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China's 8 challenges to water resources management in the first quarter of the 21st Century

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Abstract

Northern China has less than half the water per person than the absolutely water-scarce Egypt. This simple comparison helps us to understand that China will face great water-related challenges in the coming decades. Its rapid urbanization, industrialization, growing agricultural demand, environmental degradation, and potential climate-related threats will be the major driving forces that challenge the management and utilization of China's water resources over the decades to come. China's environmental pressures already exceed the carrying capacity of this densely populated land. This paper surveys China's water resource management situation and its challenges for the decades ahead. The Yangtze River basin is a special focus. The waters and hydropower of this vast basin are increasingly being exploited—besides the 400 million people who live in the basin—also those other nearby parts of China. Particularly important is the thirst of the North China Plain—with another 400 million people—seeking the Yangtze's water and power.

Keywords: China; Food; Institutions; Urbanization; Water; Yangtze

1. Introduction

The Yangtze River (Changjiang) is often called the equator of China. The river divides the country between a humid south and a dry north. The North China Plain bears most of China's water problems: its climate is changing to warmer and less rainy; its rivers are massively polluted; groundwater is overexploited; it is absolutely water-scarce, yet its cities attract new settlers in millions. The North wants more water from the Yangtze, and a good share of its hydropower as well. The catchment of the Yangtze also represents a very sharp social and economic gradient, as it flows from Tibet to Shanghai.

Four hundred million people live in the Yangtze basin. With its enormous population, this basin alone would be the third most populated country in the world. It has more inhabitants than the European Union, and almost as many as the United States and Russia together. It has 1/15 of the world's population. In terms of population size, the North China Plain equals the Yangtze basin. The Yangtze has 1/3, whereas the North China Plain has only 1/16, of China's water (Table 1).

In this paper, we summarize the major aspects of China's contemporary water resource management and the challenges related to their development, with a special focus on the Yangtze basin. Eight major challenges are identified.

- China's water resources are non-uniform and scarce,

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Table 1
Major indicators related to water resources development of China, the Yangtze basin, and the North China Plain (ADB, 2000)

	China total	Yangtze basin	North China Plain
Population	1172 M	402 M (34% of China's total)	407 M (34%)
Surface area	9.6 M km^2	1.76 M km^2 (18%)	1.35 M km^2 (14%)
Mean river runoff	2711 km^3	951 km^3 (35%)	169 km^3 (6%)
Arable land	96.4 M ha	22.9 M ha (24%)	37.9 M ha (39%)
GNP per capita	870 US$ (1997)	Shanghai 391% of national average	Beijing 261%
		Anhui 65%	Shandong 115%
		Hubei 86%	Hebei 87%
		Sichuan 65%	Shaanxi 64%
		Tibet 51%	Ningxia 69%
Net storage capacity relative to annual runoff	9.9%	10.0% (35%)	46.5% (29%)
Large-scale water projects	573	184 (32%)	178 (31%)

- China's climate has strong variations which are difficult to forecast,
- Population density is extreme,
- Urbanization is very rapid,
- Environmental degradation must be reversed,
- Food self-sufficiency requires vast efforts,
- Economic and human development offer possibilities, but disparities are wide,
- Institutional shortcomings.

These eight issues constitute a deeply interwoven entity, and no nationwide water resources policy can afford pushing any of these issues aside.

2. China and its water resources

The population of China approaches 1.2 billion at present. In spite of strict birth control, population growth continues and could reach 1.6 billion (UN, 1998) by the year 2050. Estimates of the present urban population vary between 230 and 370 million. During the next 30 years, the urban population is estimated to increase by 600 million to around 1 billion. The Chinese economy is growing fast but the country is still classified in the low-income category with its GNP per capita approaching US$1000.

The arable land area of about 96 million ha is decreasing, while the population grows. About half of the arable land is irrigated. The changing structure of the economy, i.e., industrialization and urbanization, creates situations where land is the focus of intense competition. Prime agricultural land is under pressure of being used for building or road construction. Arable land will be cleared in areas where soil is of poor quality and irrigation water is difficult to obtain.

China's renewable water resources are estimated to be about 2800 km^3/year. Water consumption is around 500 km^3/year or 18% of the quantity of usable water. The share for irrigation is almost 90%. Zhang and Zhang (1995) estimate that roughly half of the approachable water is in use already. Agriculture and food security in China are fully linked with water. Eighty-seven percent of all water withdrawals go to agriculture, while industrial use constitutes 7% and domestic 6% of all withdrawals. Recently, China has invested significantly in water resources development. There are about 85,000 reservoirs, with a total gross storage volume of around 17% of the annual runoff. The most important water project at present is the Three Gorges Dam, which is under construction on the Yangtze. It will increase the river's storage capacity from 10% to 13% of annual runoff. With its 17 GW hydropower production, it will add to China's power generation capacity by 7% by 2007.

In spite of such massive projects, not enough water is available. In the 1980s, one half of the cities suffered from water shortage. In every tenth city, the situation can be described as critical. China's particular problem is that 81% of its water resources are in the country's southern part, but the largest part of arable land, 64%, is in the north, where the nation's political and economic center is located. One hun-

dred and twenty-six million people live in North China in an area of only 426,000 km^2, where renewable water quantity is only 52 km^3/year. Water use of northern rivers now exceeds 60% of the annual rate of flow (Zhang and Zhang, 1995) In 1987, the quantity of available water was only 44.5 km^3/year and consumption rose to 87.3% of this quantity (Zhang et al., 1992). Huang He's (Yellow River) water has been used so extensively that no water flowed to the sea for 227 days in 1997 (Chen and Zong, 1999). Prior to 1991, the maximum annual number of days with a similar situation was 40 days.

Groundwater in North China is used at a rate much higher than that with which the aquifers are filled. This has caused level of groundwater to drop, in some places, by as much as 70 m. In Beijing, the drop has been 40 m and the city has subsided by over 0.5 m (Zhang and Zhang, 1995). A plan has been made to divert water from the Yangtze to the north to improve the water situation. For this purpose, a water transfer system of 53–71 km^3 of annual capacity is being planned, and some parts have already been constructed.

Besides water availability, the quality of water is also a problem for the Chinese. For instance, only 1/5 of industrial wastewater is treated to some extent before being discharged into a waterway.

Water availability is a major constraint on China's attempt to raise its standard of living. With a rising standard of living and urbanization, water consumption will increase. Market price determination for water, increasingly adopted in China, will seriously threaten irrigation water accessibility. In order to secure food production into the future, considerably more irrigated arable land is needed. Acquisition of enough water for this purpose is difficult.

China is undergoing a rapid and profound transition to a market-oriented economy. The traditional, strongly centralized political system is moving towards a more decentralized system. The lack of a unified water administration and management has been acknowledged. The gap between planning and decision making is serious. Finally, the inadequacy of financial resources is an important constraint in addressing the water resources challenges (ADB, 2000). These constitute the starting point for the consideration of the country's institutional possibilities to face the challenges to its water resources.

3. Eight major challenges

3.1. China's non-uniform and scarce water resources

A comparison of populations on each continent with available runoff (Fig. 1) shows Europe and Asia to be the most water-scarce continents. China's aver-

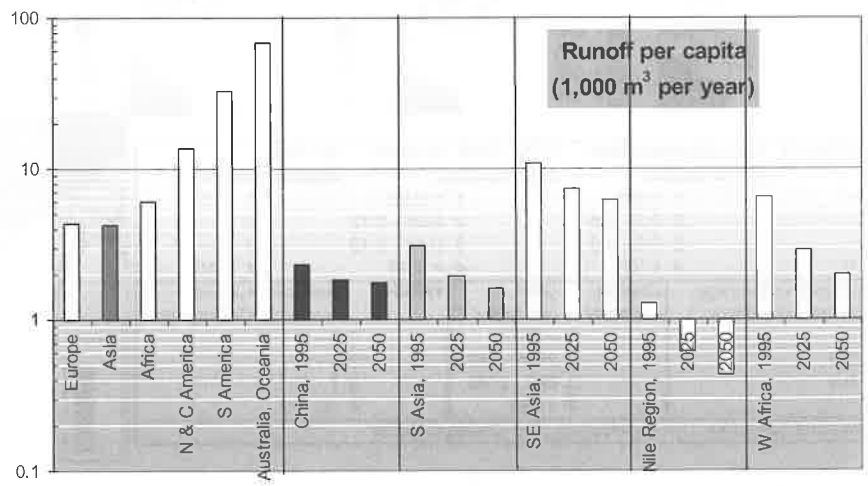


Fig. 1. Runoff per capita by continent in 1995, and by region. Data from Postel et al. (1996) and SEI (1997). People living in a basin with less than 1000 m^3 water per capita per year tend to face chronic water shortage.

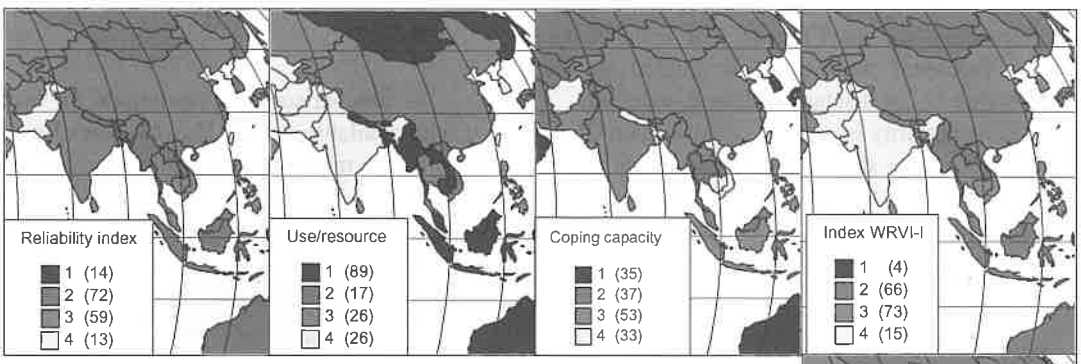
age is somewhat over 2000 m^3 water per person, keeping it above the scarcity limit of 1000 m^3.

The same outline can be seen in the recent global water availability assessments. We take the Stockholm Environment Institute's study (SEI, 1997) as an example. The analysis of future water resources is based on a set of scenarios, among which we show here the Middle Conventional Development Scenario, because it represents the most probable future situation. The results are presented as a set of vulnerability index values for each country. The five indices used, and the most important results, are shown in Fig. 2, for China and its surroundings. China's results show that with each index (reliability of water supply, use-to-resource ratio, coping capacity, and their different combinations), China falls in the category of water-stressed countries.

The larger and more heterogeneous the region or the country, the more the average values are misleading. The Island of Java in Indonesia has 110 million people in a fairly small area. The Javanese have 1200 m^3 water per capita per year, making the area as water-scarce as the Nile basin. A more dramatic pressure on water resources is, however, imposed in the North China Plain, in the basins of Hai, Luan, Huang, and Huai rivers (Fig. 3). In those basins, the total annual, renewable water availability is 212 km^3. This accounts for 7.5% of China's total water resources. These basins are the home of 407 million people, which is 34% of China's total population. This population has 39% of the nation's cultivated land. This implies that these basins have less than half of the water per capita in relation to Egypt or Java, which are recognized as water-scarce regions. The situation of the 120 million people who dwell in the Hai and Luan basins, which provide only 1/5 of water per capita of the level of Egypt and Java, is the worst.

3.2. Strong climatic variations which are difficult to forecast

China's most populated areas belong to the monsoon zone. This zone covers the region southeast of the line between Yunnan and Hebei. A notable part



Reliability	S/Q+COV+ID	*S/Q: Storage-to-flow in river basins*		*COV: Coeff. variation of precipitation*		*ID: Import dependence (%)*
	1 1 - 3	*1 > 0.6*		*1 < 0.06*		*1 < 15*
	2 4 - 6	*2 0.3 - 0.6*		*2 0.06 - 0.12*		*2 15 - 25*
	3 7 - 9	*3 0.2 - 0.3*		*3 0.12 - 0.18*		*3 25 - 50*
	4 10 - 12	*4 < 02*		*4 > 0.18*		*4 > 50*
Use-to-resource	Withdrawals of average annual resource flows		**Coping capacity**	GNP per capita	**WRVI-I**	Reliability+use-to-resource+Coping cap.
	1 < 0.1			1 > 8625		1 1 - 3
	2 0.1 - 0.2			2 2786 - 8625		2 4 - 6
	3 0.2 - 0.4			3 695 - 2786		3 7 - 9
	4 > 0.4			4 < 695		4 10 - 12
WRVI-II	Maximum of Reliability, Use-to-resource, and Coping capacity					

Fig. 2. The five water vulnerability indices of SEI (1997) projected to 2025. The Middle Conventional Development Scenario results for the Asian study regions and surroundings. The indices are also described. The categories are: (1) no water stress, (2) moderate water stress, (3) water stress, (4) water scarcity.

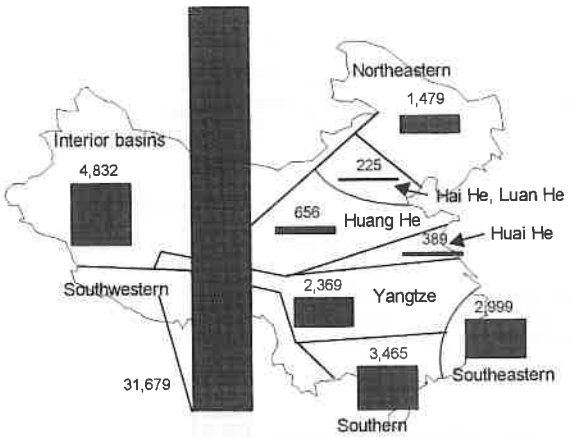


Fig. 3. Water resources availability per capita (m^3/year) in different parts of China (after Heilig, 1999).

of the Yangtze basin—from Yunnan to Hubei—lies just at the border of the monsoons, which is an important reason for the river's flood proneness. The monsoons are known to be irregular. Their timing, and particularly their intensity, varies from year to year. In some years, the monsoons bring significant rainfall to the basin, and in the others, the monsoons are weaker. In addition to this, the Yangtze basin is located at the meeting point of the Indian and the Pacific monsoons, which makes the rainfall exceptionally difficult to forecast.

The majority of world's climate-related catastrophes can be associated with monsoons. In China, both floods and droughts appear to cause enormous losses once every few years. The North China Plain and the lower Yangtze basin are particularly vulnerable, whereas one of China's rice bowls, Sichuan, has a very stable climate being just outside the reach of the monsoons, and is thus an important exception from almost the rest of the heavily populated parts of China.

In the 20th Century, most dramatic climatic changes were observed in the monsoon zone. The changes in China's climate have also been clear. The temperature increased (Fig. 4), and precipitation decreased significantly in the most water-stressed regions, east of Qinghai province all the way to the North China Plain (Zhai et al., 1999). This is China's most marginal region of the monsoons. At the same time, Tibet, Xinjiang, and Southern China had an increase in rainfall.

Accordingly, China's water-stressed regions face increasing risks to water problems due to rising temperature and decreasing precipitation. Table 2 summarizes major climate projections for China (IPCC, 1996, 1998; Varis, 1998).

3.3. Extreme population density

The population of China is huge, yet its growth is controlled more rigidly than in most parts of the world. China's share of the world's population has decreased from 22.1% in 1970 to 21.0% at present, and is expected to decrease to 16.3% by 2050. The population is expected to double in 80 years (1970–2050). The corresponding increase for West Africa is 6.6 times, and 3.4 for South Asia.

China has a large territory, 9.6 million km^2, but most of it is very sparsely populated. Ninety percent of people live on less than 1/3 of the land area, with an average density of 354 people per km^2. This is a higher density than in Japan or any European country except the Netherlands. Fifty percent of Chinese live in areas with a density as high as 740, and for 30% (346 million), the figure is 1024. In comparison, Bangladesh has 935, the island of Java has 870, and the Netherlands has 457 inhabitants per km^2 (World Bank, 1999).

The concentration of people in the narrow coastal zone, in the Yangtze valley, and particularly in water scarce and very densely populated North China Plain, is very important as a driver of water resource development.

3.4. Very rapid urbanization

In China, the level of urbanization was 22% in 1975, is currently recorded at 37%, and expected to reach 55% in 2025. The Chinese urban population is expected to increase five times during this 50-year period. Along with urbanization, the population density is increasing, particularly in the already water-scarce and densely populated basins (Fig. 5).

China's urban areas produced 35.1 km^3 of wastewater in 1997. This is expected to grow to 650 km^3 by 2010, and 960 km^3 by 2030. The treatment level was 11% in 1997, and it is targeted to grow to 40% in 2010 (Oyang and Wang, 2000). The difficulty in meeting this target becomes clear when

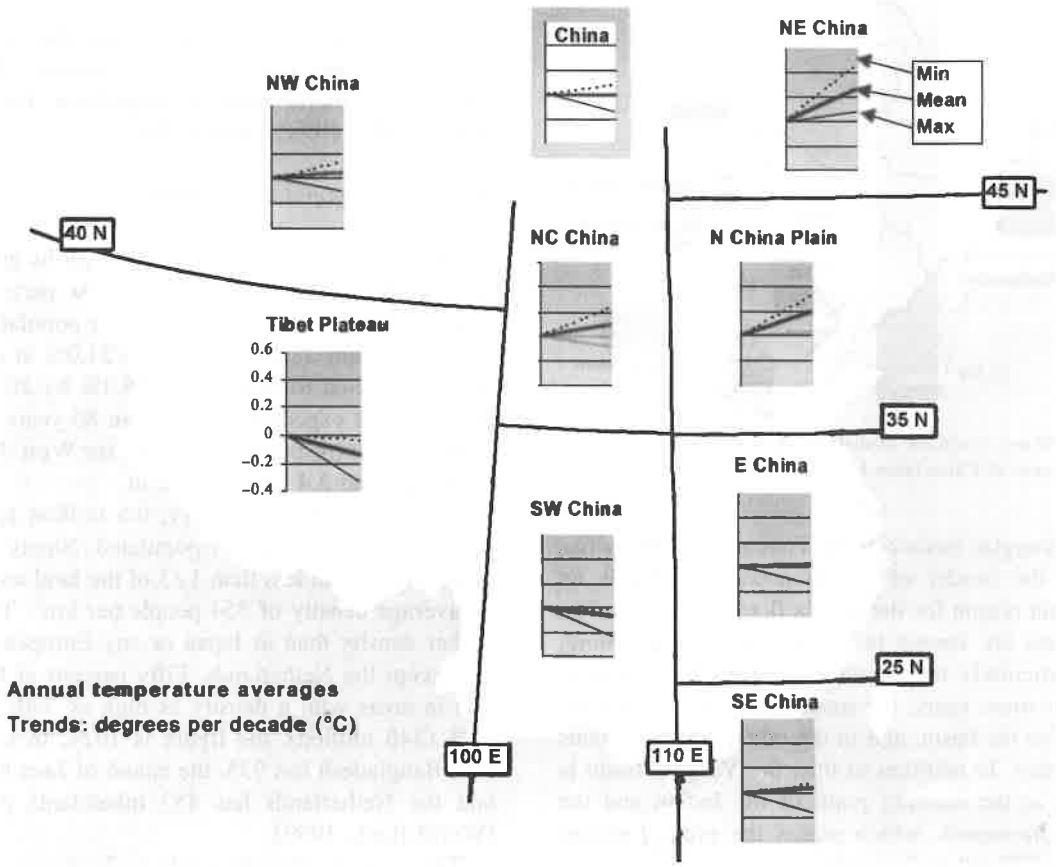


Fig. 4. North China Plain and Northeastern China get warmer, whereas Tibet and Southeastern China cool down. Thick solid line is annual average temperature, thin solid line is mean annual maximum temperature and dotted line is mean annual minimum temperature. The data covers the period 1955–1997 (Shen and Varis, 2001).

compared with the required treatment capacity in Germany (Van Riesen, 1999). In 1996, Germany treated 22% more waste waters (in cubic meters) than China. In order to reach the target of 40% by 2010, China has to build 1/3 of German's present capacity each year.

3.5. Required reversal of environmental degradation

China is extremely short of natural resources, given its dense population. An analysis of the Chinese Academy of Sciences noted that "China's environmental pressures already exceed the critical

Table 2
Future projections for temperature, precipitation, and river runoff for China. Compiled from IPCC (1996, 1998) by Varis (1998)

Temperature	Precipitation	Runoff
High uncertainty	Very high uncertainty	Extreme uncertainty
Small increase suggested, decrease is also possible. Sensitivity of coastal monsoon areas smaller than dry continental areas	Summer rains will increase towards S and winter rains towards N. Substantial decrease throughout is also possible but less likely	N China: very sensitive to any change. More likely to decrease than increase (except Manchuria). Special attention to summer flows.
		S China: increases rather than decreases

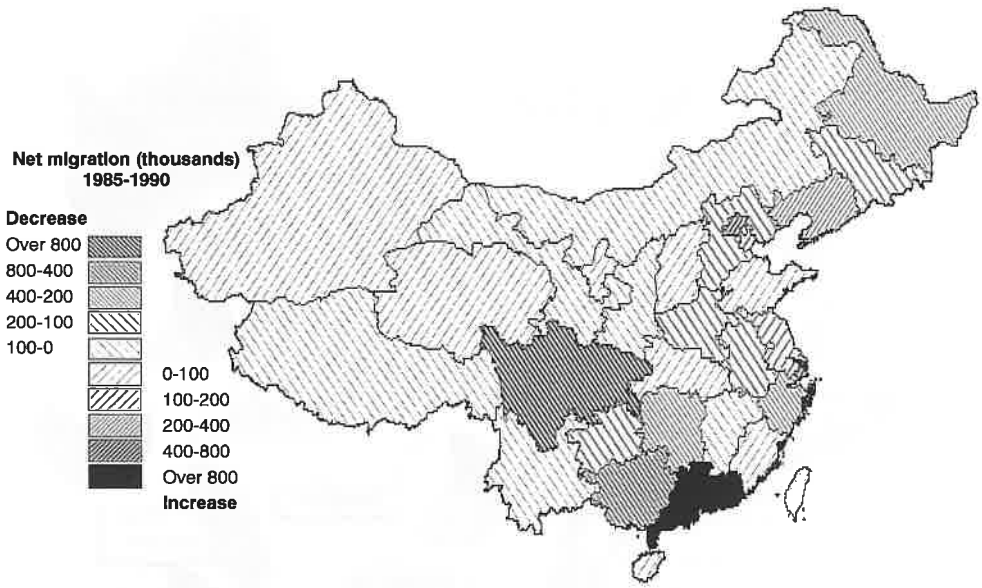


Fig. 5. Migration pattern: China's population concentrates partly on water-scarce areas (data: State Statistical Bureau, compiled by Heilig, 1999).

equilibrium limits of many ecosystems" (Chinese Academy of Sciences, 1992; Niu and Harris, 1996). Reversing environmental degradation is an expensive exercise. The World Bank (1977) estimated that 1–2% of GDP will be required to address water and air pollution. This is a large figure, but it must be seen against the economic losses due to pollution, which is equal to 8% of GDP.

Along with some parts of former USSR, China topped the world in terms of emissions per produced GNP for decades. Very recently, though, it has made rapid progress. Its resource use is improving in many respects, but there is still much to accomplish. For instance, China's average energy consumption related to GDP is 1.8 times that of India and five times the consumption of Japan. China's emissions continue to grow rapidly. Yet, apparently, the economy grows much faster than emissions. China is expected to double again its GDP in the next 10–15 years. This could happen with virtually no increase in energy consumption or related emissions, if efficiency growth and technological progress are successful (Niu and Harris, 1996). China has gone a long way to halve its emissions per produced wealth, but it still must halve its emissions once or twice to reach the level of the other industrializing countries.

The consequences of high emissions and high population density are clear in China's water, air and land. The nitrate and ammonium concentrations doubled in the Huang He and the Yangtze rivers in the 1980s (Zhang et al., 1995). Frequent, severe eutrophication problems can be observed in all major Chinese river systems. Surface water quality problems are most oppressive in the water-scarce parts of China (Fig. 6). This tendency is enhanced by the rapidly deteriorating groundwater situation—both in terms of quality and quantity—in the North China Plain (ADB, 2000).

Land degradation is a serious problem in China (Fig. 7). In the 1950s, the land area susceptible to erosion was 16% of the country's surface area, whereas in 1997, it was estimated to be 38% (ADB, 2000). In the Yangtze basin, the area from which severe erosion occurs has doubled in the last 15 years (Niu and Harris, 1996). The Yangtze's annual sediment load at Yichang is now about 0.5 billion tons. Water erosion is by far the most problematic issue in the humid parts of China, such as the Yangtze basin. Both chemical and physical degradation are growing, though. China's particular geomorphological conditions—vast areas very prone to erosion—do not make abatement policies easy.

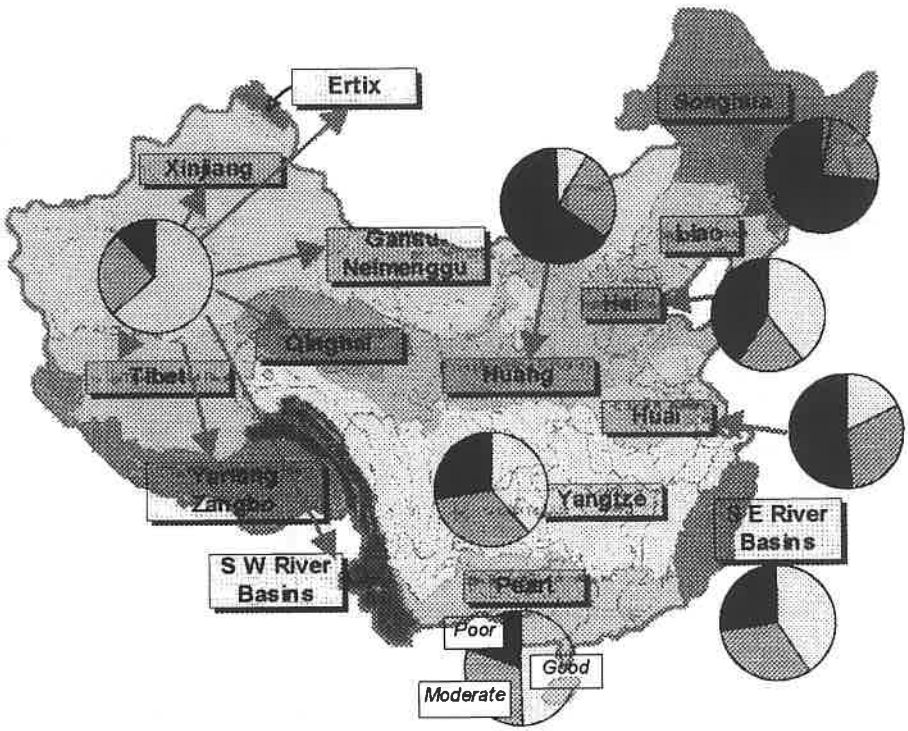


Fig. 6. Water quality in major river basins of China in 1996 (after Shen and Dafoe, 1998). The Chinese surface water quality classification was used (classes 1 and 2: good, class 3: moderate, and classes 4 and 5: poor).

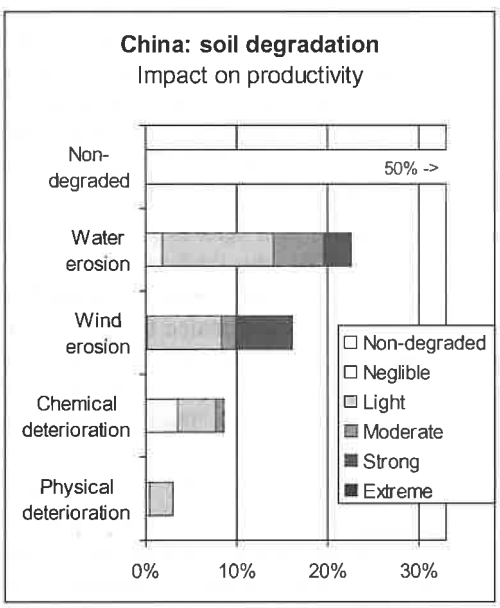


Fig. 7. Soil degradation in China, percent of total land area, by region (Lynden and Oldeman, 1997).

The impact of environmental deterioration on China's vulnerability to natural disasters is also visible. In the past 2000 years, the number of major floods in China has been 1600, while major droughts have occurred about 1300 times. The frequency of natural disasters in China has been steadily growing over the past 1500 years (Fig. 8). This can be attributed to the degradation of the environment in China over that period (Niu and Harris, 1996). The worst famine ever recorded on this planet occurred in China in 1876—79, killing 9 to 13 million people (FAO, 1995).

3.6. Food security

China's agriculture continues to face great challenges, which are deeply water-bound. China has made a very rapid progress in food production, and is now providing its citizens on average > 2600 calories per day. This has happened almost totally

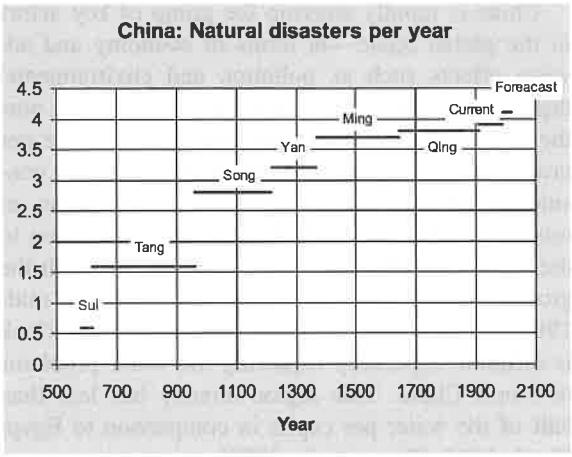


Fig. 8. China's natural disaster frequency. Average number of natural disasters per year during different dynasties and historical periods in China after 581 AD. After Niu and Harris (1996).

through intensifying farming practices. Irrigation and particularly fertilization are booming, causing colossal changes in the water environment. China's share of global fertilizer use has risen from 6% to 24% in the past three decades. Further intensification is unavoidable, since the country's arable area is expected to decrease by at least 10% by 2030 (Niu and Harris, 1996). Water has already become scarce in large parts of China, and intensification of agriculture will require much more careful water management than before.

IIASA has recently analyzed China's future possibilities to feed its people (Heilig, 1999). That study concludes that the following 10 requirements must be met to maintain China's next-to-complete self-sufficiency in agricultural production:

- China can (and should) greatly improve water use efficiency in agriculture.
- A trans-basin water diversion is necessary to better supply China's high population in the North China Plain.
- Bottlenecks in transportation infrastructure, technology, and logistics have to be removed.
- Larger farm sizes should be promoted by gradual privatization of the arable land.
- China would benefit from a moderate increase of (feed) grain imports.
- Flood prevention measures must be intensified.
- Research in biotechnology should be further supported.
- Some state intervention in the grain sector is necessary to guarantee a sufficient grain supply.
- Family planning can prevent a larger than expected growth in food demand.
- China's agriculture might benefit from climate change.

Some other analysts have reached very different conclusions. The US Ministry of Agriculture foresees the need for import to be 32 million tons in 2005. The Chinese Academy of Science's estimation for import is 35 million tons in 2010 and 45 million tons in 2020 (Crook and Colby, 1996). According to Brown and Halweil (1998), as much as 200 million tons will be needed to be imported in 2030. The scale of these figures becomes evident when we find out that the net amount of grain bought by developing countries at the turn of the decade was about 80 million tons in all.

3.7. Disparities in economy and human development

The regional income differences are significant and growing. China's coastal mega-cities and the special economic zones prosper, while the large, landlocked agriculture-dominated provinces lose their economic share. Shanghai's GNP per capita is four times the national average (Hong Kong excluded), whereas most of the landlocked provinces can provide their dwellers with only 1/10 to 1/5 of Shanghai's GNP.

In the UNDP (1999) Human Development ranking, which takes into account wealth, education, and public health, China's rank is 98 among the 174 countries evaluated. China's HDI growth has been well above the world average.

Akder (1994) analyzed the Chinese human development by province. Shanghai—the most advanced province—would rank in the top class of the world countries, even above Hong Kong. Tibet had the lowest ranking, falling below all the 174 countries. The last countries on this list are from West Africa: Mali, Burkina Faso, Niger, and Sierra Leone. The second Chinese province from the bottom was Qinghai, ranking slightly better than the above-mentioned countries. Yunnan came next. It would rank 164,

close to Guinea-Bissau, Chad and Gambia. The range of Chinese provinces is broader than that of the world's nations. Along the Yangtze, from Tibet, Qinghai and Yunnan down to Shanghai, this whole range is represented. This fact is among the most important starting points of any aspect of environmentally and socially sustainable water resources development in the basin.

3.8. Institutional mismatches

One such aspect is the institutional set-up of the water sector. The lack of unified water administration and management poses a serious problem in facing the contemporary water challenges. The institutional arrangement is overly complex, and prone to rivalries and inefficiencies. The country is moving from a centralized to a more decentralized system, but water institutions have difficulties in keeping up with these reforms. The increased independence of provincial action—bearing in mind the escalating gaps between different regions, the ambition to strengthen the thus far weak river basin authorities of the six major rivers including the Yangtze, and the strong tradition of a centralized system—is accentuating difficulties in policy coordination and action (ADB, 2000).

Planning has enjoyed a high priority in Chinese water policies. Sophisticated plans exist, yet a hiatus remains between planning and decision-making. This is partly due to financial shortcomings, but institutional problems addressed above are also responsible.

4. Conclusions

China now has a rapidly growing economy, plus many other imperatives for making conscious development choices. China's regional differences in economic and human development are large. The coastal mega-cities and special economic zones progress with a respectable rate, whereas the landlocked provinces, particularly their rural areas, have less growth. The growing sub-economies should drive the whole country, bringing up the rural areas. The opposite scenario would be that the emerging areas drain the rest of the country from wealth and human resources.

China is rapidly entering the group of key actors in the global scene—in terms of economy and adverse effects such as pollution and environmental degradation. China's economic progress exceeds now the growth of emissions. Still, the emission rate per produced unit of wealth needs to be improved considerably. For instance, China's CO_2 emissions, as related to GNP, are still manifold in comparison to the situation in high-income countries, although the growth of efficiency has been fast from the mid-1990s. With respect to water, however, the outlook is difficult, especially regarding the water problems of North China. This region already has less than half of the water per capita in comparison to Egypt (Smil, 1992; Zhang et al., 1992).

To sum up, the picture of China's water resources is polarized in a number of respects. The Yangtze lies in many ways at the midst of the following polarities.

(1) The North China Plain is extremely short of water, and the water availability is at risk of diminishing further, while the south is rich with water. Water quality degradation is, in addition, a far more severe problem in the north than in the south.

Yangtze's water will be used as a partial solution to the water problems of the North China Plain, but the planned water transfers are but a tiny drop in their sustainable solution. The real actions must be in the increase of water use efficiency and the abatement of environmental degradation in the North China Plain.

(2) Water use efficiency can and must be improved in all parts of the country. China's irrigation systems are extensive, but consume too much water. In the monsoon climate, storage and water transfer systems are of vital importance, yet some of the present, large-scale projects evoke plenty of criticism and concern. China's disastrous floods are still a serious problem every few years.

Yangtze's flood sensitivity has been China's menace over millennia, and the benefits due to completed and planned hydraulic constructions are eaten up to a large part by the siltation of the natural and man-made reservoirs and other factors that shrink storage volume in the basin, as well as intensifying land use in the flood plains.

(3) The Chinese are better off in terms of wealth and human development, yet the most developed

regions, particularly the coastal mega-cities, are growing at a rate that causes concern for the growth of socioeconomic, partly regional, gaps within the country.

The Yangtze basin has huge differences in development in its different parts. The estuary with the City of Shanghai represents high human and economic development, while the landlocked provinces, particularly Guizhou, Yunnan, Quinghai and Tibet, belong to the poorest regions of the world. This polarity in growth is not a good sign.

(4) Population control is well advanced, although population density is very high and growing in certain regions, among which the most problematic in terms of water is the North China Plain.

The Yangtze basin, with its 400 million people, has a pronounced population problem. Particularly, the Sichuan and Chongqing provinces and the river valley from Yichang to Shanghai are extremely crowded.

(5) Urbanization has been heavily controlled for decades, but recent times have witnessed relaxation in this respect. More strict control of the excessive rate of urbanization would allow more time for adaptation, but such policies appear very difficult and unappealing in the present conditions.

The migration from the rural areas to the few economic cores of the basin such as Shanghai, Nanjing, Wuhan, and Chongqing is massive, and loads the urban regions with social and environmental problems and instabilities.

(6) The "first pollute—then clean" doctrine is often used to describe China's environmental policy. It is assumed to enhance economic development and attract foreign investment. The term might already be an exaggeration and partly obsolete. China's emissions are huge in comparison to produced wealth. High pollution levels are a serious concern in a densely populated country, although it seems that certain improvements in pollution abatement trends are already in place.

The Yangtze basin has serious environmental problems, most notably in terms of soil degradation and erosion, urban air pollution, and water quality issues.

(7) China's food security has reached a stable level, and the country can feed its vast population well. However, a concern is justified about the sustainability of the agriculture—land degradation is rapid—and agrochemicals are used in very high amounts. Most watersheds suffer from the adverse impacts of erosion, as well as leaching of nutrients and pollutants. Eighty-seven percent of China's water withdrawals go to agriculture. On the other end of the production chain, water, which is scarce, receives increasing amounts of pollutants, nutrients, and eroded soil.

The Yangtze basin has some of the most productive and intensively exploited agricultural areas of the world, particularly in the Sichuan province and in the plains east of Yichang. The river has enough water, yet rapid deterioration of environment must be taken seriously. Yangtze water will be increasingly used to nourish the North China Plain as well. Therefore, the Yangtze is at the center of the food security issue of China.

(8) China decentralizes and streamlines its administration system. Regionalization is high on the agenda, especially involving the river basin agencies. Their interplay is, however, severely handicapped by rivalries and mismatches with the strong central government.

Due to historical reasons, the Yangtze basin includes factors that make the integrated water resources management in the basin difficult. The many ethnic differences, huge economic gradients, Shanghai's particular status, and the location of the basin outside the power center of the country are factors that hamper the consideration of the basin as one unity.

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