



## CHINA'S POLLUTION ISSUES:- 2. WATER POLLUTION

### Scale of the problem in China

Most types of water pollution create a health risk for humans and animals, not always immediately but sometimes after long term exposure. Industrial, domestic and agricultural sources produce toxic materials which if not reduced at source or diluted during the pathway and sink of the pollutant will hinder economic growth and affect quality of life and longevity. In the rapidly expanding economy of China, research by the O.E.C.D. in 2007 found that:

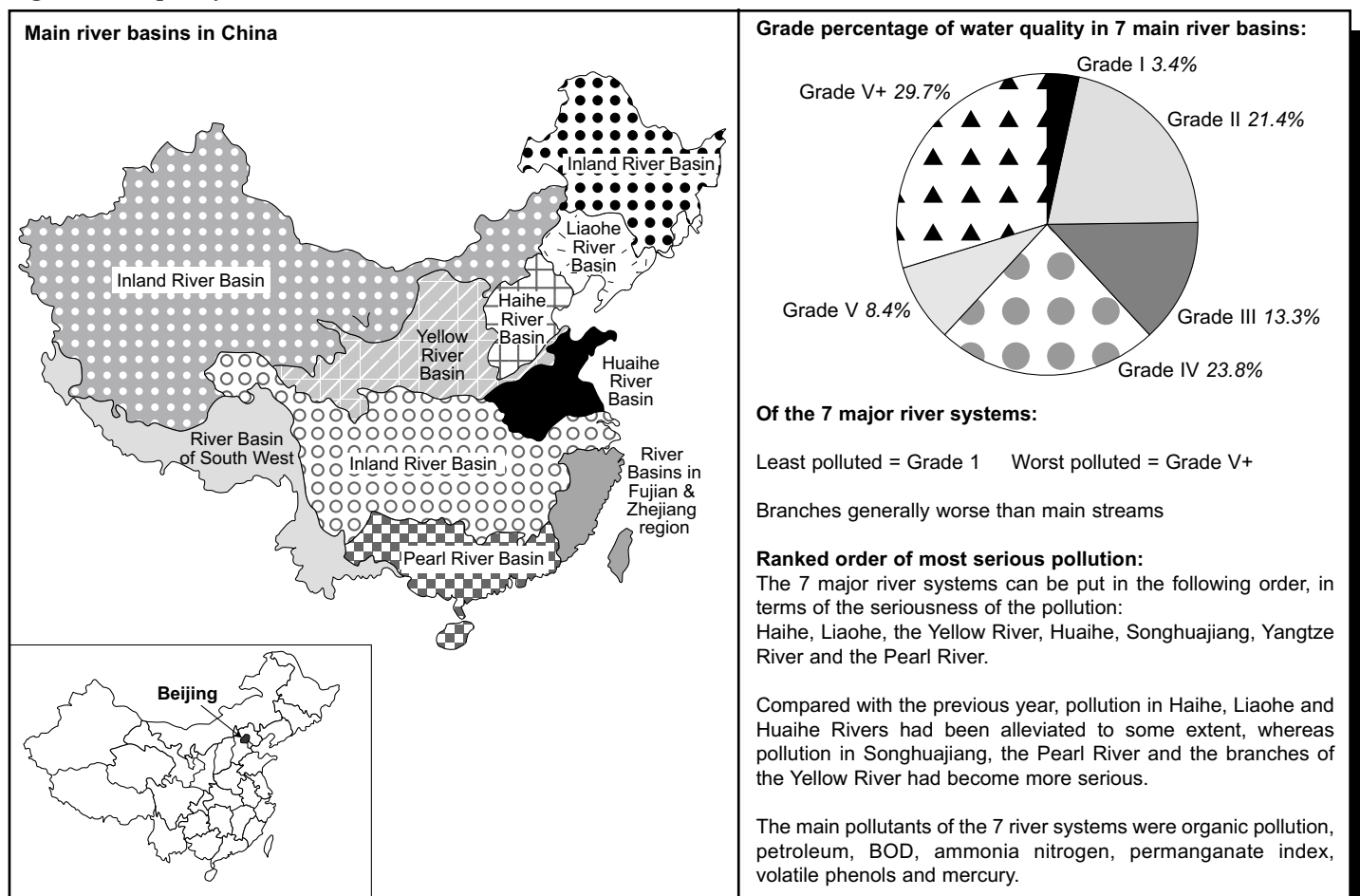
- 300 million people use contaminated water daily.
- 190 million suffer from water-related illnesses annually.
- One third of all rivers, 75% of major lakes and 25% of coastal rivers are now classed as 'highly polluted'.
- China is now the biggest polluter of the Pacific Ocean, since rivers carry the pollution load into the sea.

The Chinese press has reported that about 2 million people suffered diseases including cancer, caused by drinking water with high arsenic content, with sewage contamination of drinking water in many cities.

Water in 54% of the 7 main rivers of China is now considered unsafe for human consumption by the Chinese authorities, especially in rapidly urbanising NE China, a 12% increase since the early 1990s. The Yellow River supplies water to over 150 million people and 15% of China's agricultural land, but two-thirds of its water is unsafe to drink, and 10% is classified as pure sewage! Out of approximately 660 cities, only Lianyuan in Hunan Province, population 200,000, provides clean drinking water straight from the tap. Even in Beijing residents boil their water or buy it in bottles.

Water pollution problems are also acute in rural areas: with industries naturally attracted to river locations such as pulp and paper, tanning, and chemical factories indiscriminately emitting effluents, often protected by local officials. An external factor is that of the international trade in toxic waste, especially e-waste, often highlighted as a major reason for cancer hotspots despite the 1989 UN Basel Convention. This was a landmark international agreement that restricts trans-national trade in toxic waste, and China's itself bans illegal imports of e-waste since 2002.

Fig. 1 Water quality in China's main river basins.



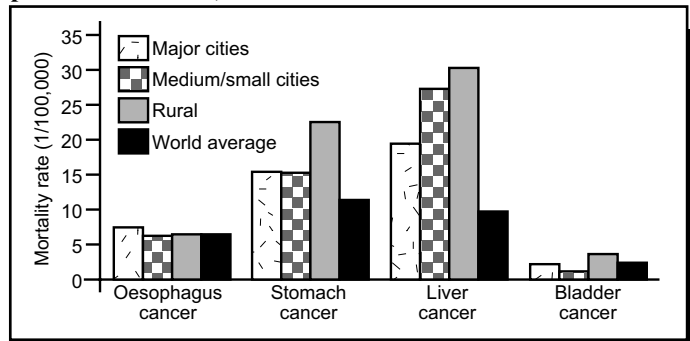
**Spatial distribution**

As in the UK, water is classified on its quality, with category 1 the best quality. The most severely polluted river systems are the Liao, Hai, Huai, and Songhua, all in Northern China, as also seen with air pollution. These also often suffer water shortages, and low levels of water in a river increase the concentration of pollution. However, whilst exposure to air pollution is directly linked to population clusters and economic activity, water pollution has a more complex pattern, depending on whether people rely on surface water, which is more easily polluted than groundwater. The World Bank estimates about 115 million people in rural China rely primarily on surface water as their main source of drinking water. However, up to 80% of rural areas have no access to a sanitary toilet, and overall 20% rural households depend on unsafe drinking water, so water related diseases like diarrhoea are a leading cause of death among under five year olds.

**Fresh Water Pollution**

Two internationally famous but contrasting problems will be assessed here: one from sustained sources, the Yangtze River in the 3 Gorges Dam area and the other from a point source incident: the Harbin accident.

**Fig. 2 Mortality rate for diseases associated with water pollution in China, 2008.**



Source: [http://siteresources.worldbank.org/INTEAPREGTOPENVIRONMENT/Resources/China\\_Cost\\_of\\_Pollution.pdf](http://siteresources.worldbank.org/INTEAPREGTOPENVIRONMENT/Resources/China_Cost_of_Pollution.pdf)

**Case Study 1: The Yangtze River - 3 Gorges Dam area**

Solid waste pollution and water quality is an issue in the Three Gorges section of the Yangtze River, which once completed in 2009 will need to deal with the waste from not just flooded settlements but the continuous waste effluent from the huge local population. An estimated 16m tons of solid waste is dumped into the Three Gorges area annually, and apart from health issues, this could affect the workings of the dam! The sources are:

- **Sewage and industrial effluents:** over the last 50 years there has been a 73% increase in pollution levels from the hundreds of cities in the main stem of the Yangtze River. The annual discharge of sewage and industrial waste in the river has reached about 25 billion tons, which is 42% of the country's total sewage discharge and 45% of its total industrial discharge.
- **Agricultural effluents:** CCICED (China Council for International Cooperation on Environment and Development) Task Force on Reducing Non-Point Pollution from Crop Production) concluded that 92% of the nitrogen discharged into the Yangtze is from agriculture.

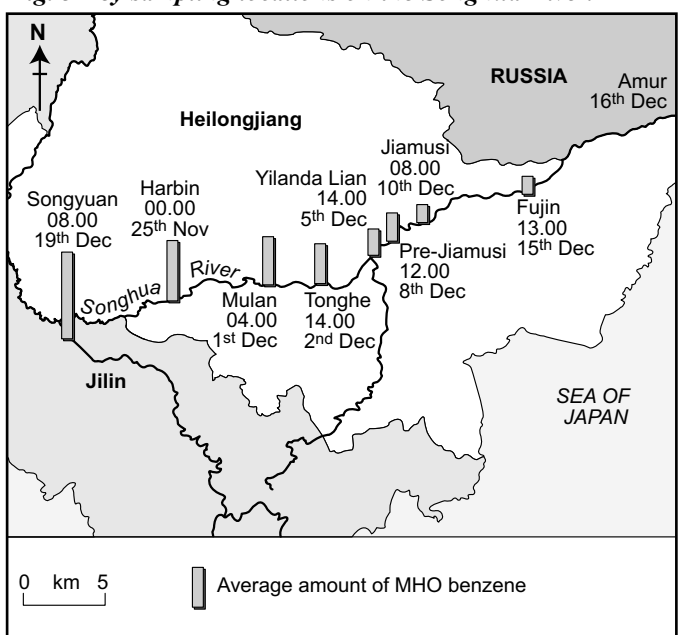
- **Shipping discharges** are also to blame for the river's declining health.
- As well, the **extensive loss of floodplain areas to agriculture** has reduced the basin's ability to detoxify pollutants. The major pollutants are suspended substances, oxidising organic and inorganic compounds, and ammonia nitrogen. This has severely reduced drinking water quality and contributed to dramatic eutrophication, increased by the dam which reduces water flow and traps sediment. Even before the Three Gorges Dam, health impacts in the area were already substantial including intestinal infectious diseases such as hepatitis A, and dysentery incidence rates some 50% higher than the national average. E.coli bacteria are common in water sources, and as high as 15,000 E.coli/L in some parts of Chongqing city. The WWF blames lack of clean up of toxic waste in settlements now flooded by the reservoir.

**Case Study 2: China's Chernobyl: Harbin's trans-boundary pollution incident** (see Fig. 3 for the progress of the spill)

The Songhua River Basin is the third largest river in China and also one of the most polluted rivers. It was already receiving aid from the Asian Development Bank to improve quality before the November 2005 incident. State-owned petrochemical plant Petrochina, in Jilin City, released about 100 tons of highly toxic benzene into the river which quickly flowed 80kms downstream to the mega city of Harbin (see Fig. 3). And beyond and its impacts forced changes in attitudes and legislation, rather like the Chernobyl nuclear explosion in 1985. Benzene is used as a cleaning agent, solvent, in dyes and paints but is lethal to humans exposed to it in high levels. Chronic exposure leads to progressive degeneration of bone marrow and leukemia. The incident created an international issue, since the polluted slick entered into Russia's Amur River. This threatened the water safety of the Russian border city Khabarovsk, with over 600,000 residents. Moscow's involvement probably forced the Chinese government to publicise the incident, but it took 9 days for the Chinese authorities to admit that water in the area may have been contaminated by the accident, and to remove many officials from their jobs. Water supply to Harbin was shut off for 4 days as tests showed benzene levels were 108 times higher than that considered safe.

Rural areas were less well informed however, a feature typical of many pollution incidents in China. This highlights the issue that authorities are often more concerned with appeasing better-educated urban residents, more likely to question actions than less well educated and mobilised peasant farmers.

**Fig. 3 Key sampling locations on the Songhua River.**



Source: SEPA, December 2005

### Cancer Village Hot spots

By 2007 China's health ministry named cancer as the biggest cause of mortality, ahead of other degenerative diseases. Coming to world attention is the concentration of some types of cancer in rural pollution hot spots, called 'cancer villages'. Shangba, is a small village, population 3,300, in southern China's Guangdong province, a rural community dominated by sugar cane fields and rice paddies. However it is known as the "Village of Death" because liver and digestive system type cancers have been responsible for approximately 80% of recent deaths. The cause seems to be heavy-metal-toxins from Dabaoshan Mine washed into the Hengshui River and infiltrating into groundwater. Mining zinc, copper and iron ore exposes naturally occurring heavy metals like arsenic and cadmium, which are both carcinogens. Poverty means inability to pay for bottled water, and many have no surplus to pay to see a doctor.

### Marine Pollution: Dead Zones and Red Tides

The most widespread, chronic environmental problem in all coastal regions is caused by an excess of chemical nutrients causing HABs (Harmful algal blooms). China's State Oceanic Administration estimates that 60% of China's marine pollution flows out of rivers, and is heavily focused around the mouth of the Yangtze River, in the Pearl River Delta, and the Liao River in Liaoning Province. Escalating consumer and industrial/agricultural demands mean ever decreasing fresh water inputs to coastal areas and hence less dilution and more concentrated pollution.

- **Eutrophication** results from the excessive concentrations of nutrients (nitrogen, phosphorus) and consequent phytoplankton or algae growth. This leads to HABs, often known as Red Tides, an inappropriate term since many are different colours or even clear; and Dead Zones. These are areas depleted of oxygen dissolved in bottom waters causing hypoxia (<2mg oxygen per litre of water, the minimum for animal life). This affects the whole coastal ecosystem, with direct and indirect effects on human health, food supplies, and recreation.
- **Hypoxia** is linked to Red Tides since some toxic forms of algae and phytoplankton thrive in nutrient rich but oxygen poor zones. Some phytoplankton contain reddish pigments and potent neurotoxins that paralyse fish and kill throughout the food chain. Humans may be affected if they eat shellfish. Skin irritation and burning eyes among swimmers also result. Respiratory ailments also affect people who are not even in the water, by onshore winds blowing inland its toxic aerosol. By 2000, China was estimated to lose over \$US100m per year by disrupted key inshore fisheries. The number of reported 'red tides' escalated from 19 in 1999 to 77 in 2001, with worst affected areas being the Bohai Sea in the NE, East China Sea, South China Sea. The Pearl River Delta is now renowned for its Dead Zone! In 2007 China's Shenzhen Bay experienced the biggest 'HAB' recorded to date.

*Note: Lake pollution caused major concerns for the Beijing Olympics as the sailing area had to be cleared up because of huge amounts of algal blooms (Fig. 4).*

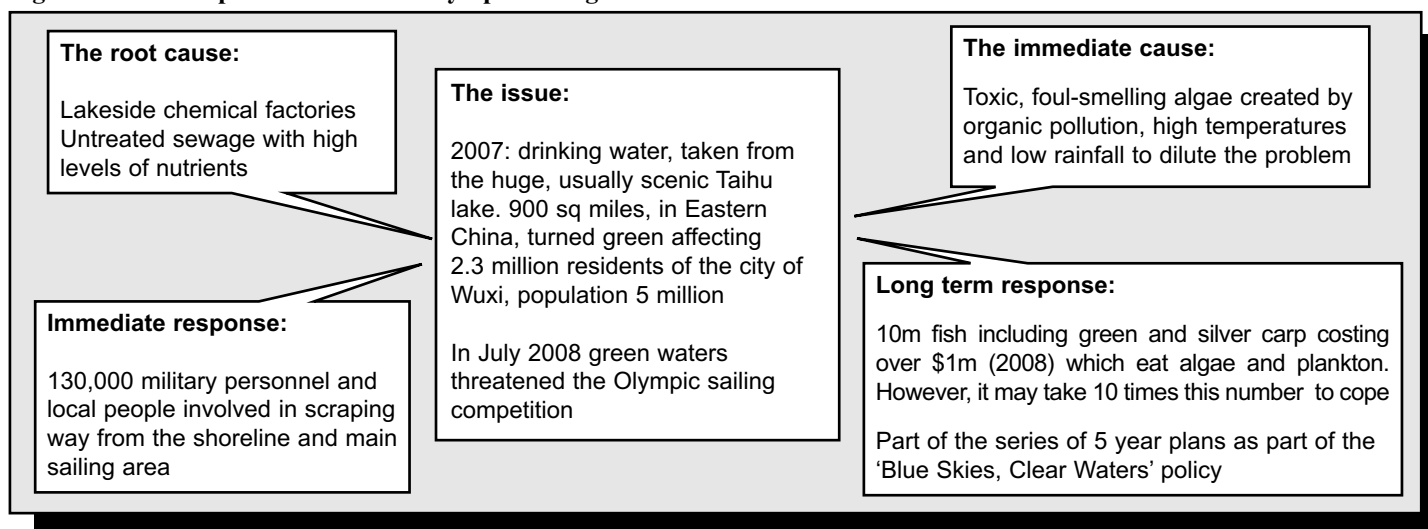
### Management of pollution issues and challenges

There are many blocks to effective management and conservation in China, outlined in *Geo Factsheet 238* on air pollution, involving arguments between central and provincial governments, few laws and enforcement in place and lack of monitoring. The basic problem is the conflict of long term environmental quality with shorter term goals of industrialisation and demand for rising living standards.

#### 1. Marine pollution

- The best answer is to tackle the dead zone pollution is at its source and reduce pollutants feeding the algae, aided by monitoring. The response in China is a long way from meeting any of these solutions, although since 2001 monitoring stations have been increased and some forecasting has started. External funding via the UN Global Environment Facility involves a multi-million dollar programme to protect marine biodiversity: the Guangdong Pearl River Delta Urban Environment Project.
- From the mid 1990s China's Ocean Agenda 21 developed an action framework for the protection of maritime resources, elimination of pollution, and the implementation of sustainable development, by an improved legal system and increased public participation- as much as there can be in this communist run state. In 2002, the Sea Area Use Law started to link sea area use activities with zoning plans, started formally licensing of sea users, and designated resources as public property, so users must pay. The Polluter Pays Principle was invoked: fines started to discourage misuse and abuse of sea areas.
- The latest growth pole in China, the **Beibu Gulf Economic Cooperation Zone (ECZ)**, currently being developed on China's border with Vietnam, has an extra component to existing growth poles such as Pearl River Delta in S China, the Yangtze River Delta in E China and Bohai Sea Rim in North China, all infamous for their pollution levels. Bilateral aid has been given by the USA involving NOAA in GIS work to provide data to help plan the coastline. This development has a more environmentally friendly green development approach, with compulsory environmental protection assessment built into developments and increased focus on recycling and protection of, for example, mangrove forests. However, the provincial Environmental Protection Bureau has voiced concerns that accelerated development, increasing influx of migrant workers into the Beibu Gulf area and the resulting rapid urbanisation will inevitably put ever greater pressure on the area's environmental and ecological balance, and inevitably create another pollution hotspot.

Fig. 4 Lake Taihu pollution - site of Olympic sailing.



## 2. Freshwater pollution

The Three Gorges Environmental Protection Program started in 2002 with SEPA's 10 year plan to build waste water treatment plants and waste disposal plants in the area, costing \$4.8m. It also includes:

- Reafforestation in the surrounding catchment, to reduce sediment runoff.
- Replacement of small polluting paper mills by larger more efficient plants.
- Control of agricultural effluent.

It is estimated that the annual water volume at the dam site will be 451 billion tons, with the reservoir designed to hold 39.3 billion tons, while waste water discharged to the river is approximately 1.2 billion tons. This means that the ratio of water and waste water in the Yangtze River is 400 to 1, compared with the international standard of a polluted river of 20 to 1.

In 2007, preceding publicity about the Olympics, and following a massive algae outbreak in the country's third largest Lake Taihu, making tap water undrinkable for 2.3 million residents of Wuxi, the government announced the start of a national inspection network to monitor quality, with 71 new standards, including limits on microbe content, organic matter and disinfectants.

The Harbin incident increased pressure for changes to the environmental protection agency SEPA. Petrochina was fined the maximum allowed at the time: but this was only 1m yuan (£ 64,000)! However in 2008 new legislation in China came into effect: the Water Pollution Prevention and Control law, and SEPA was given more power to enforce it. This is a response to the water pollution problems that are threatening not only the public's health, but also the country's social stability, economic growth and international image. More supervision and accountability is to be created, effectively the Polluter Pays Principle being enforced at a more effective scale.

- For "serious" pollution incidents, the enterprise in question may be ordered to shut down, and the responsible officers may be fined up to 50% of their annual income from the previous year and 30% of the direct damages caused by the pollution have to be paid for.
- Furthermore, a 'class action' can now be initiated against a polluter where there are a "large number" of victims. This is the first time that an environmental law explicitly stipulates in what situation a class action can be brought. It will apply to any foreign investors as well as Chinese companies.

### Role of NGOs

- The role of international pressure groups such as the Blacksmith Institute is critical to help improve management. This influential US NGO has been publicising, pollution hotspots for decades. In 2007 it launched it's the Global Pollution Remediation Fund following a meeting in Bellagio Italy with stakeholders concerned about toxins in the developing world including :
  - Recipient countries (China, India, Russia, Kenya, Mozambique, the Philippines),
  - Donor countries (the US, Germany)
  - International organisations (World Bank, UNIDO, Blacksmith Institute, Green Cross Switzerland),
  - World experts in pollution and toxins, from Johns Hopkins Bloomberg School of Public Health, University of Idaho and the US Army.
- In 2006 an NGO based in Beijing started publishing China's first database using digital mapping on national water pollution, called the China Water Pollution Map. Both local firms like Guixianghe Soybean Industry Corporation and Beijing Automobile Works Co. Ltd. are cited, as well as famous TNCs like American Standard, Panasonic, Pepsi, Nestle, and 3M. These have all been fined recently for discharges of substandard waste water and for unauthorised construction activities without proper environmental impact assessments.

- A similar influential internal NGO is The Chongqing Green Volunteers Union, promoting environmental protection and sustainable development in the upper part of the Yangtze River including the Three Gorges region.

### Conclusion

The pollution situation is deteriorating at a fast speed due to China's extremely rapid economic growth. Central government investment in environmental protection remains well below the 2.2% of GDP Chinese scientists claim is the minimum necessary to prevent further degradation of the environment.

Pollution fines have been traditionally so low that it is cheaper to pollute and pay up! One estimate is that fines only cover 10-50% of the true cost of any incident. There is little tradition of recycling or conservation and administrative bureaucracy and inaction underlies the whole system. NGOs and discontent within China are gradually pressurising for pollution cleanup, especially in urban areas.

The two basic management principles: precautionary and polluter pays are starting to be invoked, but are long way behind European standards, and meanwhile millions of Chinese people are suffering increased morbidity and mortality from water pollution.

Although China is facing many development problems on a level unknown to most of the world, it may be argued that the nature of the challenges to their fresh and coastal waters are no different than many others, but perhaps the rate and scale of change is larger!

### Student Focus Questions

1. Identify the changes shown towards supporting the precautionary principle and polluter pays principle in China.
2. Identify how dealing with toxic pollution is not an isolated challenge but is linked with meeting the Millennium Development Goals: poverty (goal 1), child mortality (goal 4), maternal health (goal 5) and most importantly environmental sustainability (goal 7).

### Key references

- Blacksmith Institute and Green Cross on worst polluted sites in world 2008: [www.worstpolluted.org](http://www.worstpolluted.org)
- Green global NGO : People and Planet on red tides in China: <http://peopleandplanet.net/doc.php?id=2387>
- Good summaries of incidents, e.g. Harbin: [www.worldwatch.org/node/3884](http://www.worldwatch.org/node/3884)
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