China's Water Crisis and Management Options

Ge Sun (USDA Forest Service)

&

Jun Xia

Chinese Academy of Sciences

2nd International Conference on Forests and Water in a Changing Environment, Sep 14, 2009, Raleigh, NC

Outline

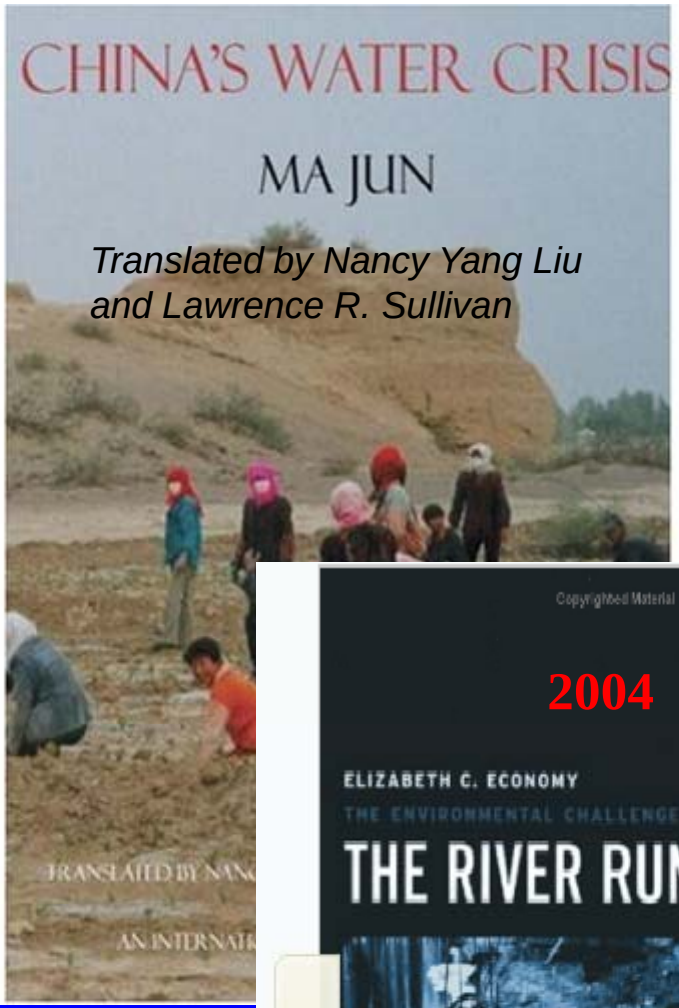
- Water Resources Challenges in China
- Causes
- Ecological and Economic Impacts
- Strategies towards sustainability

SGCP

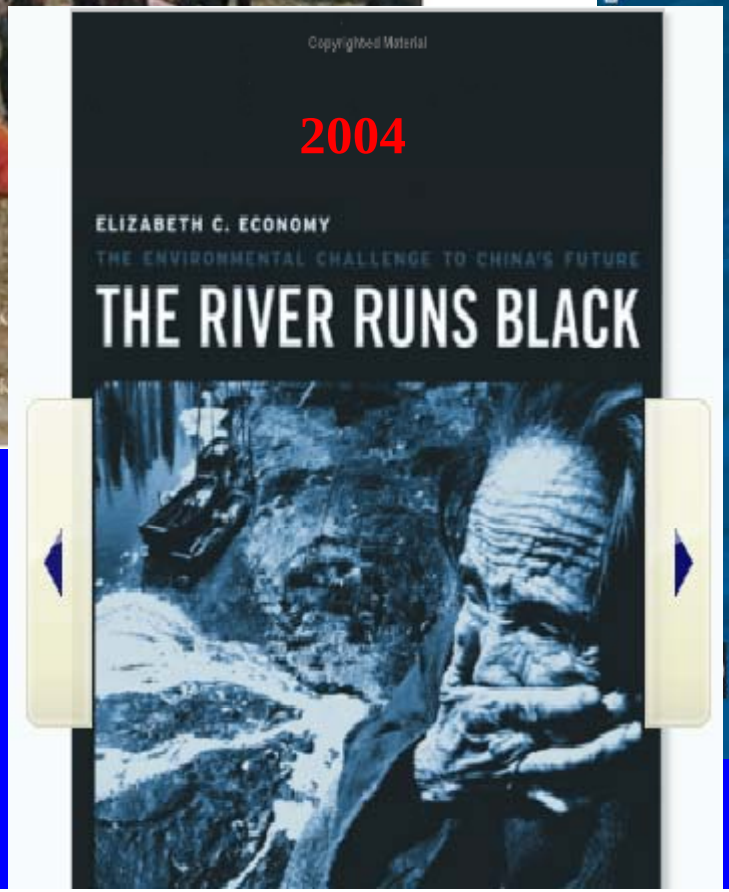
"Those Who Control the Water Rule the Nation"

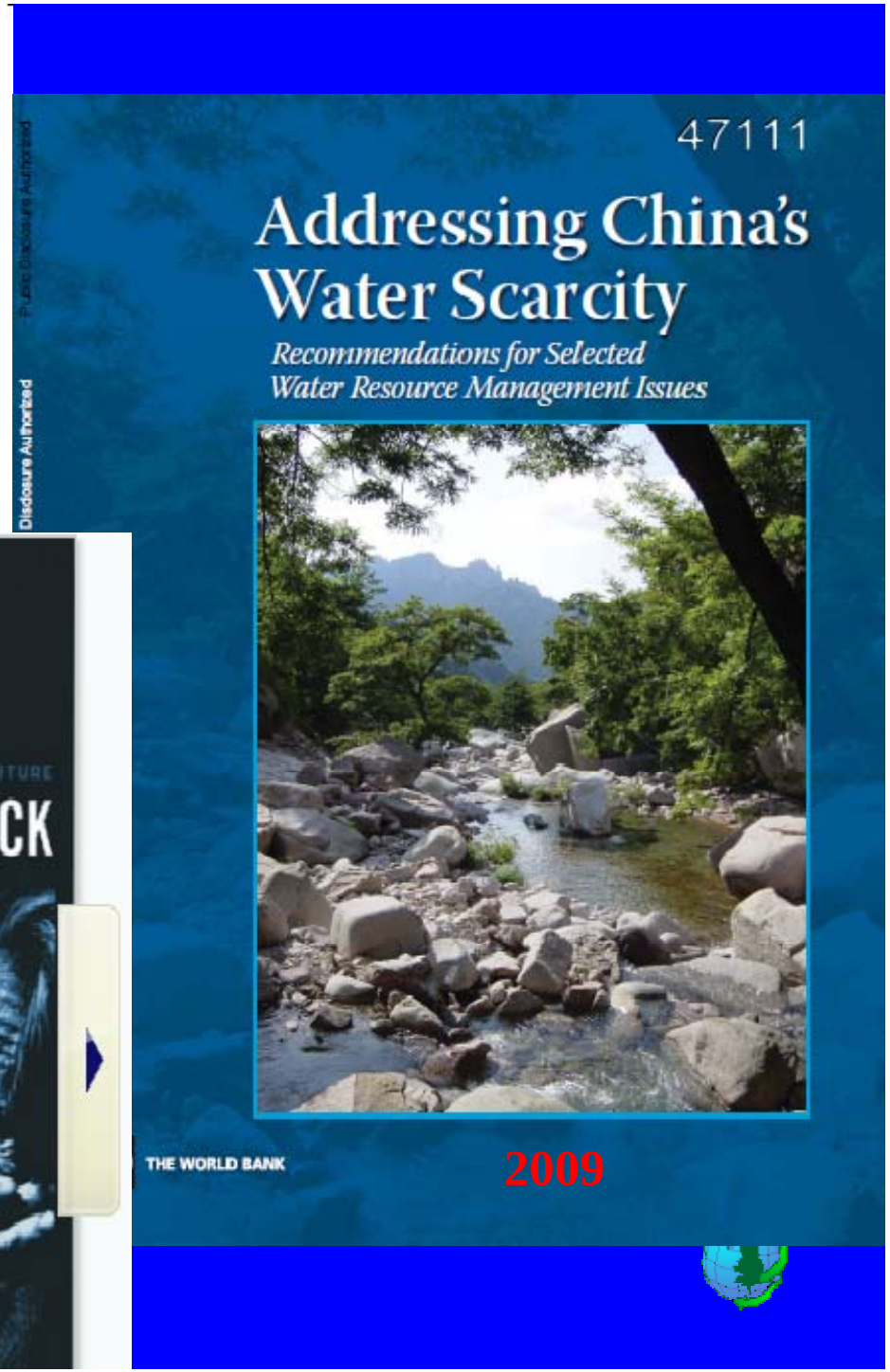
SGCP

Irrigation:
Central to Chinese Civilization

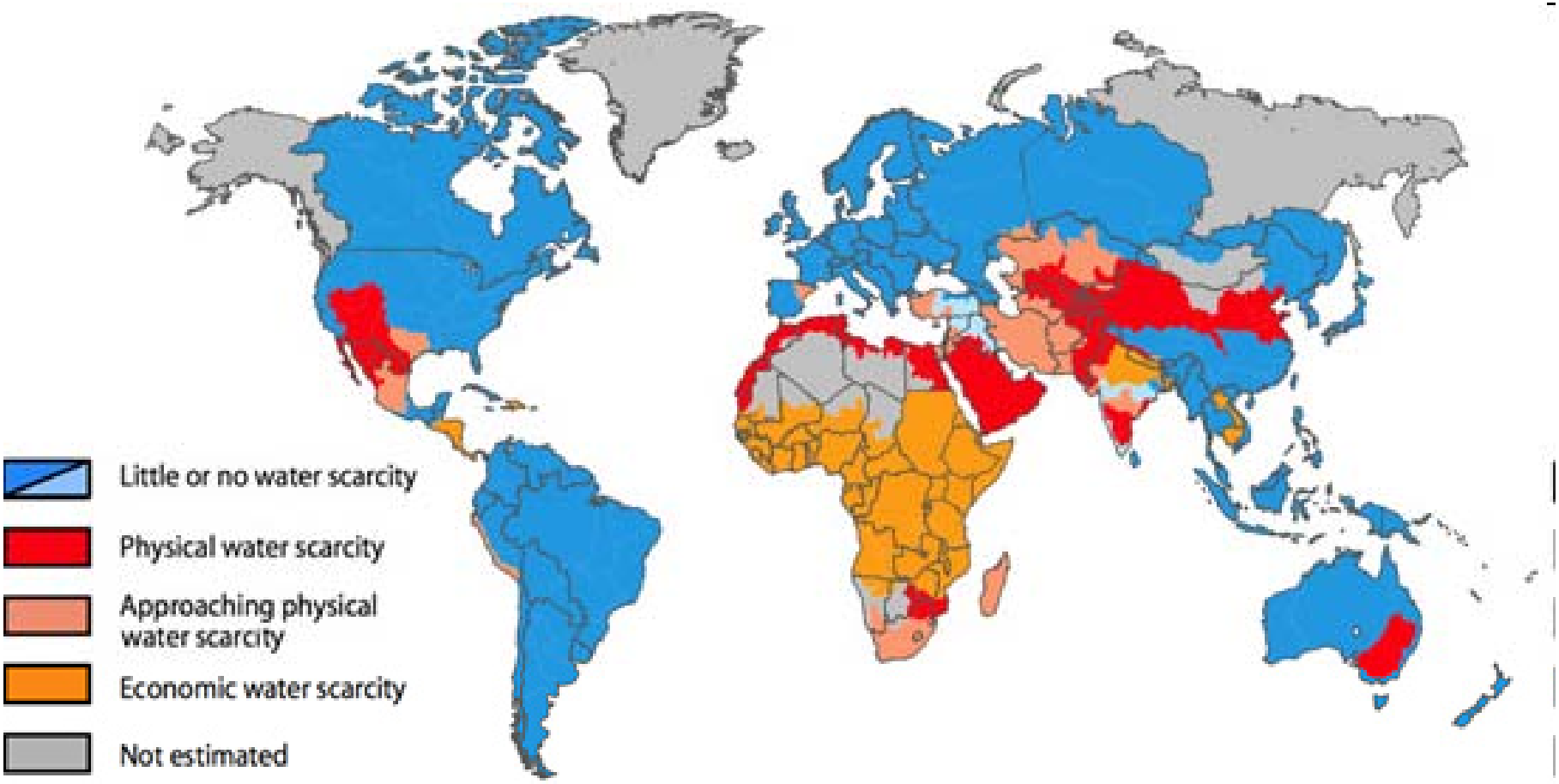

CHINA'S WATER CRISIS
MA JUN
Translated by Nancy Yang Liu
and Lawrence R. Sullivan

2004


Copyrighted Material
2004
ELIZABETH C. ECONOMY
THE ENVIRONMENTAL CHALLENGE TO CHINA'S FUTURE
THE RIVER RUNS BLACK


47111
Addressing China's
Water Scarcity
Recommendations for Selected
Water Resource Management Issues
Disclosure Authorized
THE WORLD BANK
2009

World Water Crisis



SGCP

Water Issues in China

- Too much
- Too little
- Too dirty

SGCP

Floods: the #1 Natural Cause of Economic Losses (1990s)

a) Deaths

Rank/Date	Country, region	Total losses**	Insured losses**	**Deaths**
1 10.6. - 30.9.1998	India, Bangl., Nepal	5,020	--/< 1	**4,750**
2 May - Sep. 1998	China	30,000	1,000	**3,656**
3 21.6. - 20.9.1993	China	11,000	--/< 1	**3,300**
4 May - Sep. 1991	China	15,000	410	**3,074**
5 27.6. - 13.8.1996	China	24,000	445	**3,048**
6 Oct. - Dec. 1997	Somalia	--	--/< 1	**1,800**
7 4.9. - 2.10.1992	India	1,000	--/< 1	**1,500**

* storm surges excluded

** US$ m (original values)

b) Economic losses

Rank/Date	Country, region	**Total losses***	Insured losses*	Deaths
1 May - Sep. 1998	China	**30,000**	1,000	3,656
2 27.6. - 13.8.1996	China	**24,000**	445	3,048
3 27.6. - 15.8.1993	USA, Mississippi	**16,000**	1,000	45
4 24.7.-18.8.1995	North Korea	**15,000**	--/< 1	68
5 May - Sep. 1991	China	**15,000**	410	3,074
6 21.6. - 20.9.1993	China	**11,000**	--/< 1	3,300
7 4.-6.11.1994	Italy, N	**9,300**	65	64

* US$ m (original values)

SGCP

Yangtze River Floods

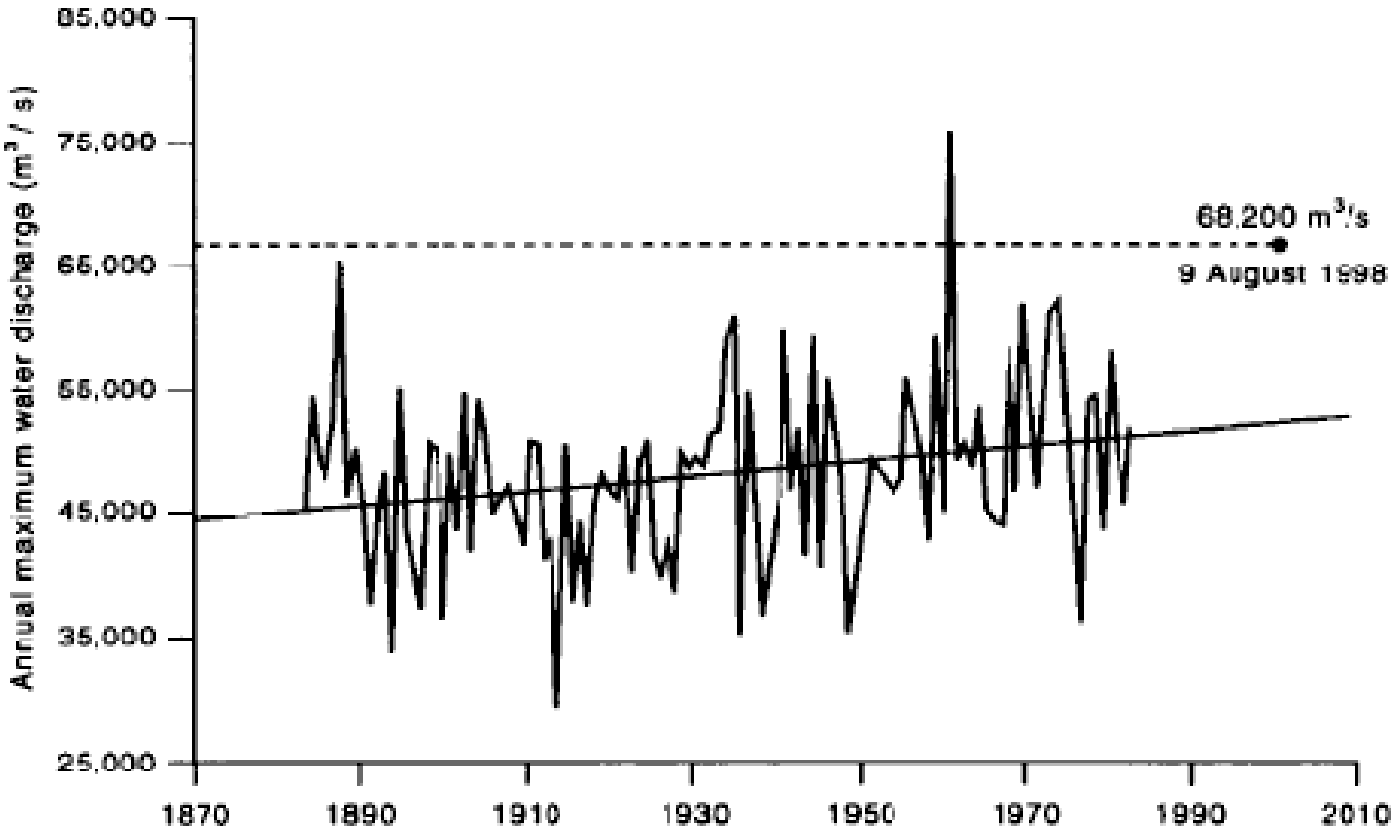
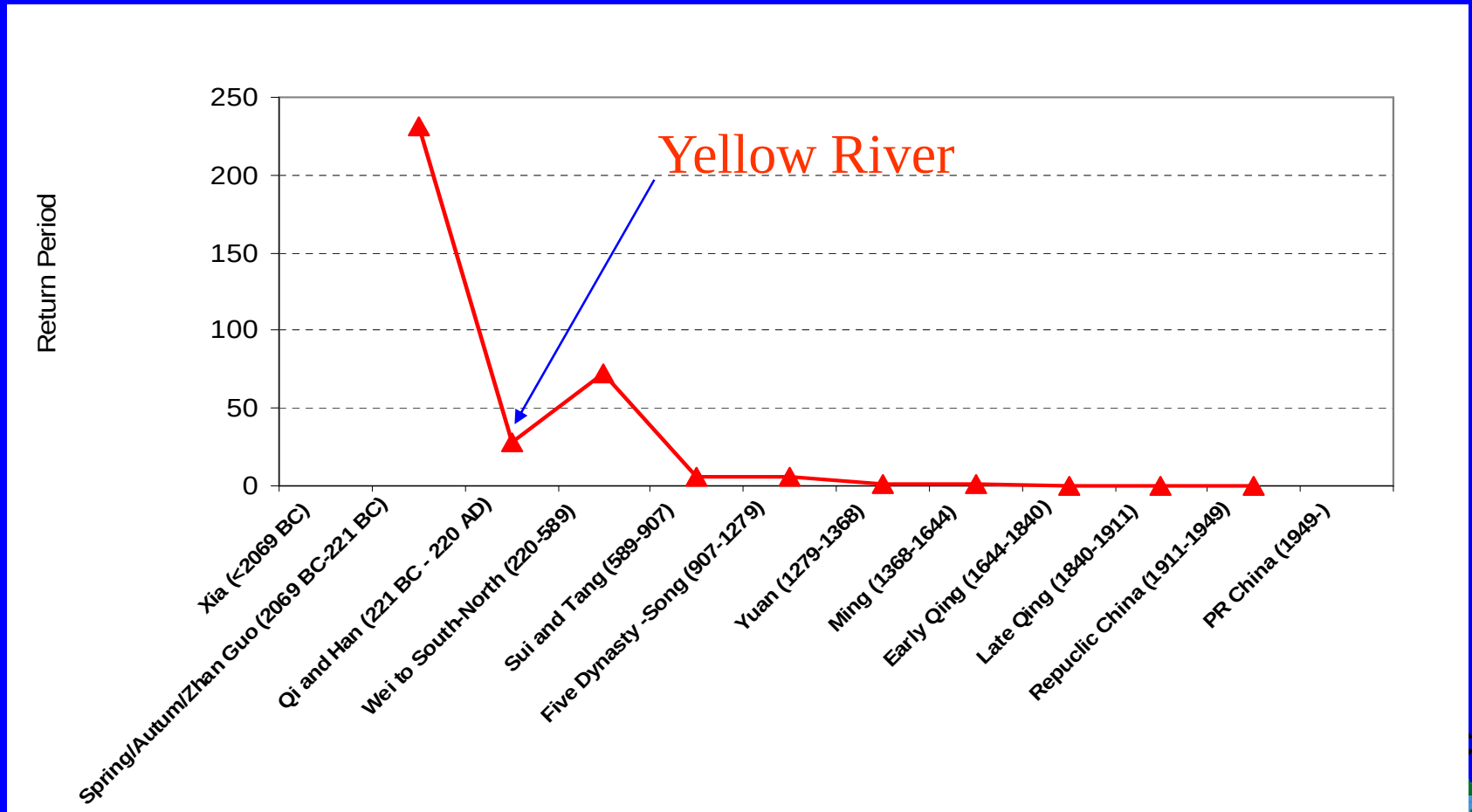


Figure 5. Annual maximum water discharge at Wuhan since 1865 AD shows a rising trend. The record for 1998 is the second highest in record but considerably lower than that recorded in 1954.

Zong and Chen, Natural Hazards, 2000, Vol 22:165-184

Yellow River Floods
(Overflow, Dike burst, Changing river course)



Too Little, too Dirty（有河皆无，有水皆污）

- 40% of rivers became ephemeral; no perennial rivers around 800 km around Beijing.
- Discharge to the sea reduced 90% since 1950s in Northern China
- >50% exiting rivers polluted
- 75% lakes considered polluted
- 2.5 billion m^3 of polluted water are used annually for irrigation

SGCP

The Yellow River is drying up (*Cong et al., 2009, WWR*)

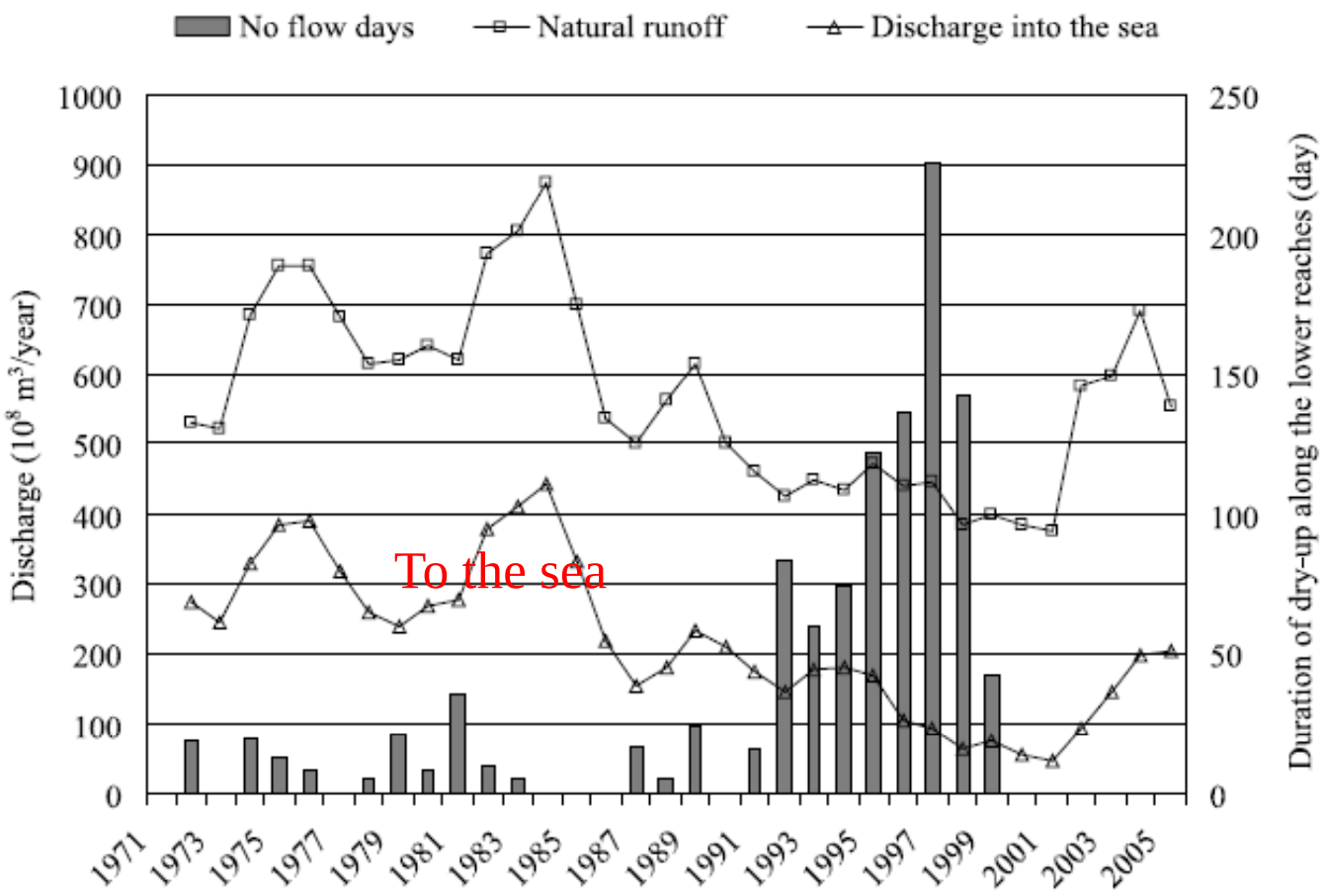
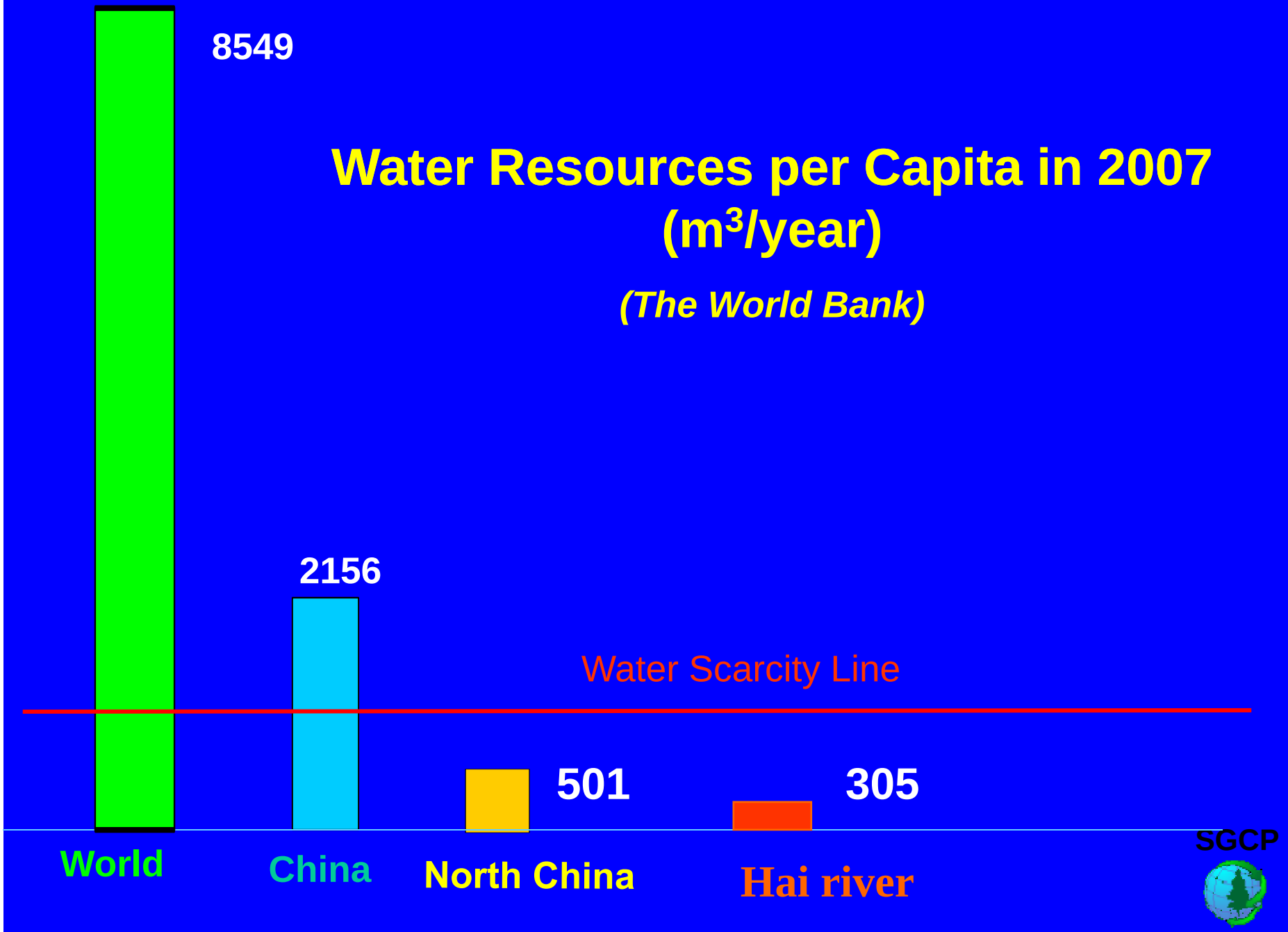


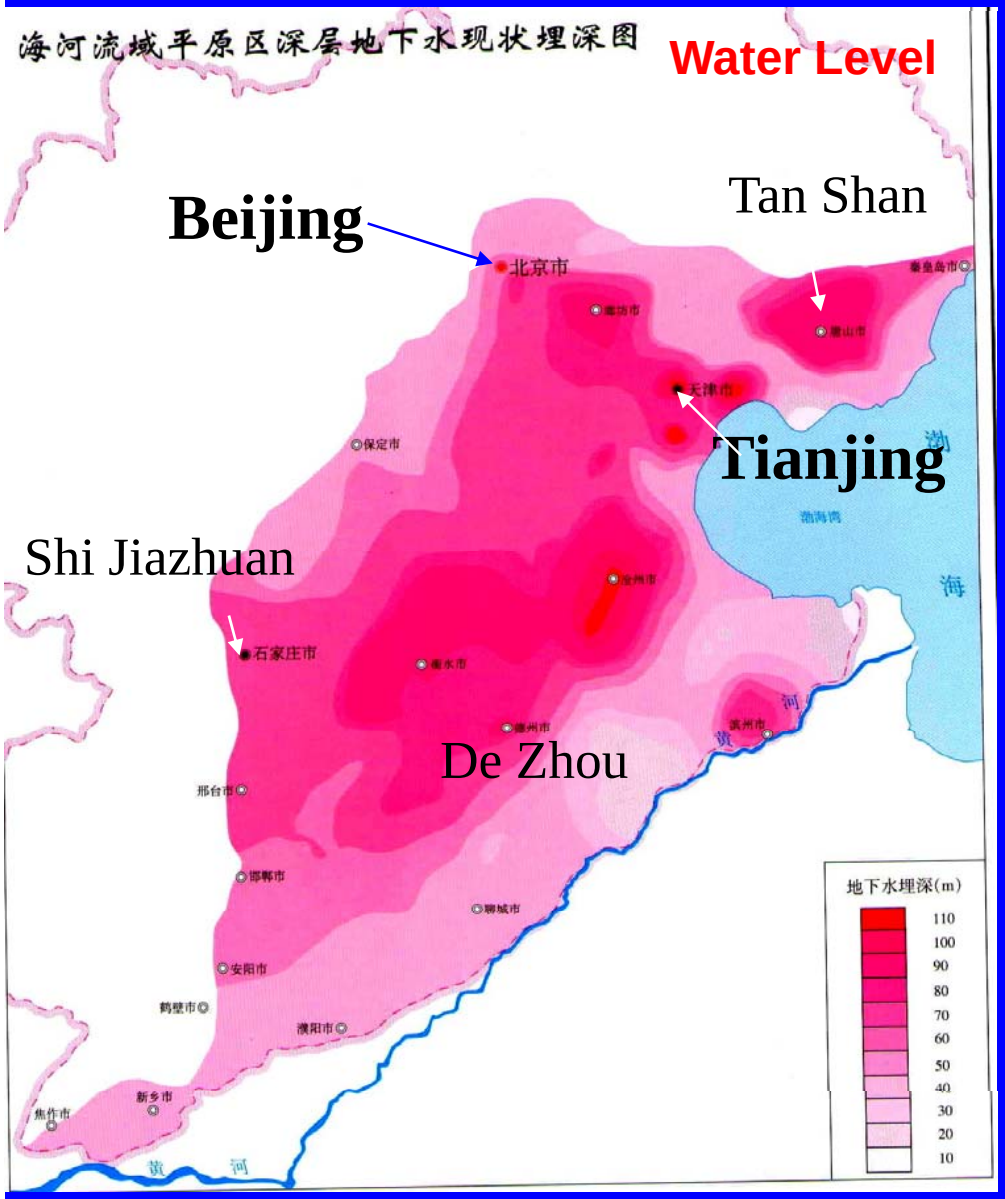
Figure 6. Relationship between the natural runoff, discharge into the sea, and the duration of the dry up (the natural runoff and discharge into the sea are 3-year average values).

Water Resources per Capita in 2007 (m^3/year)

(The World Bank)



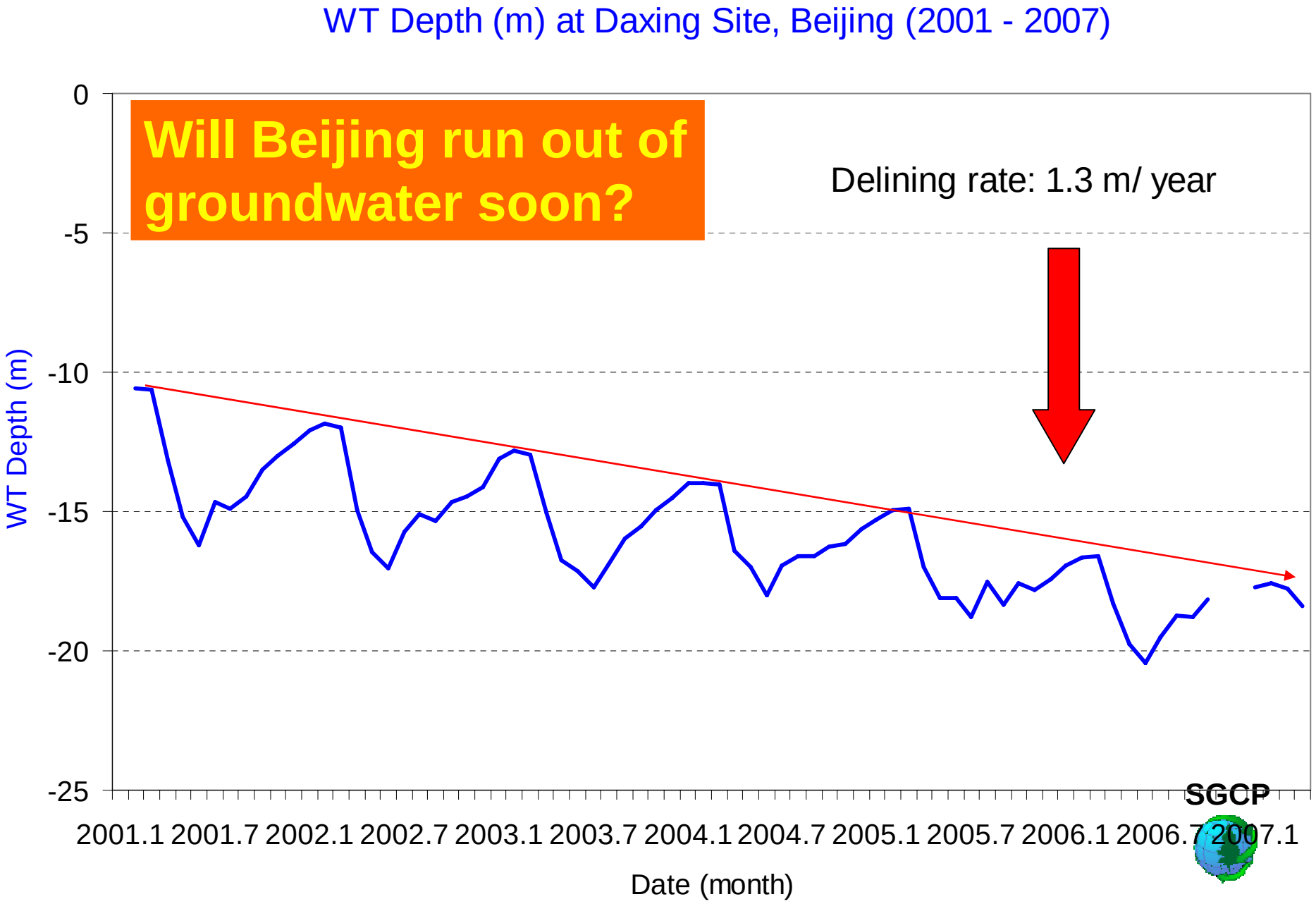
Water Crisis in North China



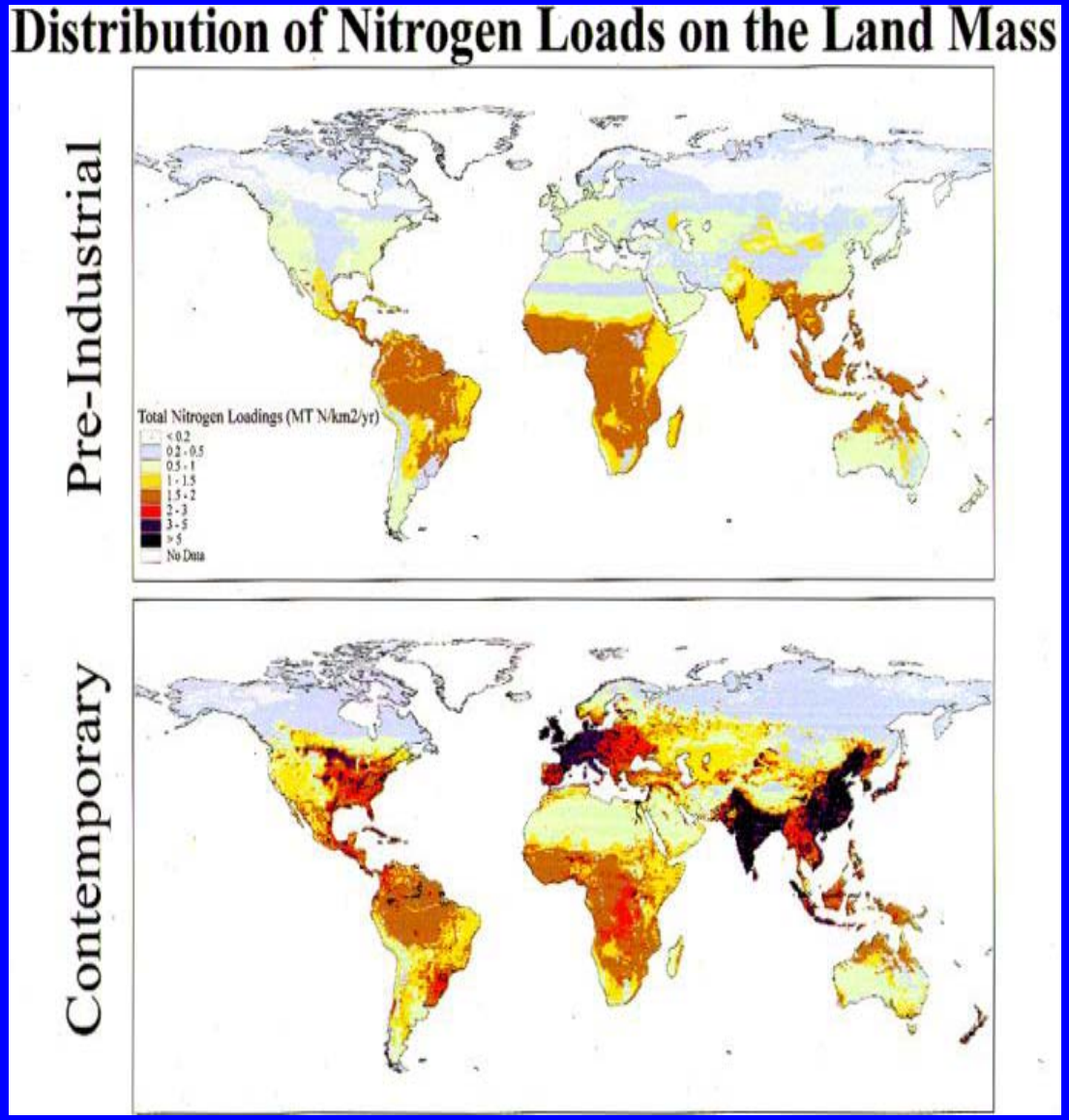
Over exploitation of ground water : 100 billion m^3

Water shortage in 2000: 8 billion m^3

SGCP


WT Depth (m) at Daxing Site, Beijing (2001 - 2007)
Will Beijing run out of groundwater soon?
Delining rate: 1.3 m/ year
WT Depth (m)
0
-5
-10
-15
-20
-25
2001.1
2001.7
2002.1
2002.7
2003.1
2003.7
2004.1
2004.7
2005.1
2005.7
2006.1
2006.7
2007.1
Date (month)
SGCP

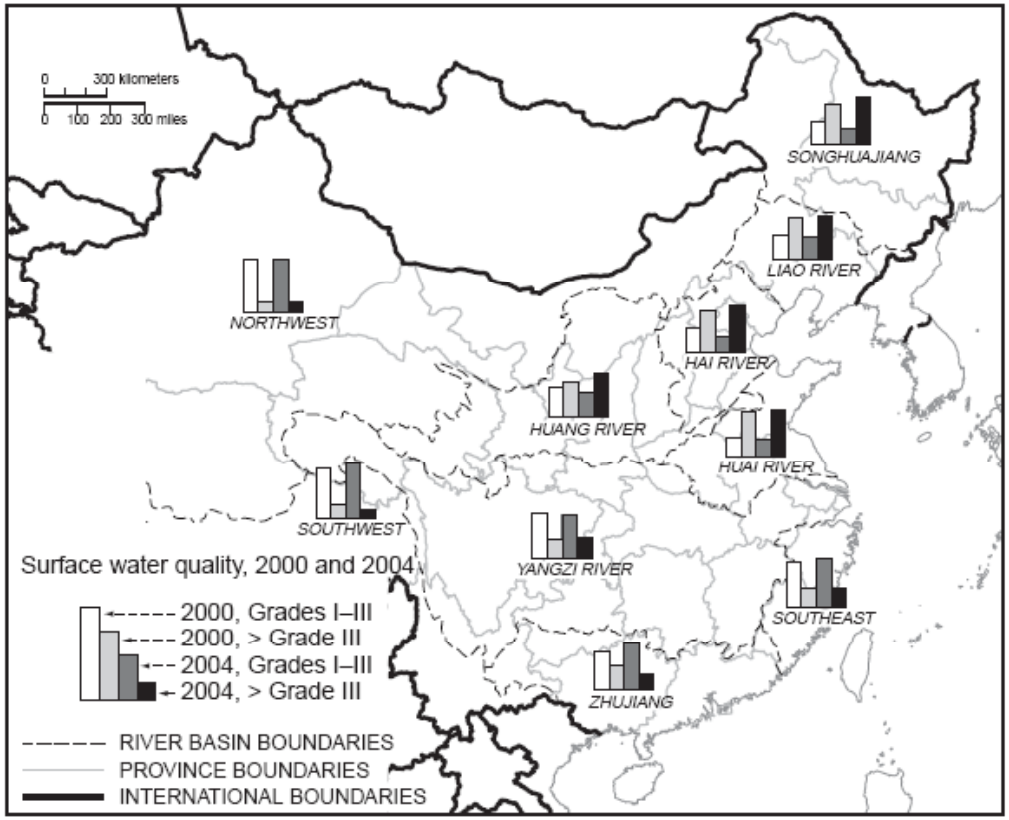
Water Quality



SGCP

Water quality is getting worse

FIGURE 2.6 Surface Water Quality, 2000 and 2004



Source: World Bank 2006a.

SGCP

Red Tides

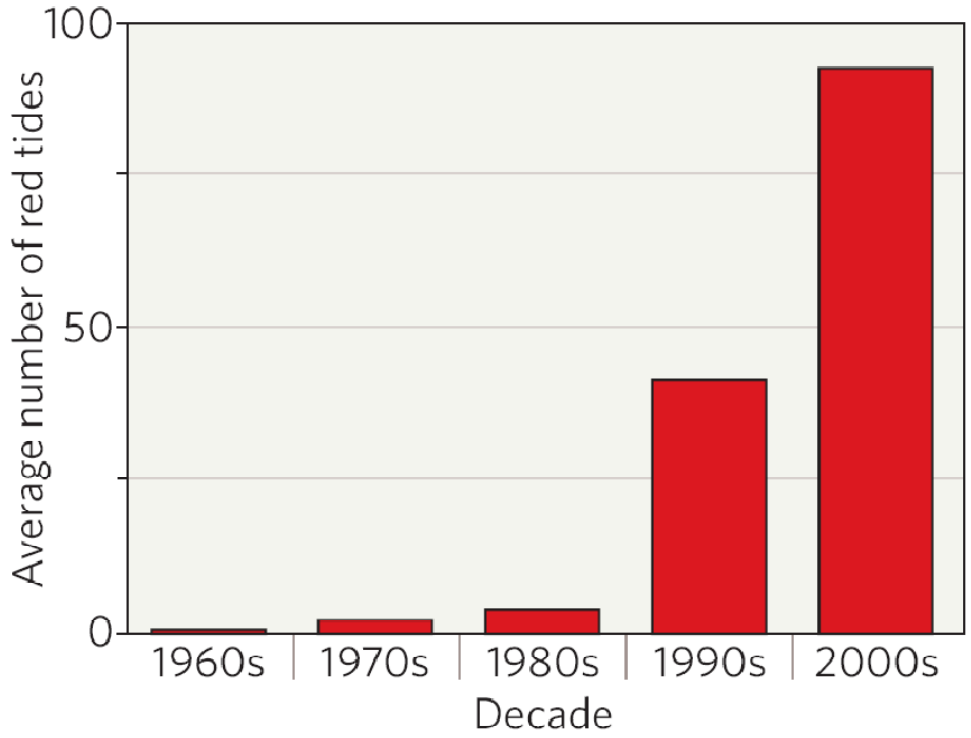


Figure 5 | Average annual number of red tides in Chinese seas.

(from Liu and Diamond, 2005 Nature)

SGCP

1/3 of China's Land is under soil erosion today

SGCP

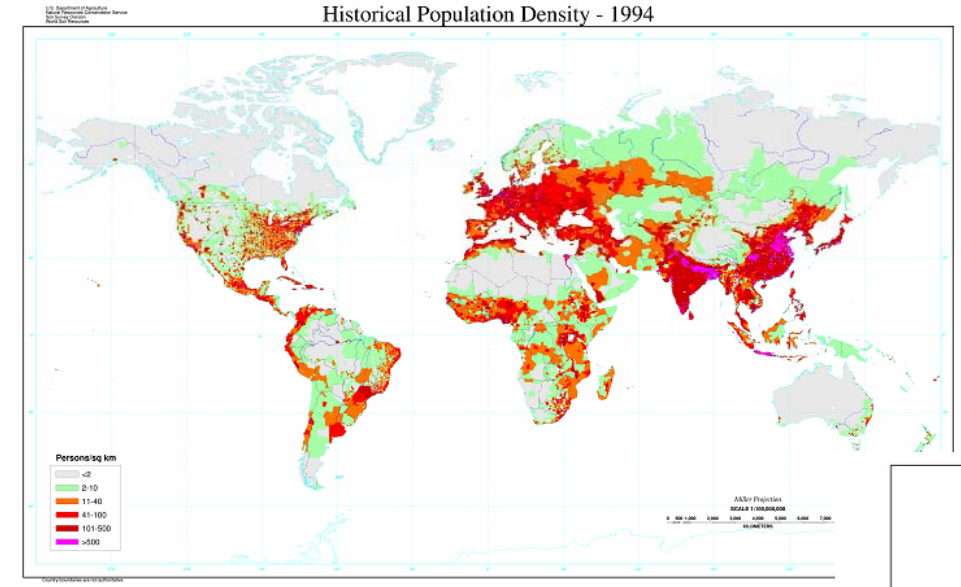
From W.C. Lowdermilk: Conquest of the Land through Seven Thousand Years

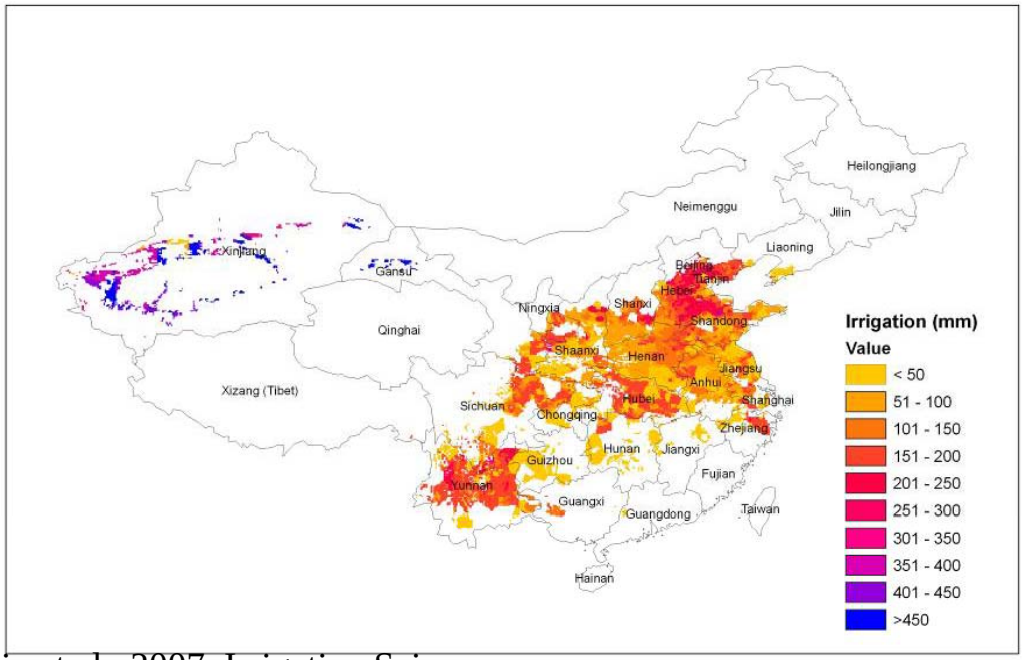
Causes

- Population growth (Large demand)
- Mis-land management (Grain-central-irrigation; Reclamation of ‘waste lands’);
- Urbanization from 18% to 45% in 20 years
- Low water use efficiency, low crop water productivity
- Lack of law enforcement, governance, the recent economy boom
- Climate change + Uneven water distribution

SGCP

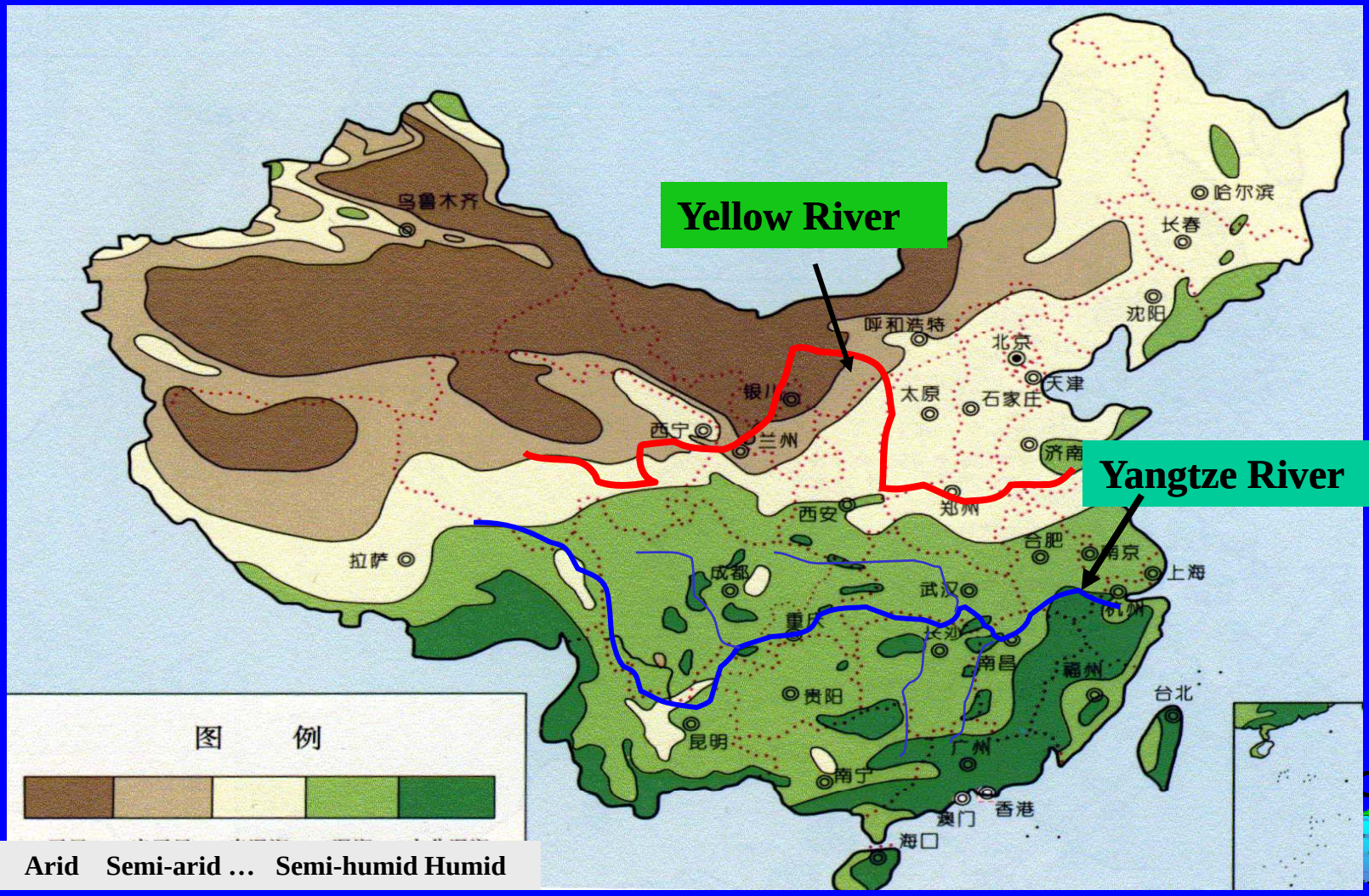
Population Density





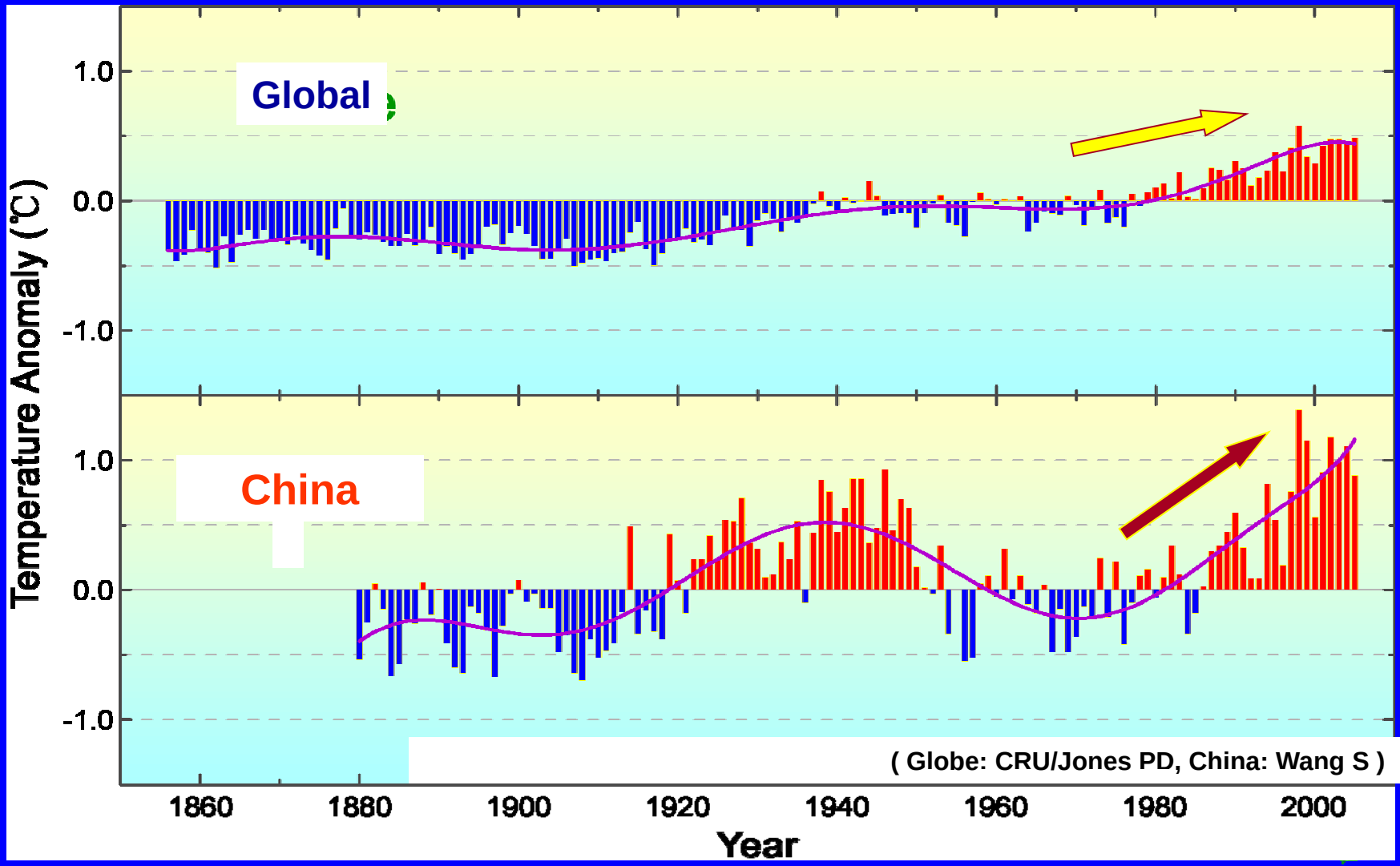
Liu et al..,2007. Irrigation Science

Uneven Water Distribution



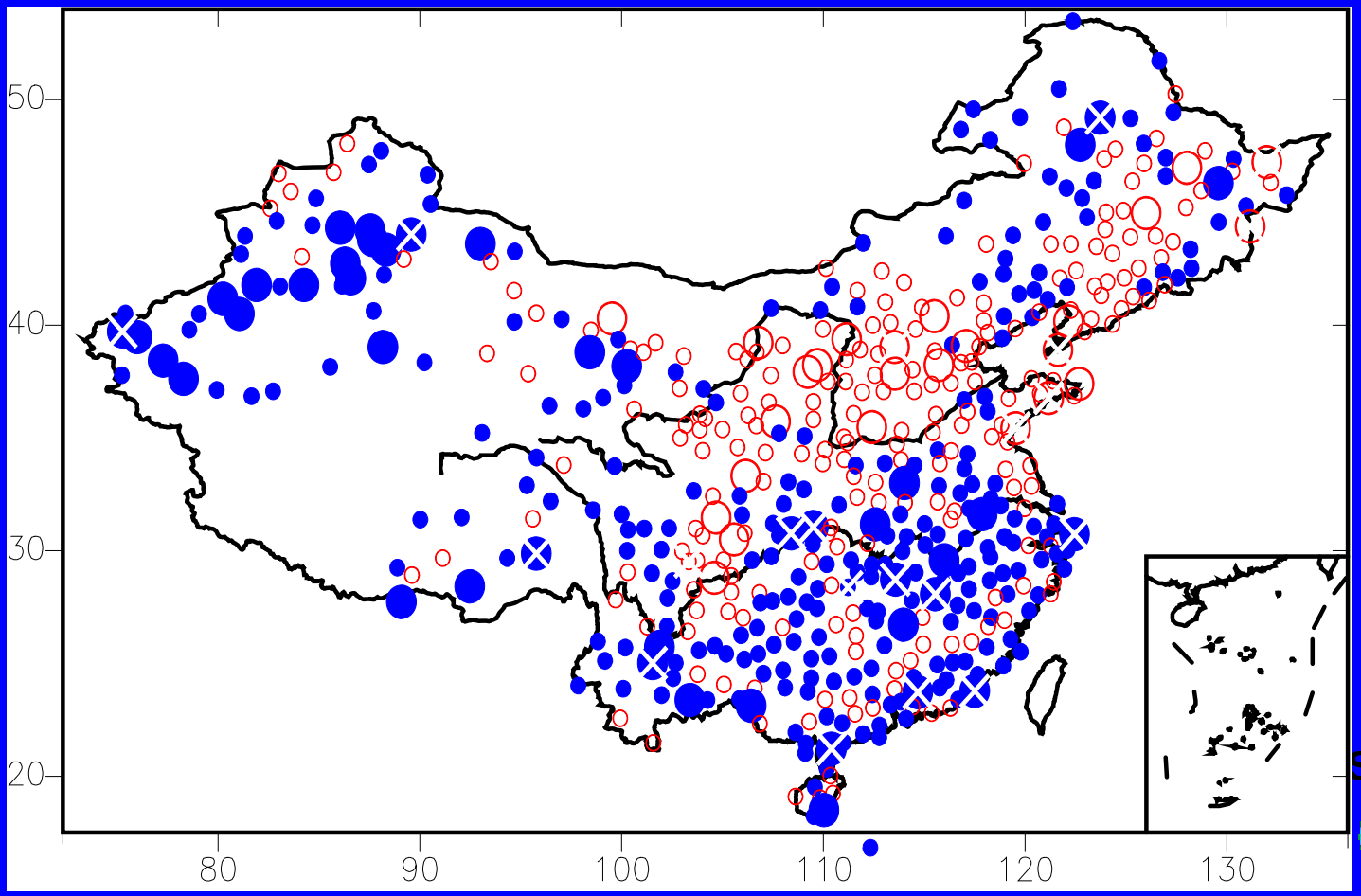
GCP

Global Warming



Global Warming

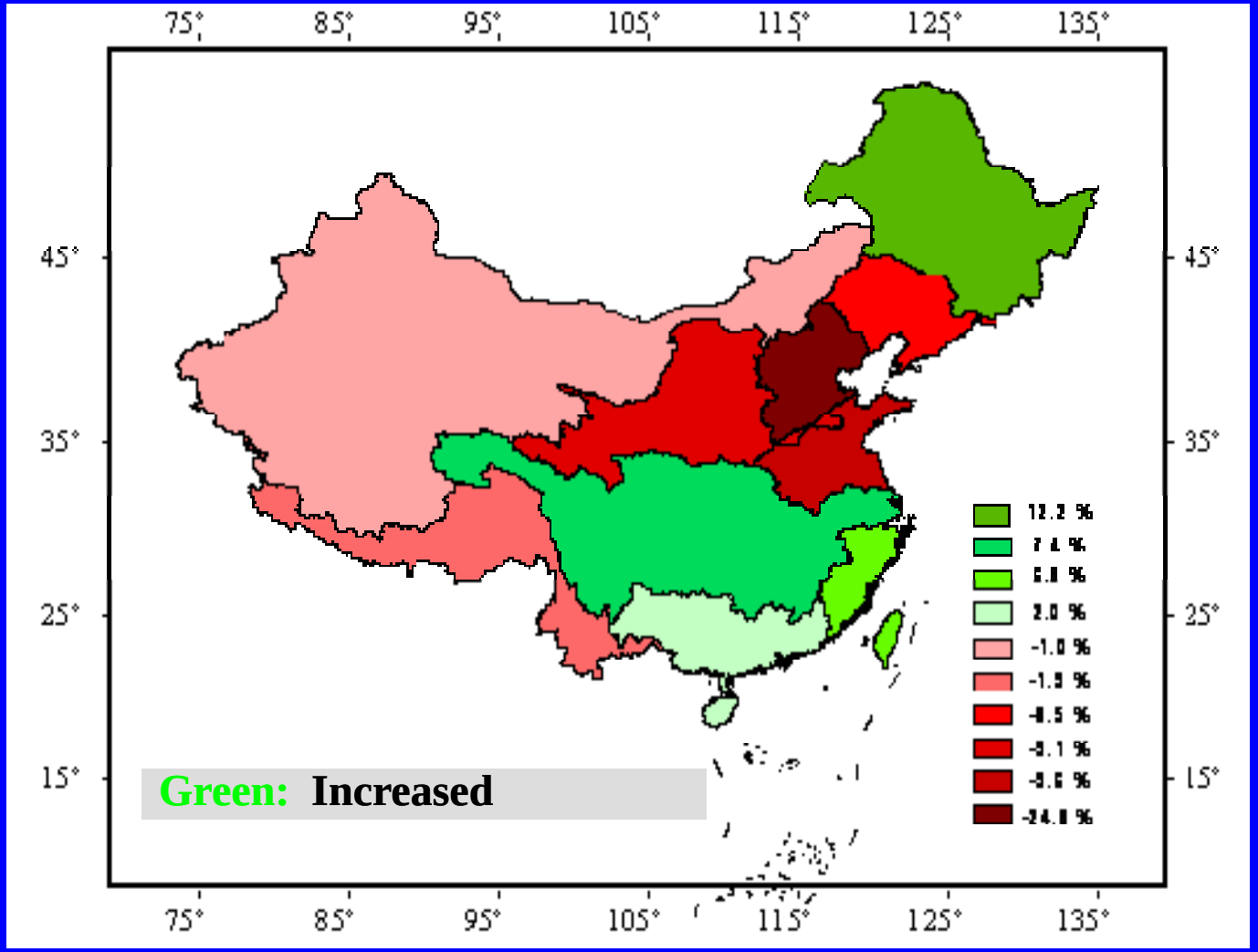
Trends of days with heavy rain in summertime (April to September) during 1951-2000.



SGCP

Change in Runoff

(1980-2000 compared to 1956-1979)



SGCP

Ecological Impacts

- Loss of wetlands and associated functions and services (e.g. Biodiversity, Habitats) – lost more than 1000 natural lakes;
- Aggravated desertification as a result of ecosystem degradation due to water overuse up streams;
- 400 Invasive species (intentionally and unintentionally introduced);
- Many unknowns …….

Socioeconomic Impacts

- 59% of total areas in China face to water stress; Impact 60% of population;
- 72% of GDP produced from impacted areas
- Cost 2.3% of GDP (*World Bank estimate*)
- 1/3 billion peoples no safe drinking water

What can we do about it?

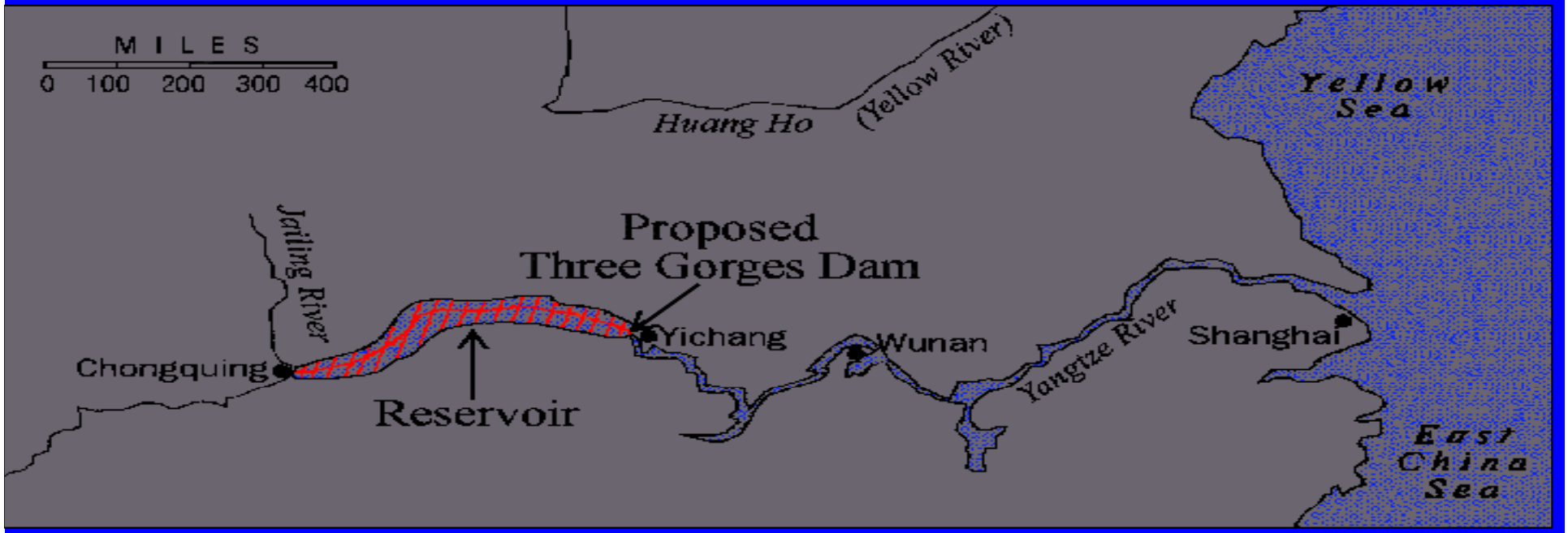
SGCP

Strategies to Solve China's Water Crisis

- The Three Gorges Dams (flooding control?)
- South-North Water Transfer Projects (Since 2002 cost >$9 billions each) – the last straw?
  - Two routes construction is ongoing to be completed in 2020
- Payment for Ecosystem Service Programs (i.e. "Grain for Green", Natural Forest Protect Projects, other soil conservation projects)
- Climate change adaptation measures (climate screening)
- National water management policy (MWR)
  - Unified, coordinated management system
  - Water demand management
  - River basin to regional management
  - Water right trading

SGCP

The Three Gorges Dam (completed 2009)

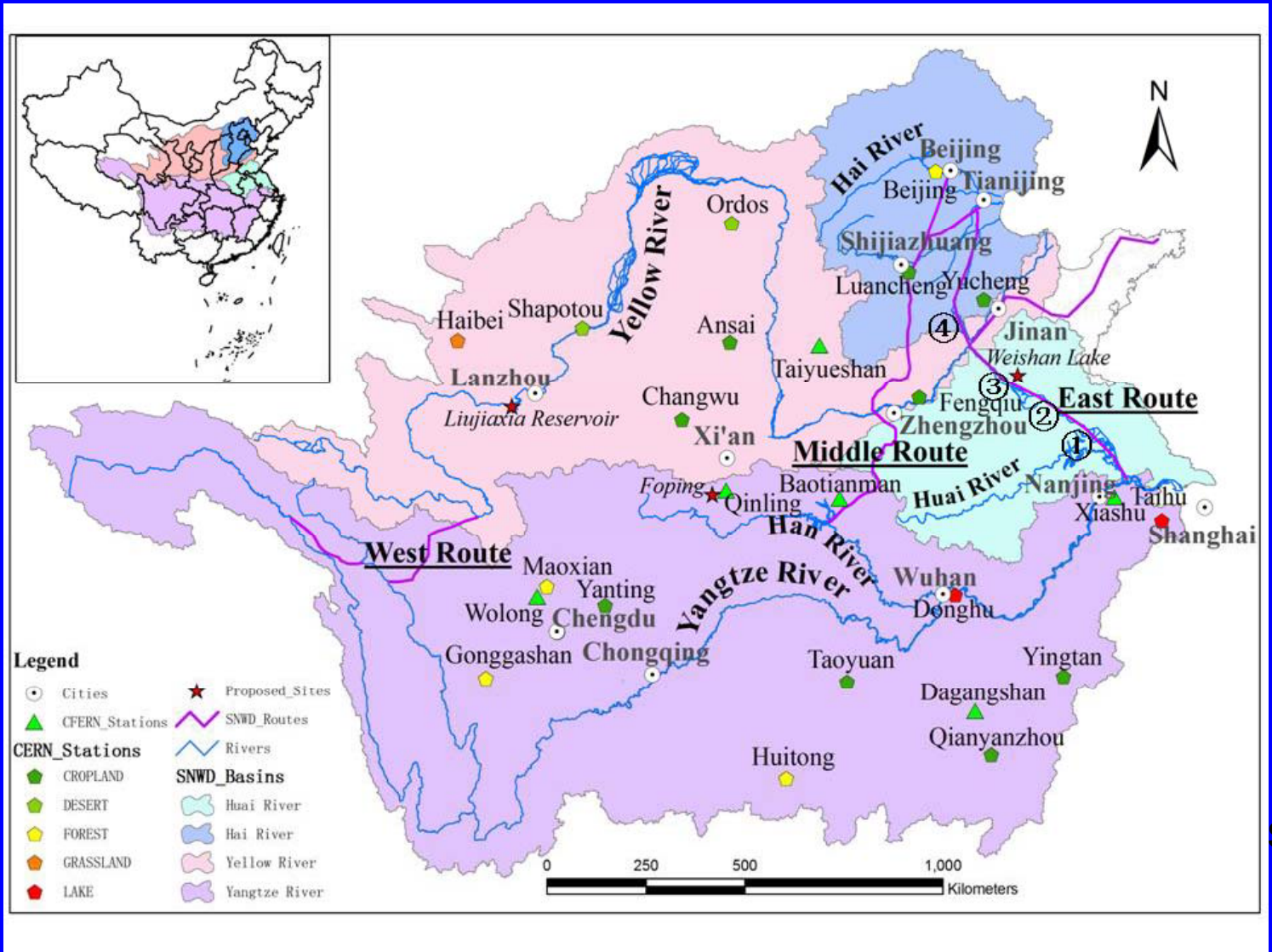


SGCP

The Three Gorges Dam
Emerging water quality problems?

SGCP

South-North Water Transfer Projects



SGCP

Massive Reforestation Campaigns

SGCP

Summery

1. It is clear China is facing an emerging water crisis in the 21st century
2. Unique challenges in water resource management in China. How to meet multiple demands on water under a changing climate?
3. It is not clear about the long-term impacts of the existing large water projects and management options.
4. Bold initiatives and reform in institutional and policy are needed (*The World Bank, 2009*)

SGCP