

A Policy Review on Sustainability and the Three Gorges Dam in China

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Abstract

The construction of large dams has become a controversial environmental issue around the world. The Three Gorges Dam on the Yangtze River in China is by far the largest hydroelectric power plant in the world. Supporters of the project argue that it would help control catastrophic flooding along the Yangtze River, provide much-needed electricity to the central region of China along the river, and enhance the economic advantage of the interior. The most important role is for the dam to act as an important power station and reservoir in the middle and lower reaches of the Yangtze River, as it will not only solve natural disasters, such as floods and mudslides, but also promote economic development in the middle and lower reaches of the Yangtze River through power generation. The dam is also intended to protect millions of people from periodic flooding along the Yangtze River, although there has been debate about its effectiveness. However, the dam has also caused damage to ecological and wildlife habitats, archaeological and cultural sites, and the displacement of millions of people.

Keywords: Three Gorges Dam, hydropower, infrastructure, environmental impact

1. Brief Introduction

1.1 Research Background

The Three Gorges Dam is located in the middle of the Yangtze River, China. Its main function is to undertake hydropower generation and distribution of the whole middle reaches of the Yangtze River. The dam, which is 7,660 feet long with a maximum height of 607 feet, was started in 1992, and the main part was completed in 2006. The dam, which forms a huge deep-water reservoir in the Yangtze River, generates an average of 22,500 MW of electricity per year, making it the most productive hydroelectric dam in the world (Petruzzello, 2021). Figure 1 shows the location of the dam (Figure 1). However, due to its huge scale and consequent environmental and social issues, the project has become one of the most controversial projects in China (Xu et al., 2011).

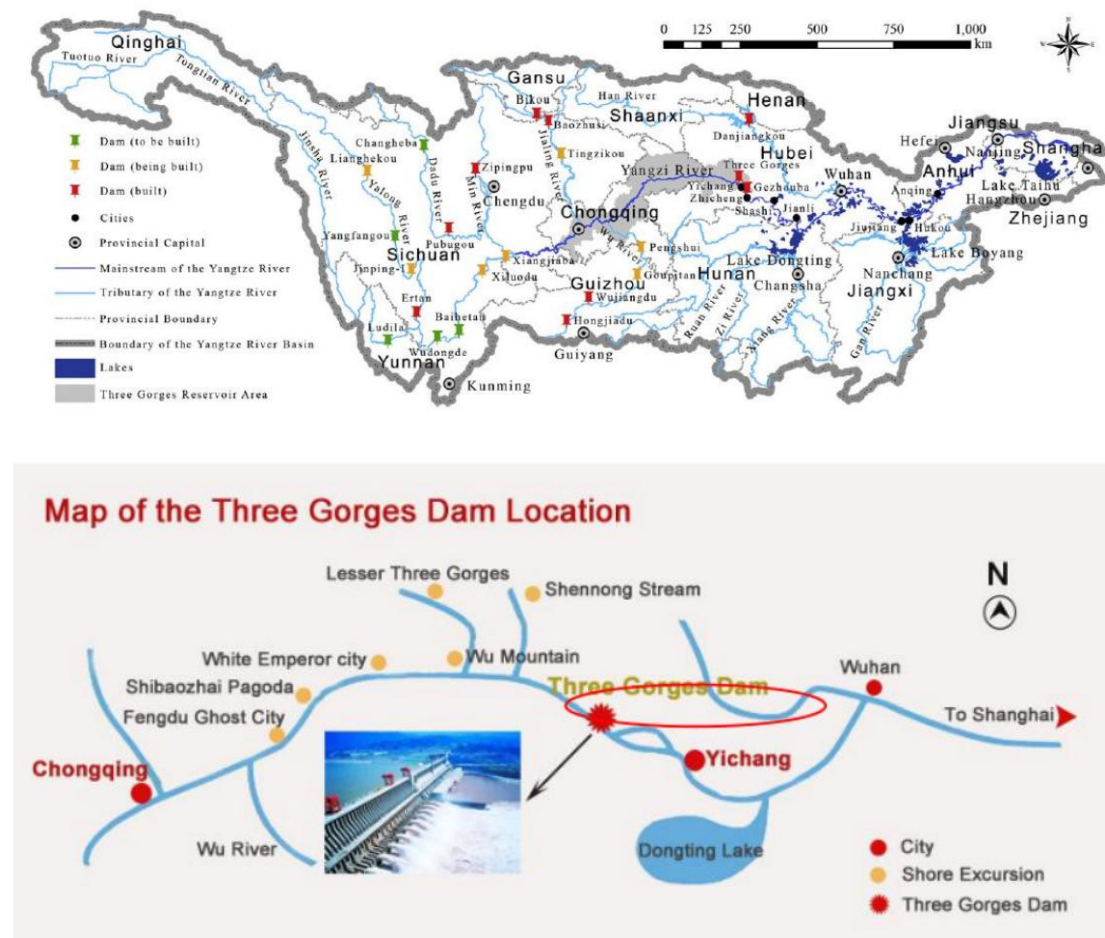


Figure 1. The Yangzi River Basin and large dams, including the Three Gorges reservoir area (Xu Tan & Yang, 2013)

1.2 Policy Context

Before the construction of the Three Gorges Reservoir, the Three Gorges region of China was prone to geological hazards. Due to the unique topography of the Yangtze River Basin, it has been frequently threatened by natural disasters, such as floods. Since the beginning of the 20th century, cities along the basin have frequently reported secondary disasters and economic losses caused by extreme weather events, such as rainfall. Although more than 90 years ago, Chinese leader Sun Yat-sen proposed solving the problem of disasters in the middle and lower reaches of the Yangtze River, the project had not been carried out smoothly due to the financial and technical pressure of the government at that time (Ponseti & Lopez-Pujol, 2006). After 1949, the Three Gorges Dam became a political task for the newly established Communist government due to the dam's critical role in water storage and power generation in order to control floods and develop industry. Until the implementation of the reform and opening-up policy in 1984, China's policy orientation began to focus on modernisation and economic development, emphasizing that the reform of the market economy must generate more electricity to promote economic growth. A devastating flood in 1991 (about 3,000 people died) motivated the dam's proponents to stress the urgent need for such infrastructure for further flood prevention (Ponseti & Lopez-Pujol, 2006). However, it was not until 1992 that China's National People's Congress formally approved the "Resolution on the Construction of the Three Gorges Project on the Yangtze River", marking the conclusion of a decades-long debate among Chinese leaders over dam projects to support the world's largest river (Chang et al., 2018).

2. Main Components of Policy

2.1 Strategic Objectives

The National People's Congress officially approved the project in 1992. The main strategic objectives of the project are: (1) flood control for downstream residents; (2) the provision of energy and large amounts of hydroelectric power; and (3) improved water navigation (Tullos, 2009; Rouch, 2019).

By nature, China's vision of a big hydropower push is not only about the benefits of clean energy and efficiency.

The completion of a giant dam could also provide critical infrastructure for safe and reliable basic services, such as food, water, energy, transportation, and electricity. These functions can be interdependent and interrelated (Li et al., 2015). It can be said that dams are part of China's industrial development plan. Many economies, industries, and daily lives depend on hydroelectric dams, which are critical infrastructures. The Chinese government hopes the dams will help stimulate rapid economic growth in the short term, driving commerce and orders for decades to come. The most important thing is to improve the quality of life through the services that such a critical infrastructure can provide and change backwardness.

Further, hydropower plays an important role in energy transition (World Bank, 2017). As Figure 2 shows, most of China's electricity comes from fossil fuels. However, hydroelectric generation, as one of the major energy facilities, can provide a large amount of alternative renewable electricity. A clean fuel source does not pollute the air as power plants that use fossil fuels such as coal or natural gas. In recent decades, the Chinese government has advocated for promoting green development and lifestyle in an effort to better balance economic growth and environmental protection. This is part of a broader plan to utilise water resources for development and is good for achieving China's strategy to support sustainable development.

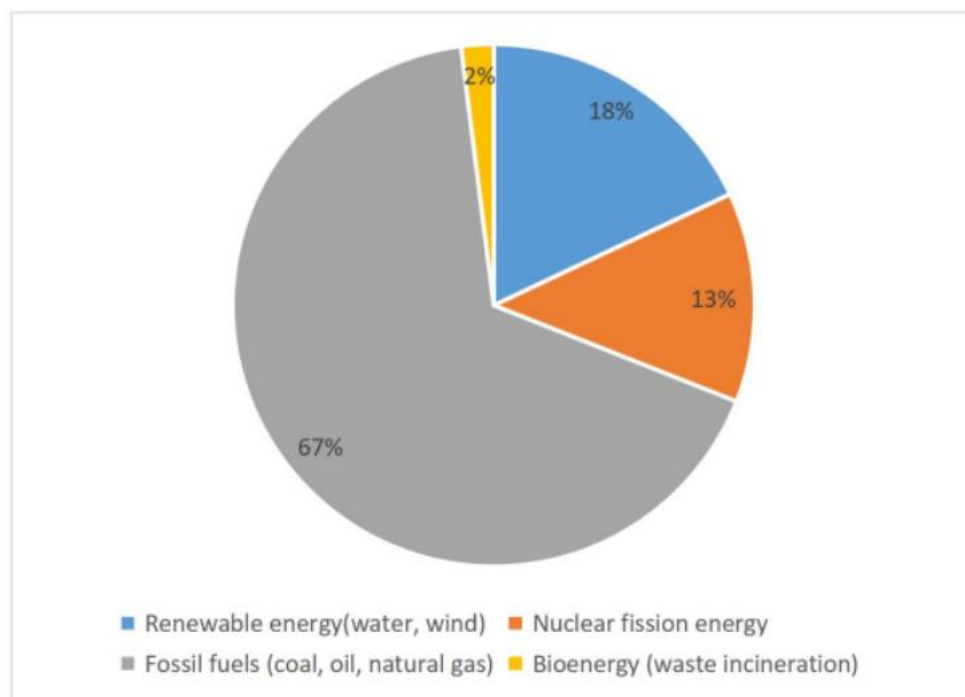


Figure 2. Proportion of energy generated in China (Goncalves, 2018)

2.2 Expected Outcomes

The Three Gorges Dam is an ambitious infrastructure target through which China dreams of effective river flow control and changing the hydrology of the Yangtze basin. The main objectives of the scheme are:

- (1) Since the reform and opening-up policy, China has been committed to the steady growth of hydropower development, in which the 12th Five-Year Plan (2011-2015) set a hydropower target of increasing installed capacity from about 200 GW to 260 GW, a 30% increase. The share of hydropower generation was expected to increase from about 19% in the late 1990s to 40% by 2015 (McCormack, 2001).
- (2) After the reform and opening up, market-oriented economic reform policies emphasised the need to produce enough electricity to promote economic growth. As the first-order policy of China's expected economic development after the war, the dam plan is expected to bring economic benefits of more than 20 billion yuan per year to coastal areas (Jackson & Sleigh, 2000).
- (3) The Three Gorges Dam will be the most reliable energy supplier in China in the future. It is estimated that 10.3 trillion gallons of water will be reserved annually for strategic storage and irrigation use. The government considers the dam to be meeting its goal of producing pollution-free electricity, which is expected to meet 10% of China's electricity demand in the future (Yang & Lu, 2013).
- (4) The dam supports achieving economic balance and addressing social inequality. Over the past 30 years,

China's economy has grown by 10% per year (World Bank, 2017). However, China's economic development has a spatial component, and the industrial and manufacturing industries in coastal special economic zones contribute to more than 70% of the national GDP (Zheng, 2015). To address this imbalance, the government plans to divert industrial production and new sectors of the economy to less developed inland areas of the Yangtze River through tourism and trade.

3. Discussion of the Research Results and Critical Evaluation

3.1 Institutional Arrangements

Throughout the 20th century, China's political leaders regarded dams as symbols of the country's industrialisation and modernisation. The value orientation of the Communist Party's charging of nature plays an important role in this political view. Throughout Chinese history, the political vision of building infrastructure has been regarded as a political measure to enhance economic strength, strengthen political power, and maintain rule. After the founding of the People's Republic of China in 1949, dam construction became an important development direction as a policy to promote rapid economic growth and industrialisation. This view is not limited to China; the idea of people controlling nature for economic benefits is still evident all over the world (Beckett, 2016).

Further, unlike other countries, the highest decision-making institute in China is the central government; thus, the final decision to build a dam depends largely on the direction of the central and Communist authorities. Figure 3 shows the decision-making process for the Three Gorges Project. This means that the dam is under the control of the most authoritative and powerful institutions in China, and is sufficiently feasible and efficient from final decision to implementation to project delivery. Arguably, the dam is a demonstration of China's "reform and opening up" policy, as well as an example of a lack of transparency and debate, autocratic decision-making, and potentially unfair working conditions (Refugees, 1995).

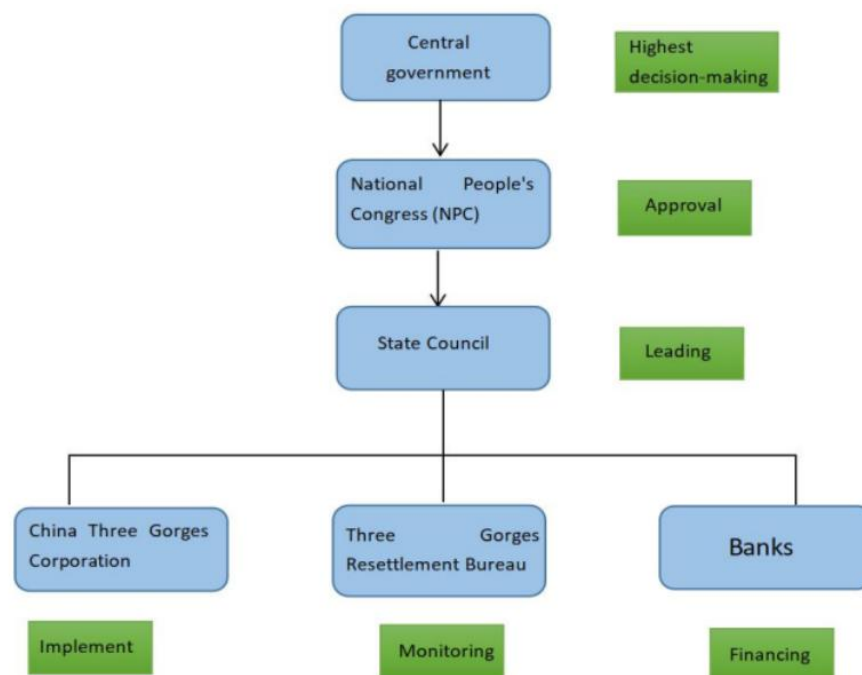


Figure 3. The decision-making process of the Three Gorges Dam

3.2 Main Output and Benefits

3.2.1 Energy Supply Innovation

China's dream of damming the Yangtze comes from three social needs: flood control, power generation, and navigation. In the mid-1980s, due to the scarcity of water conservancy facilities and power plants, power shortages forced 70–80% of factory capacity to stop operations, and urban power failure was particularly common (Ponseti & Lopez-Pujol, 2006). Although there has been talk about restarting coal-fired power generation, China's coal resources are limited, and the infrastructure associated with burning coal is highly polluting. However, as a new energy source, water power is cleaner and more efficient than coal. This will not

only reduce labour and time costs but also help solve the medium-and long-term energy shortage. Therefore, since the 1990s, large-scale projects to develop hydroelectric power have been carried out. According to statistics, the Three Gorges Dam can undertake long-distance power transmission, supplying 52% of the power produced to cities in central China (such as Chongqing) every year (Li et al., 2015). It largely meets the electricity needs of nearly a third of China's population.

Table 1. Comparison of coal and water as energy generators

	Coal	water
Labour cost	Expensive	Cheap
Environmental impact	High pollution	Cleaner
Storage	Hard	Easy
Capacity	Short-term	Middle and long-term

3.2.2 Economical Considerations

In terms of economic development and prosperity, many local people support the project due to flood control and the economic benefits it brings. First, as explained in Section 3.2.1, the Three Gorges Dam can save the cost of transporting coal from the north, which greatly reduces economic expenditure. Second, the huge amount of water storage in the dam generates significant power, which greatly improves the efficiency of the plant's power generation, and thus significantly improves the economic benefits in industries. Further, navigation is the second potential economic benefit. Dams and reservoirs will improve the navigation capacity of the Yangtze River, broaden transportation routes, and eliminate strong currents and obstacles, such as rocks and sandbars (Rouch, 2019). The water flow rate is significantly reduced, and the safety of the ship route is greatly strengthened. The second advantage of improving navigation is that it promotes tourism. After the completion of the Three Gorges Dam, it became one of the most famous local tourist attractions. As shown in Figure 4, since 2008, the dam has brought more than 2 million tourists to Hubei Province every year, with an economic benefit of 25 billion yuan (Kan et al., 2010). As a result, the Chinese government continues to view the Three Gorges Dam as a significant part of its plans for economic growth and improved living standards.

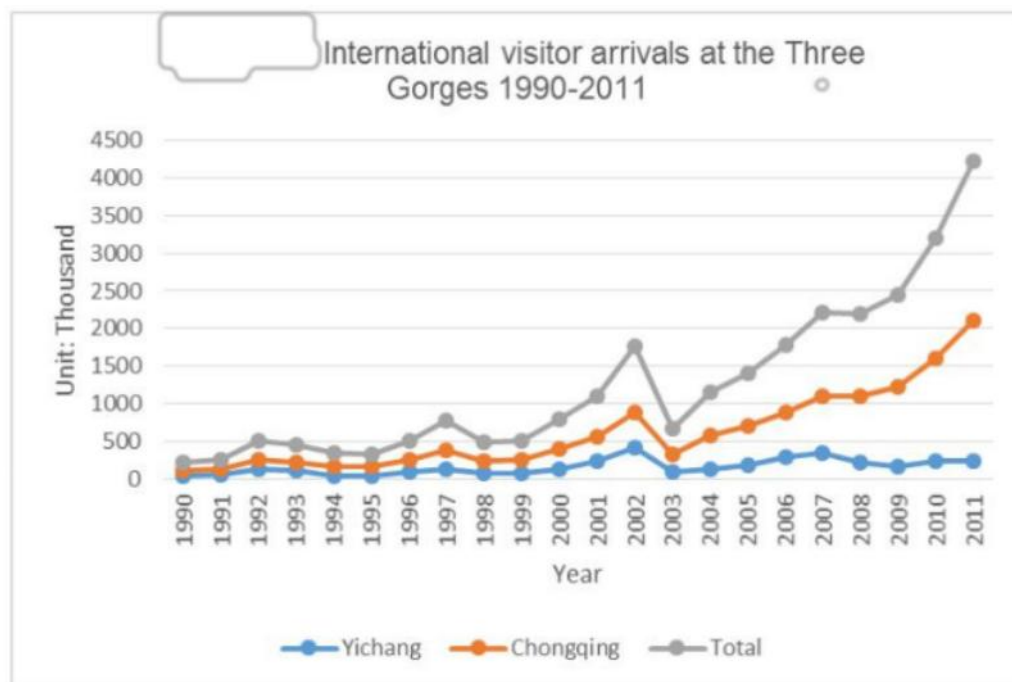


Figure 4. Trend of international visitor arrivals at the Three Gorges Dam (Kan et al., 2010)

3.3 Key Challenges and Controversies

The benefits of building the dam are significant; however, it should also be acknowledged that the project has brought about negative effects. Although the project has brought development and progress to China, many international organisations have opposed it on environmental and humanitarian grounds, and large dams have become increasingly unpopular.

3.3.1 Social Impact: Resettlement

The most immediate impact of the Three Gorges Project has been to relocate people living in flooded areas. For the smooth operation of the Three Gorges Dam scheme, more than 1.2 million residents were forced to migrate during the entire planning and implementation process (Ponseti & Lopez-Pujol, 2006). However, in addition to the instability of regional security caused by more illegal immigrants mixing into the migration team, there are also problems, such as how the government provides housing or allocations housing subsidies (Fearnside, 1988). Moreover, a large number of population transfers may affect local ethnic groups, increasing employment pressure and unemployment. The difficulties brought by migration for these people include more severe poverty and marginalisation (Beckett, 2016). Given that these populations are mainly rural, this means that they mostly live off their land, and leaving the land means displacement and declining economic conditions (see Table 2). This has raised international questions about Beijing's decisions, as the political nature of the dam seems to far outweigh its economic rewards.

Table 2. Households stating income and food production are insufficient before and after resettlement (Wilmsen et al., 2011)

Location	Before (%)	After (%)	N
Changjiang	17.5	38.6 [*]	57
Leijiaping	6.2	27.4 ^{***}	113
Both villages	10.0	31.2 ^{***}	170

Source: Household survey, 2003-2004.

Note: Before-after proportions are significantly different according to paired-sample, two-tailed t test. significance levels are ^{*}p < .05, ^{***}p < .001.

3.3.2 Negative Environmental Impact

One of the negative effects of the Three Gorges Project is that it fails to take into account environmental changes, which may have disastrous consequences for the ecosystem. It has been questioned whether the construction of large infrastructure will itself increase emissions, since the solid waste consumed by the whole plan and related projects accounted for 95% of the total carbon emissions that year (Li et al., 2018). Furthermore, the project will have a significant impact on both upstream and downstream communities and ecosystems, destroying biodiversity. Further, dams change wildlife habitats, leading to the destruction of animals and plants in some areas (Li et al., 2018). The dam has seriously damaged the riparian ecosystem. According to the research, the total number of fish fry in the Yangtze River declined by about 90% in 2008. The main reason for this is that dam operation changes the flow status and affects wetland maintenance, as well as the migration and spawning of fish (Cheng et al., 2018). In addition, if the rising water level around the reservoir causes the land to flood, it will change the regional ecological environment. Moreover, if the original ecological structure is destroyed, the reservoir may induce earthquakes or other geological disasters.

4. Key Stakeholders and Policy Actors

4.1 State and Local Government

Unlike in many countries, the decision-making power in China ultimately rests entirely with the top leaders of the Chinese Communist Party. Despite the complex interconnection between the CPC and the central government, the central government itself is the decision-making body (Chang et al., 2018). As a result, the central government had the final say in the Three Gorges Dam decision. Some government agencies, such as the Ministry of Water Resources and the Chongqing Municipal Government, also provided constructive suggestions on the construction of the dam and were responsible for the final implementation and implementation. Local governments are responsible for receiving and managing resettlement funds from the central government. The Three Gorges resettlement bureau is in charge of immigration planning and supervision.

4.2 Infrastructure Providers

Throughout the assessment and decision-making process of the operation of the Three Gorges Dam, the State Administration of Cultural Heritage was invited to inspect the middle and lower reaches of the Yangtze River to assess the feasibility of the dam. The China Three Gorges Corporation and the Yangtze River Water Resources Commission are responsible for the coordination and operation of the dam, such as managing daily discharges from the dam. The construction and delivery of the dam are mainly undertaken by the China Three Gorges Corporation (Cheng et al., 2018) (see Figure 5).

4.3 Non-Government Actors

In the early 1990s, the Chinese government applied for loans from international organisations to build the dam. The World Bank financed half of the total investment. In addition, some investments come from the China Development Bank, China Construction Bank, and Industrial and Commercial Bank of China, as well as some foreign credit institutions (Cheng et al., 2018).

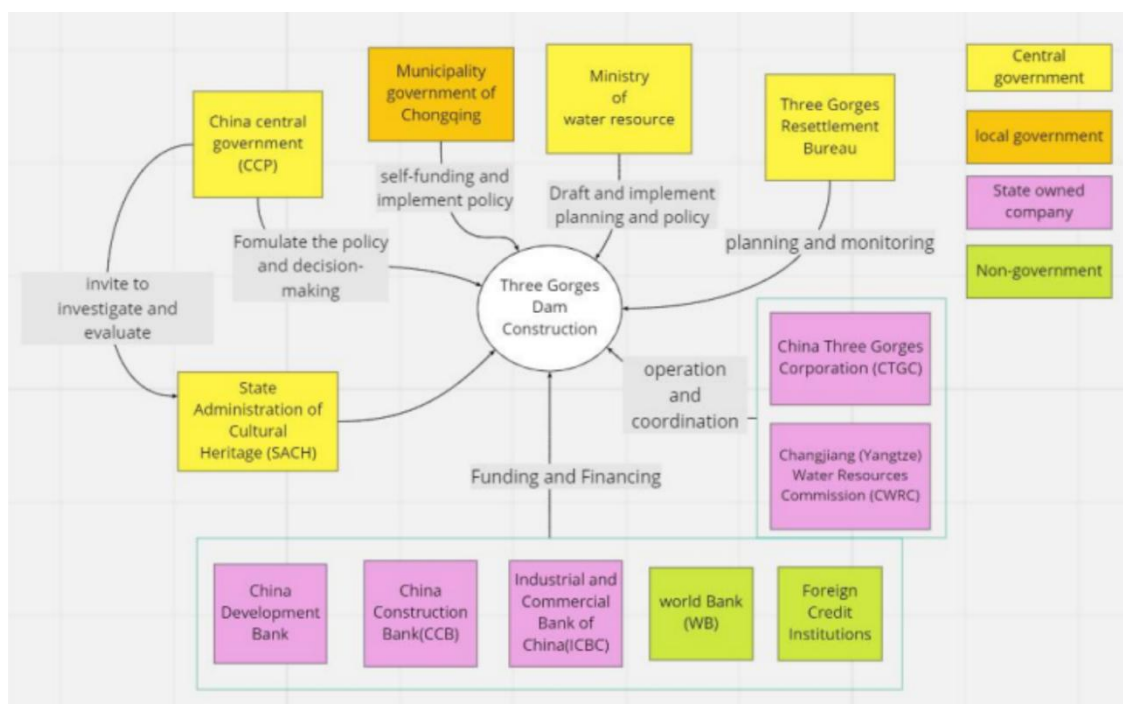


Figure 5. Key actors and stakeholders relationship for Three Gorges Dam Construction

5. Suggestions of the Research

Clearly, the Three Gorges Dam is a product of the Chinese people's increasing demand for infrastructure. Its decisions are driven by the rising standard of living of the people and the need for more critical infrastructure to develop the economy and provide the necessary domestic energy. Therefore, the main existence value of the Three Gorges Dam depends on meeting China's national development goals and people's living practices. In terms of bringing jobs and improving the quality of life for thousands of people, the Three Gorges Dam is justifiable.

The author believes that reservoir migration is a problem that cannot be ignored, affecting the development of hydropower stations in China. The government should focus on compensation to help affected migrants. It is suggested that the Chinese government set up an independent expert committee to monitor and supervise the follow-up progress of population transfer in the Three Gorges Project. The main purpose of this committee is to show the government's concern for these people, to effectively solve their housing and work problems, and to protect the interests of the people.

Further, given the environmental problems caused by dams, China could continue to develop other clean energy sources, such as solar power. The reason is that solar power is easier to obtain than water, less harmful to nature, and less costly. The author calls on China to carry out policy reforms on environmental protection and biodiversity protection in the future. At present, the dam's institutional structure is a multi-tiered model, with the State Council at the highest level. Although the dam is mainly managed by the China Three Gorges Corporation, the project is managed by at least dozens of bureaus under the State Council. Due to the similar ranking of the bureaus, they cannot force each other to implement certain policies (Yang & Lu, 2013). Fragmental management

structures lead to conflicting uses of resources, exacerbate biodiversity loss, and ineffective flood control and drought measures.

6. Conclusion

As one of China's most famous infrastructure successes, the Three Gorges Dam is one of the most challenging decisions to be made at a time of controversy. In China's unique political environment, the Three Gorges Dam is a huge political and economic task. It is the product of a complex historical background in which industrialisation, modernisation, communism, and economic development all contributed to the construction of the dam. Although the construction of large dams has become a controversial environmental issue around the world, the construction of the Three Gorges Dam will help prevent floods in the middle and lower reaches of the Yangtze River, address energy shortages, and improve the river's navigability. However, to address the current problems of ecosystems and the environment, it is still necessary for the government to reform the existing policies and support the objective integration of hydropower projects under the premise of minimising the burden on the ecosystem, society, and economy.

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