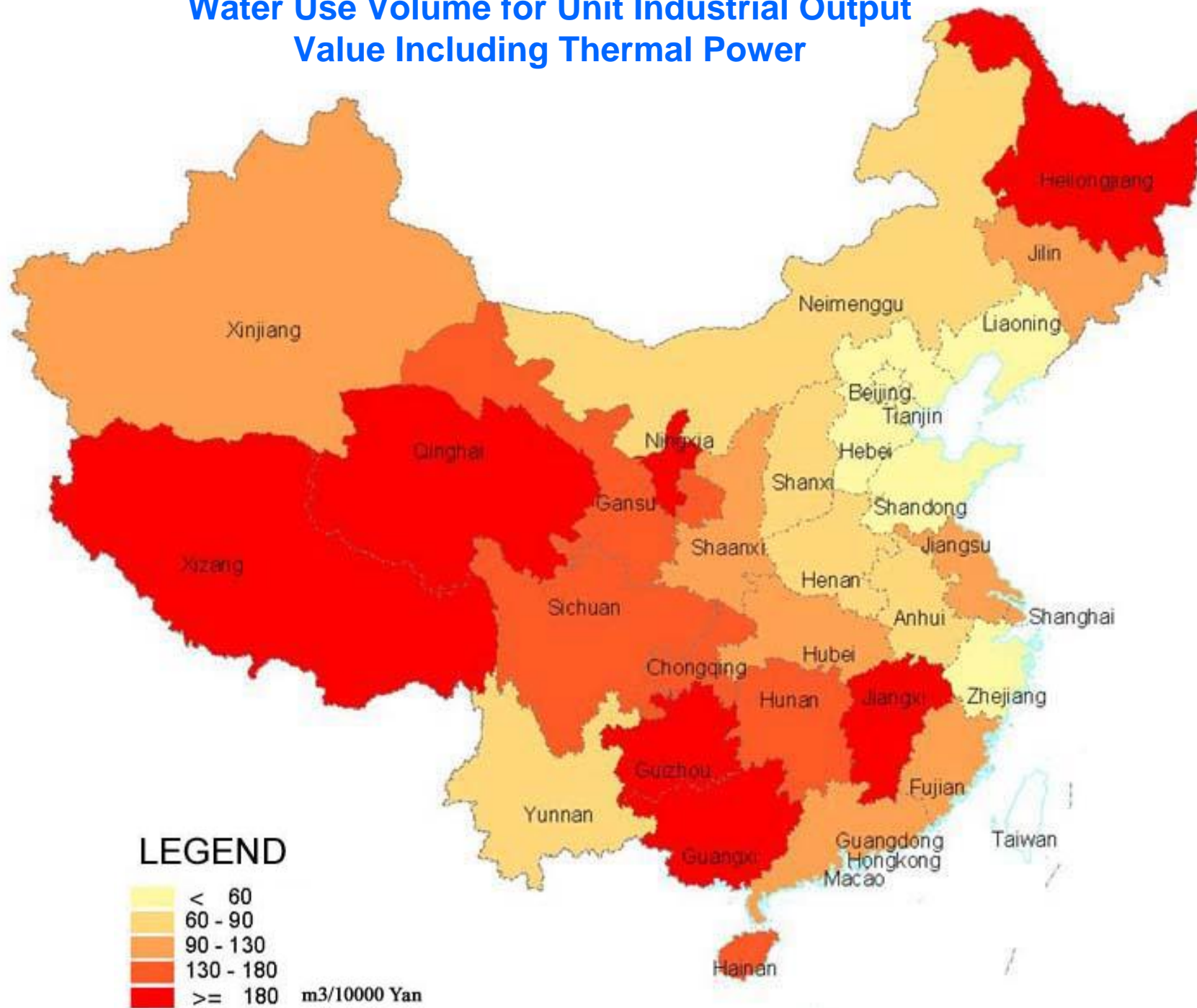
Water Use Volume for Unit Industrial Output Value Not Including Thermal Power

LEGEND

	< 50
	50 - 70
	70 - 110
	110 - 200
	>= 200 m3/10000 Ton

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Competition between sectors in future China

¡ It is predicted that the actual irrigated area (IA) in China 30 years later will be 64 million hm², 14 million hm² more than that of today. Then, in North China IA will increase by 11.4 million hm² and reach 39.25 million hm², in South China by 2.55 million hm² and reach 24.6 million hm².

The irrigated area in North China will increase from 45.1% to 61.1%, and that of South China from 67% to 74.6%. On the basis of 1993's irrigation quota, the agricultural water use volume 30 years later will total 521 billion m³, 130 billion more than today. This implies that without the decline of irrigation quota, the expansion of irrigated area to the above-mentioned scale will be impossible.,

¡ Total industrial water use volume 30 years later will top 1300 billion m³ (by 1993's quota). However, normally, water use volume per 10000 GDP of industrial production will go down after rudimentary industrialization is realized. If the quota equivalent to that of 1995 in the United States is applied for calculation, industry water use volume 30 years later in China will total 250 billion m³, only 157.5 billion more than in 1993.

¡ The proportion of population in urban area near 2030 will be 50%, that is, 8 million people will live in cities or towns. Total water volume used by citizens will be 110 billion m³ (per capita quotas: 250L/d and 125L/d for urban and rural areas). The competition for water use among sectors in future China will be definitely vigorous. The remedy to alleviate the tension is to lower water quotas in various sectors.

Competition between sectors in future China

Future of water withdrawal in China

¡ The prediction analysis indicates: the water use volume 30 years later in China will have unavoidably overridden its water resources capability if current water use level keeps unchanged and expending trend goes on, which is not only unreasonable but also impractical.

¡ The key is to spare no efforts in saving water through all kinds of water-saving approaches, among which the decline of water use quota is crucial.

¡ If the irrigation quota declines from 7830 m^3 per hectare to 6480 m^3 per hectare and water use volume per 10,000 GDP from 267 m^3 down to 50 m^3 during the coming 30 years, then, total water use volume of China will be able to be controlled around 775 billion m^3, which is quite near to current total supply capacity. Compared with current supply capacity, the discrepancy will be only about 225 billion m^3, among which 120 billion m^3 belongs to North China .

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The estimate of total water demand in the first half of 21th century of China

Year
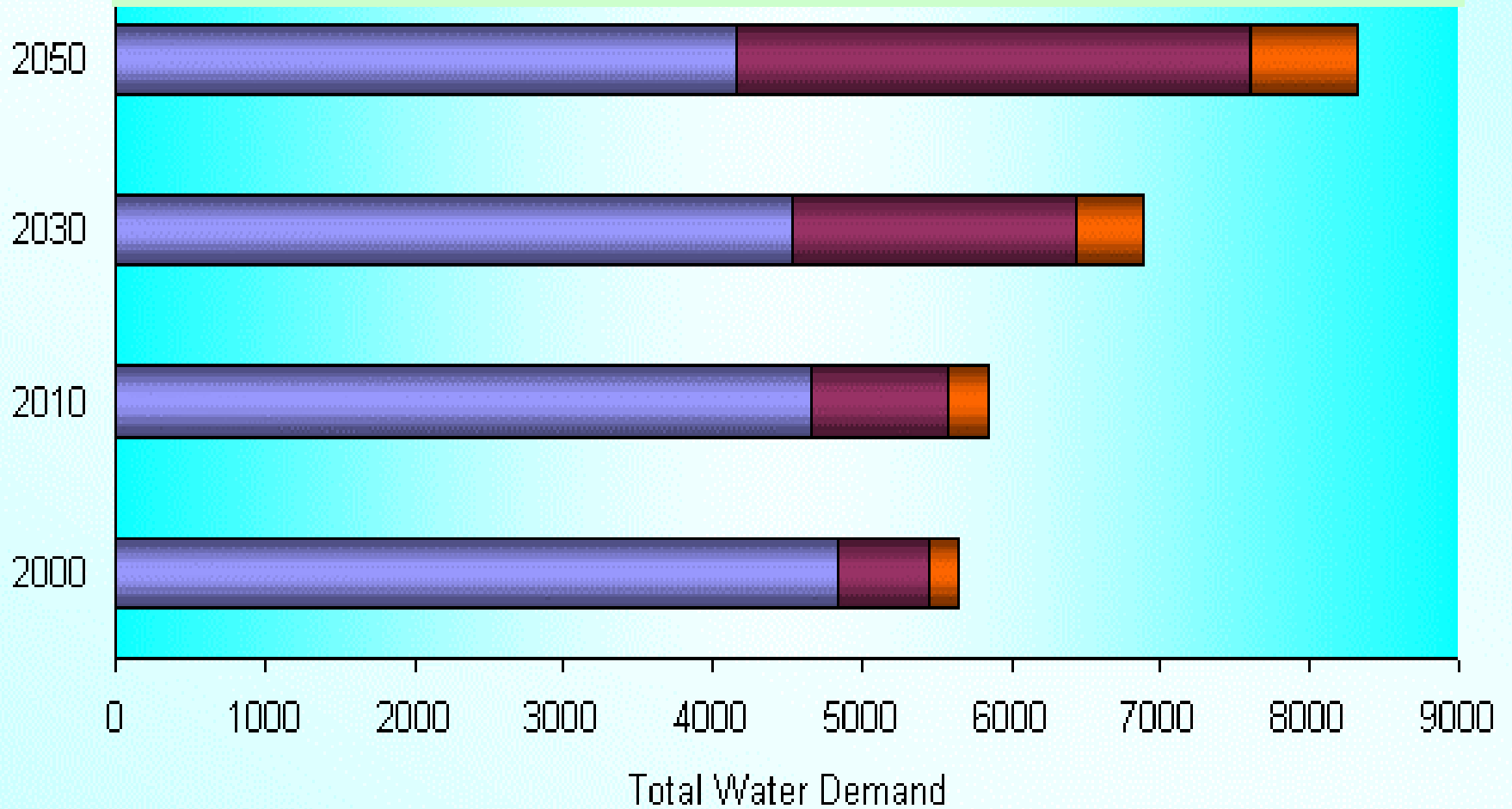
- Agriculture water use volume
- Industrial water use volume
- Urban water use volume ($10^8 m^3$)

Total Water Demand

THE END

May, 2002

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