



Green economic practices of the Three Gorges Project

Basic information about the case

Name of case: Green economy practices of the Three Gorges Project

Type of case: Water technology

Region: Asia, China

The approach

The Three Gorges Hydropower Complex Project, commonly known as the Three Gorges Project (TGP), is the essential backbone engineering project for rectifying and developing the Yangtze River, producing significant integrated benefits, including flood control, power generation, and navigation facilitation. The TGP was a century-old cherished dream of the Chinese nation. It's an iconic project whose feasibility was studied vigorously for almost a century and which represents the highest level of China's existing technology development and integrated management expertise.

Technological Innovations: The TGP is built on the strength of advances in science and technology, and has, in turn, driven the advancement of science and technology. The project construction has led to the establishment of more than 100 sets of quality standards and technical codes, over 700 patents, 14 National Awards for Advances in Science and Technology, and more than 200 Provincial or Ministerial Awards for Advances in Science and Technology. Moreover, a number of world records have been set in river closure, deepwater earthwork cofferdam construction, rapid roller compacted concrete cofferdam construction, continuous high-intensity concrete placing, temperature control and crack prevention in massive concrete blocks, and installation of large-scale turbine generating units. The project's operations are also based on advances in science and technology, as reflected by the project's hydrological forecasting system, the optimized operations of the project's five-stage ship lock, and research on optimized reservoir operations.

Evaluation: economic, social and environmental impacts

Economic development

Since the commencement of the operations of its first batch of generating units in July 2003, the Three Gorges Hydropower Plant has produced a cumulative total of 450 billion kWh of electricity (as of the end of 2010), equivalent to one-tenth of China's total power production in 2009, contributing tremendously to the rapid growth of China's economy. Water storage in the Three Gorges Reservoir has also strongly facilitated navigation along the Yangtze River and the development of the regional economy.



Environmental impact

The TGP's environmental impact is complex. Research on the impact started in the 1950s. In 1992, researchers published *The Report on the Assessment of the Environmental Impact of the Three Gorges Hydropower Complex*, which was subsequently accepted by the National Administration of Environmental Protection. The report covered local climate, quality and temperatures of the river, environmental geology, land plants and vegetative covers, land animals, aquatic organisms, potential reservoir sedimentation, potential scouring of the lower course of the waterway, potential impact on the lake district on the plains in the middle reaches of the river, estuary environment, potential impact of reservoir inundation on the environment, residents, natural landscapes and cultural heritage sites, impact of project construction on the environment, and other environmental issues of public concern (including whether the project would increase the risks of floods in the upper reaches of the river and threaten species and habitats, how to prevent soil erosion in the upper course of the Yangtze River, what shelter forest systems would be required to buttress the upper and middle reaches of the river, and whether the dam has the risk of collapse).

In accordance with the environmental impact assessment report, the Chinese government has raised funds through various channels, and all segments of society (including government agencies, business enterprises, and social groups) have been making concerted efforts in the TGP's ecological and environmental protection. In the reservoir area, systematic geological hazard prevention and mitigation works have been carried out, joint monitoring and prevention systems have been instituted, and water pollution prevention and treatment programs have been launched in the reservoir area and in the upper reaches of the river. At present, 49 percent of household sewage and 70 percent of waste in the towns in the reservoir area receives treatment, higher than the national average. Various biodiversity protection programs have also been launched. And the trans-regional, cross-sectoral, multidisciplinary and multifaceted TGP Ecological and Environmental Monitoring System has been operating with high efficiency since its inauguration in 1996. Data collected by the monitoring system has laid a solid foundation for the ecological and environmental protection in the middle and lower reaches and estuary of the river.

Poverty reduction

Funding for the resettlement of residents relocated for the TGP, dedicated domestic air programs for the affected areas, and the facilitation of navigation along the Yangtze River have created opportunities for transforming the mode of economic growth in the reservoir area and for lifting local residents out of poverty and improving their living standards. By taking advantage of resident resettlement and town reconstruction, the Three Gorges Reservoir area has engaged in structural adjustment, significantly transformed its model of economic growth, further upgrade





and optimized its the structure of its economic sectors, and constantly optimized its economic structure. In 1996, agriculture, industry and service accounted for 29 percent, 40.4 percent and 30.6 percent of the reservoir area's economy, with agriculture remaining a sizable portion of the local economy. The development of the TGP has helped speed up industrialization in the reservoir area, the industrial sector as an engine of growth has been playing a stronger role in driving local economic growth, and the service sector has grown by leaps and bounds, accounting for a rising proportion of the local economy. In 2009, non-agricultural sectors accounted for 87.5 percent of the reservoir's economy, up 16.5 percentage points from 1996. Also in 2009, industry became a pillar of the local economy, accounting for 54.3 percent of the local economy, up 13.9 percentage points from 1996; thus, agriculture, industry and service made up 12.5 percent, 54.3 percent and 33.2 percent of the local economy, respectively. In the same year, the area's GDP hit RMB 276.466 billion, representing a 515 percent growth from 1996 and an average annual growth of 12.1 percent; and per capita GDP surged to RMB 19,518, up 524 percent from 1996, but remained far below the national average. Nevertheless, in terms of development foundation and starting conditions, the area's economy has been quickly catching, narrowing the gap with the nation's average level. Moreover, education, public health and culture in the area have significantly advanced, and a large number of high-standard schools, hospitals and cultural establishments have been built.

Flood control and disaster reduction

The Three Gorges Reservoir has a flood storage capacity of 22.15 billion cubic meters, and is therefore able to effectively control floodwaters from the upper reaches of the river and reducing flood crests in the middle and lower reaches of the river, thereby providing a protection against flooding. With the TGP in operations, the embankments in the middle reaches of the Yangtze River and along the main course of the river are now able to withstand floods of a magnitude that occurs once every 100 years, compared with its previous ability to withstand floods of a magnitude that occurs once every 10 years, thus protecting the areas across the Jing River from devastation and ensuring the safety of the 20 million residents and 1.533 million hectares of farmland in the Jiangnan Plains and towns along the river. In the event of floods of a magnitude that occurs once every 1,000 years or floods of the magnitude of the catastrophic flood of 1870, the TGP, along with floodwater diversion facilities on the Jing River and other floodwater diversion and impoundment works, can ensure the safe passage of floodwaters through the Jing River, reduce the risk of the Dongting Lake area being flooded by the Yangtze River, save the 75 million residents, 6 million hectares and large and medium-sized towns in the 126,000-square-meters plains in the middle and lower reaches of the river from inundation, and avert flooding and environmental deterioration and epidemics arising from and floodwater control measures.



In June 2006, the RCC cofferdam was successfully removed and the Three Gorges Dam started blocking water across the river. In early November 2008, trial water impoundment in the Three Gorges Reservoir hit 172.8 meters, ushering in the TGP's functions of flood control. In late July 2007, the TGP successfully conducted its first proactive flood control operation, impounding a total of 1.043 billion cubic meters of floodwaters and clipping the flood crest by nearly 5,100 cubic meters per second. In late July 2008, in a flood control operation that reduced the flood crest by 52,500 cubic meters per second, the TGP held back downward flows by 48,000 cubic meters per second, and impounded 1.334 billion cubic meters of floodwaters. In 2009, the TGP clipped the flood crest by up to 15,000 cubic meters per second. In 2010, the Three Gorges Reservoir conducted seven flood interception operations, impounding a cumulative total of 26.43 billion cubic meters of water, and clipping the flood crest by up to 30,000 cubic meters per second; as a result, water level dropped by as much as 2.5 meters at the Shashi Station and at least one meter at the Chenglingji Station. During the entire flood season, the water level at the Shashi Station on the Jing River never rose above the warning level, thereby ensuring the safety of the middle and lower reaches of the Yangtze River.

Reduction of Greenhouse Gas Emissions: As a form of clean energy, hydropower production can help reduce greenhouse gas emissions. From July 10, 2003, when the Three Gorges Hydropower Plant's first generating unit was integrated into the power grid for operations, to December 31, 2010, the TGP produced approximately 450 billion kilowatt-hours of electricity; if the same amount of electricity were produced by coal firing, about 380 million tons of carbon dioxide would have resulted. Water shipping is also the most energy efficient mode of transport and can save huge amounts of energy, thereby contributing further to the reduction of carbon dioxide emissions. With the improved navigational conditions between Yichang and Chongqing on the Yangtze River as a result of water impoundment by the TGP, shipping costs along this segment of the river have dropped by 35 to 37 percent, and the unit energy consumption has decreased by 46 percent per ton of goods. Water replenishment by the TGP during the dry season has also significantly improved navigational conditions on the segment of the river downstream of Yichang. From June 16, 2003, when the Three Gorges Ship Lock began trial operations, to the end of 2010, a total of 443 million tons of cargos passed through the dam, with about 361 million tons going through the ship lock. The amount of cargos passing through the Three Gorges Ship Lock during that period of time was more than double the 210 million tons of cargos passing through the Gezhouba Ship Lock over the 22-year period from June 1981 to June 2003 prior to the TGP's water impoundment.

Ecological Water Replenishment: Since its initial phase of water impoundment, the Three Gorges Reservoir has been replenishing water in the lower reaches of the river during dry seasons, thereby improving water quality and navigational conditions, reducing salinization at



the estuary, and increasing water supply for industry, agriculture and other sectors in the lower reaches of the river. From 2006 to 2010, the Three Gorges Reservoir supplied more than a cumulative total of 27 billion cubic meters of water to the lower reaches of the river. For 107 days from January 1 to April 11, April 18 to April 20, and December 29 to December 31 in 2010, the Three Gorges Reservoir supplied 12.19 billion cubic meters of water for navigation facilitation and ecological water replenishment, averaging 1,477 cubic meters a day and increasing the average depth of the waterway by about 0.47 meter. This significantly improved the productive, household and ecological water consumption and navigational conditions in the middle and lower reaches of the Yangtze River.

Aside from fully harnessing hydro-energy resources, the TGP has also made painstaking endeavors to eliminate poverty, reverse ecological damage, preserve biodiversity, and reduce greenhouse gas emissions, scoring remarkable achievements. It has explored paths to eco-friendly utilization of water resources for the green economy as well.