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The environmental changes and mitigation actions in the Three Gorges Reservoir region, China

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ABSTRACT

The Three Gorges Dam (TGD) is by far the world's largest hydroelectric scheme. Due to its unprecedented magnitude, the TGD has been controversial ever since it was proposed in the early 20th century and building commenced in 1993. Recent problems, including geological disasters (e.g., landslides) in the uplands and algal blooms in the aquatic environment since the reservoir's partial filling to 156 m in 2006, suggest that the environmental challenge has never been greater than now. The environmental deterioration might be further intensified when the reservoir reaches its final water level of 175 m. Solving the environmental challenges will be essential for the sustainable development of the Three Gorges Reservoir region (TGRR), and environmental sustainability in the TGRR is a high priority for the nation considering its critical location in the Yangtze Basin, which contributes 40% of China's GDP. This article reviews primary environmental assessments for biodiversity conservation, the water environment, water level fluctuation zone, and the uplands after the partial filling in the reservoir region. It also discusses the success of mitigation efforts to date. Although there are successes in mitigation particularly in conservation of endangered plants and fishes, it seems likely that environmental conditions in the TGRR could only get worse in the short term. Building a partnership among the TGD stakeholders, including local residents, governments, and international communities is necessary to meet the mounting environmental challenge in the TGRR and beyond.

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1. Introduction

Sun Yat-Sen first proposed that a series of large dams be built in the Yangtze River in his 1919 article "The International Development of China", and it remained an aspiration for China over the 20th century. Since the 1930s, a number of feasibility studies were undertaken for constructing a large dam in the upper reach of the Yangtze River even after the China's revolutionary governmental transition in 1949. From 1958 to 1984, China built the Lushui Dam in Chibi City, about 110 km south of Wuhan City of Hubei Province, and conducted

a variety of small-scale experiments and technical tests for a big dam in the Yangtze River. The Gezhouba Dam, built 38 km downstream of the current Three Gorges Dam (TGD) site between 1970 and 1988, essentially concluded the final tests before commencing building the TGD.

The TGD, begun to be built in 1993 and completed in 2009, is by far the world's largest hydroelectric scheme. It is designed to help control floods and improve navigation on the Yangtze River, and perhaps more importantly increases China's energy supply for its rapid economic development. The dam is a concrete gravity type with a height of 185 m and total water storage capacity of 39.3 billion m³. Its flood control capacity is

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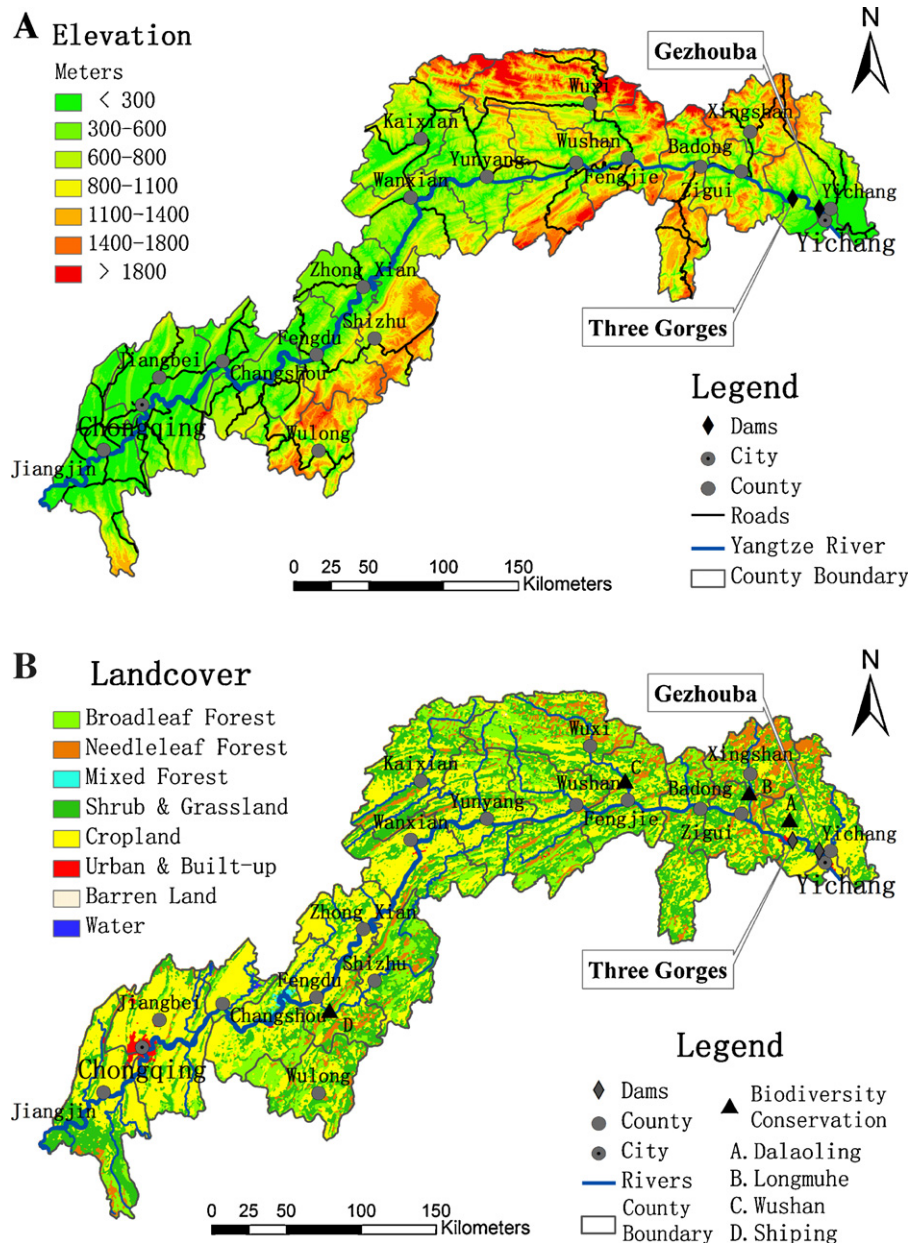


Fig. 1 – The Location of the Three Gorges Dam, the Gezhouba Dam and the Three Gorges Reservoir Region (TGR), China. (A) DEM and roads and (B) land use and land cover and locations for biodiversity conservation networks.

22.1 billion m^3 , increasing the flood control ability from the present 10-year to a 100-year frequency flood. It has installed a total generating capacity of 22,400 MW (100 billion kWh), equivalent to consumption of more than 60 million tonnes of raw coal annually, dramatically increasing energy supply for China's economic development. Meanwhile, the dam increases water depth by more than 100 m, effectively improving the navigability in the 600 km section of the Yangtze River between Yichang and Chongqing (Fig. 1A).

The TGD will form a reservoir with a total water surface area of 1080 km^2 in the Yangtze River between Chongqing and Yichang. The region surrounding the reservoir, with a total area of approximately 58,000 km^2 , has now become known as the Three Gorges Reservoir Region (TGR) (Fig. 1). Due to its unprecedented magnitude, the TGD has been controversial

ever since its implementation. A comprehensive environmental impact assessment was conducted in the 1980s (RCEETG, 1987), and many of the predicted environmental problems have been realized recently by the partial filling of the reservoir in the past 5 years (RCEETG, 1987; Shen and Xie, 2004; Wu et al., 2004; Liu et al., 2006a,b; Xu et al., 2006; Zhang et al., 2006). Systematic monitoring since 1997 have also provided the evidence of environmental changes in the TGR and downstream of the Yangtze Basin (<http://www.tgenvironment.org/>).

Solving the environmental challenges surrounding the TGD will be essential for the sustainable development of the TGR and remains a high priority for the country as well. However, any efforts will have to rely on the determination of the environmental changes in the region that are due to the

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