CHINA'S THREE GORGES DAM PROJECT: AN UPDATE

by Olly Phillipson

CONSTRUCTION of China's ambitious Three Gorges Dam Project, begun in 1994, is due for completion in 2008, a year ahead of schedule. China is the world's most populated country, with over 1 billion people, and has one of the fastest growing economies. The Chinese see the project not just as a way to control the river, but also as a symbol of the country's rapid growth and development into a modern world economic power. It could also be just the first of several other large-scale projects. However, despite being the largest dam and hydro-electric power (HEP) scheme in the world, it is highly controversial.

Figure 1 shows the River Yangtze (Chang Yiang) and the location of the new dam and its vast reservoir. The project is named after the Qutang, Wi and Xiling, three limestone river gorges found along a 200 km section of the Yangtze in Hubei and Chongqing provinces, upstream from Yichang. The Yangtze, at 6,300 km, is the world's third longest river. It drains an area of 1.8 million km^2, and is home to a population of over 400 million – about a third of China's population – supplying water to a twelfth of the world's people.

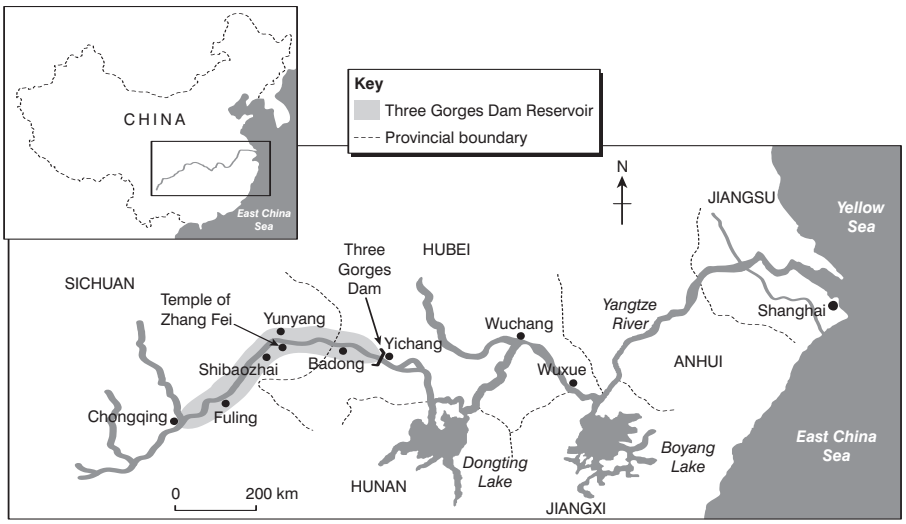

Figure 1: **The Three Gorges Dam Project**

Description	Concrete gravity dam 181 metres high, 2.3 km wide
Reservoir	660 km long
Water levels	Original level = 65 metres above sea level June 2003 = 135 metres October 2003 = 139 metres Sept 2006 = 156 metres 2009 = est. 175 metres (145 during 'flood' season)
Power generators	Left bank = 14 units x 700 MW Right bank = 12 x 700 MW units Underground = 6 x 700 MW units Capacity = 22.4 million KW
Power output (billion kW hours)	49.1 (2005) 84.7 (2009 est.) 100 (2011 est.)
Shipping	2 x 5 2-way step lock systems on left bank, over 100 metres change in water level 1 x 1-way step elevator to lift ships
Land submerged	632 km^2
Cost	US$ 22.5 billion (disputed)

Figure 2: **Three Gorges Dam factfile**

Aims

The Three Gorges Dam Project's statistics are impressive (Figure 2). The project has three main aims:

- to reduce flooding
- to improve navigation for shipping
- to generate electricity via HEP.

For centuries the Yangtze has flooded, causing over 300,000 deaths during the 20th century alone – 200,000 in the 1930s, 30,000 in 1954 and over 1,500 as recently as 1998. A dam to control flooding was first proposed in 1919, but variously fell in and out of favour.

Construction eventually began in 1994 (see Figure 3), with the last concrete being poured in May 2006. The reservoir has gradually been filled with water, raising levels from the Yangtze's original 65 metres above sea level, step by step, from 135, 156 and finally to

1919	Three Gorges Dam first proposed
1930s	Over 200,000 deaths by flooding. Area surveyed
1954	30,000 killed in floods. Plans revived
1960–90	Plans dropped and revived several times
1992	Government approval finally granted
1993–97	PHASE 1
1994	Construction work begins
1997	River Yangtze dammed
1998–2003	PHASE 2
1998–2002	Concrete pouring on left bank
2003	Concrete pouring on right bank
2003	Reservoir starts filling.
2003	First electricity generated (left bank)
2004	5-way ship locks officially opened
2004–09	PHASE 3
2006	20 May, concrete pouring complete
2007	First electricity from right bank
2008	One-way step ship elevator scheduled to open
2009	Estimated completion (1 year early). May be finished in 2008.
2010	First electricity from underground generators
2011	Full generating capacity onstream

Figure 3: **Important dates in the life of the project**

175 metres. During times of high risk, the water level is to be reduced to 145 metres to allow room for floodwater. The capacity of the reservoir should reduce the risk of flooding downstream from a 1 in 10 years event to a 1 in 100 years event. Not only will this benefit over 15 million people living in high-risk flood areas, it will also protect over 25,000 hectares of farmland.

With the water flow able to be controlled by the dam, the project should allow easier and safer navigation of the Yangtze. Raised water levels above the dam enable more and larger ships to navigate further upstream than before. To do so they have to by-pass the dam itself via massive five-step locks. Two of these have been built on the left bank and are designed to take barges of up to 10,000 tonnes. By the completion of the project there should also be a one-way shiplift able to lift 3,000 tonne ships in one step.

The Three Gorges Dam Project is easily the world's largest HEP scheme in terms of both size and power generation. In 2003 the first electricity from the new power stations on the left bank of the river was generated, followed in 2007 by electricity from the right-bank generators. In 2011, when all 32 generators – including 6 underground stations – should be completed and operating to full capacity, it is hoped that they will provide 10% of China's electricity needs. Twenty-eight cities will be supplied by the project including Chongqing (above the dam) and Shanghai (on the coast). China currently produces 80% of its electricity from coal. Hydro-electric power from the Three Gorges Dam is the equivalent of 50 million tonnes of coal a year, so it should help reduce pollution, especially harmful greenhouse gas emissions produced by burning fossil fuels.

Problems

The dam is already having a positive impact on flood control, navigation and power generation, but it has also caused problems. Some have already had major effects, whilst others may cause future difficulties.

The main purpose of the dam is to control flooding (although flooding from tributaries downstream will still take place). However, this can only happen by keeping levels in the reservoir low enough during high-risk times to store floodwater. Water levels could have an impact on how much HEP can be generated. Another major concern is the likely silting-up of the reservoir behind the dam. The Yangtze used to carry over 500 million tonnes of silt every year. Up to 50% of this is now deposited behind the dam, and could quickly reduce the storage capacity of the reservoir. Decreased silt and sediment downstream will cause increased river and coastal erosion. This is shrinking the wetlands at the mouth of the Yangtze near Shanghai, the winter home of 95% of the remaining population of the endangered Siberian crane, at a rate of 4 km^2 per year.

The water in the reservoir is becoming heavily polluted, from shipping and waste discharged from cities, eg Chongquing pumps in over 1 billion tonnes of untreated waste per year. Toxic substances from factories, mines and waste tips submerged by the reservoir are also being released into the reservoir, eventually moving downstream as water is released through the dam.

The extent of the impact on the environment and specific ecosystems like the wetlands is only just being seen. Altering the natural flow of the Yangtze has contributed to the decline of the *baiji* or Chinese river dolphin, thought to have become extinct in 2006. With less fresh water and sediment reaching the East China Sea, especially during the summer, fish stocks may decline as the number of phytoplankton they feed on falls. Deforestation, both during the construction of the dam and afterwards to provide land for people displaced by the project, has affected local habitats and increased surface run-off into the reservoir, therefore increasing siltation.

Although the Yangtze can now be navigated by larger ships further upstream, the increased traffic has frequently caused long delays at the new five-way locks around the dam – sometimes for several days. There have also been technical difficulties with the planned shiplock.

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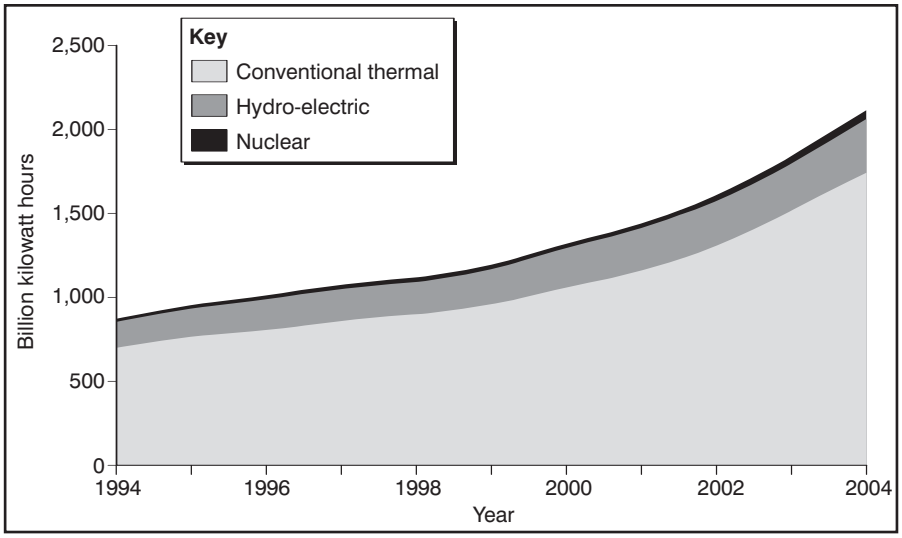

Figure 4: **Electricity generation in China, 1994–2004**

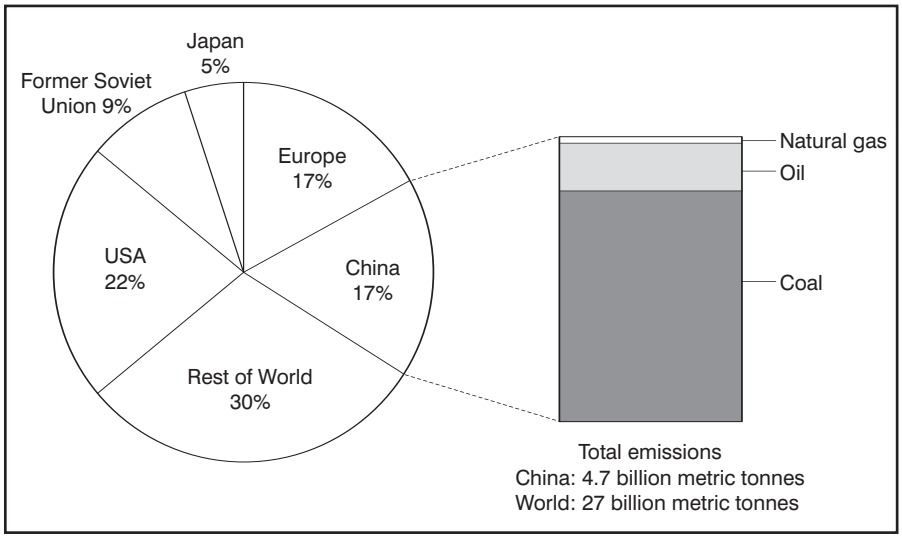

Figure 5: **Carbon dioxide emissions from the consumption of energy, 2004**
Source: EIA International Energy Annual

Most controversially, at least 1.4 million people were forcibly moved from their homes to accommodate the dam, reservoir and power stations. Those displaced were promised compensation for their losses, plus new homes and jobs. Many have not yet received this, and recent newspaper articles in China have admitted that so far over $30 million of the funds set aside for this has been taken by corrupt local officials. The money has been used to pay debts, provide wages for staff who don't exist and given to people not affected by the development. The reservoir has also flooded fertile agricultural land and over 8,000 historical sites and monuments, including the famous Zhang Fei temple.

A further problem concerns the location of the dam in a tectonically active region, where earthquakes and landslides are common. Whilst there have been no major events so far, any earth movement close to the dam and reservoir could have disastrous results.

During the construction of the Three Gorges Dam, economic growth in China has been far more rapid than predicted. The resulting increase in demand for energy means that it is unlikely to provide the 10% of electricity originally estimated (Figure 4), meaning that China will continue to rely on coal to produce most of the electricity it needs.

Acid rain from thermal power stations (mainly coal) already affects a third of China which has 15 of the world's 20 most polluted cities. Exempt from the emissions reductions put in place by the Kyoto Protocol, it is predicted that it will soon overtake the USA as the leading producer of carbon dioxide emissions (Figure 5), and there is increasing pressure on China to produce clean energy. This is planned via the construction of more large-scale HEP schemes and other renewable energy sources, but China needs to find further ways of reducing its total carbon dioxide emissions. However, given the increasing demand for energy, there is unlikely to be a major reduction in fossil fuel use in the near future, despite the introduction of new laws on renewable energy by the government in 2006.

Conclusion

One of the world's largest and most controversial multi-purpose river management schemes, the Three Gorges Dam Project has already had major social, economic and environmental impacts on the country and will continue to do so in the future. Despite this, it is likely to be the first of many such massive schemes, eg four new dams are planned along the Yangtze and its tributaries, including one that will flood the spectacular Tiger Leaping Gorge.

As China continues to develop its economy, the need to provide power, transport and water for a population eager to enjoy the benefits of increased prosperity will continue to increase. However, with such a vast population, this demand will place a huge strain both on its own and on global resources.

Activities

1 Explain what is meant by the terms:

- *siltation*
- *displaced*
- *phytoplankton*
- *multi-purpose river management scheme.*

2 (a) What was the main reason for building the Three Gorges Dam?
(b) Why was this so important?

3 Use the information from Figures 2 and 3, and a large copy of the outline in Figure 6 below, to draw a detailed timeline for the Three Gorges Dam Project.

4 Why is the generation of electricity from the dam via hydro-electric power so important to China?

5 (a) How has the project affected the flow of the River Yangtze?
(b) What problems has this created?

6 (a) Make a large copy of the small table (right). Use it to summarise the different social, environmental and economic impacts that the building of the Three Gorges Dam has had / may have in the future. To begin, place each of the six impacts below in the correct space (one in each space), and then add any others you can think of.

Location	
Size	
Population	
Main industries	
Other features	

Figure 7: **Framework for Chongqing factfile (Activity 10)**

Over 1.4 million people displaced

Caused wetland areas to decrease

HEP (compared with coal) reduces carbon dioxide emissions

Provides safer navigation for shipping

Silting could reduce amount of HEP produced

New homes provided

	Advantages	Disadvantages
Social		
Environment		
Economic		

(b) With reference to your completed table, who are the biggest losers and the biggest winners? Explain your answer.

7 Why is the Three Gorges Dam Project described as 'controversial'?

8 Study Figure 5.
(a) Describe and compare the figures shown for Europe, the USA and China.
(b) Why is China predicted to become the leading emitter of carbon dioxide in future?

Research/extension

9 Find out in detail why China was exempt from the Kyoto Protocol.

10 Compile a factfile for the industrial city of Chongqing. You could use a framework like the one in Figure 7 above.

11 Undertake your own online research into other planned schemes for the Yangtze.

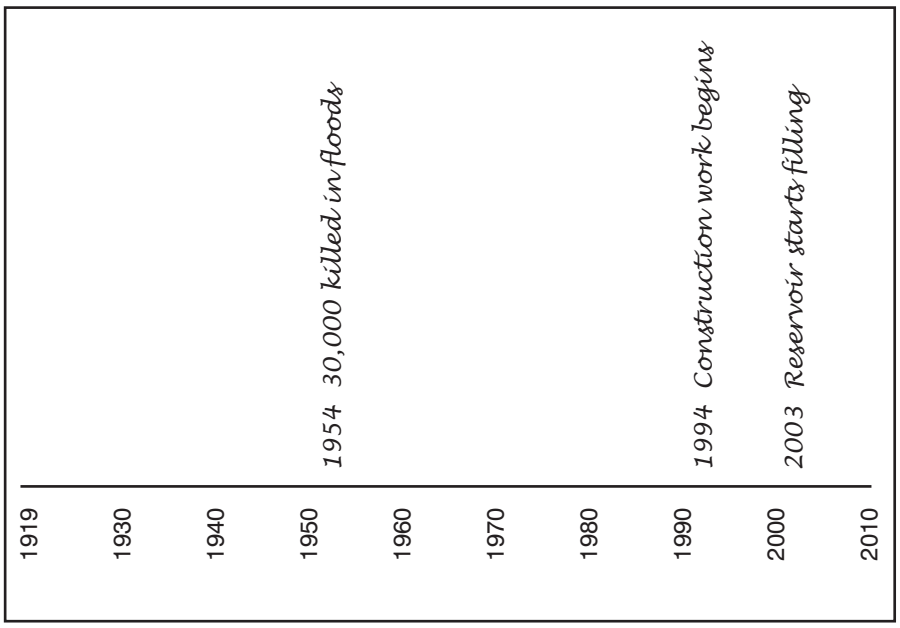

Figure 6: **Timeline for the Three Gorges Dam Project (Activity 3)**

Some useful web links

International Rivers Network: www.irn.org/programs/threeg/

China Three Gorges Project: www.ctgpc.com/

Travel China Guide Photo Gallery: www.travelchinaguide.com/picture/yangtze/three_gorges_dam/index.htm

Three Gorges Probe: www.three-gorgesprobe.org/tgp/index.cfm

Chongquing: www.chongqing.org/

China - Energy Information Administration(EIA): www.eia.doe.gov/emeu/cabs/China/Background.html