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A Study on the Three Gorges Dam's Response to the Environment Based on the Ethics of Engineering Professionalism

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Abstract

As the world's largest hydraulic engineering project, the construction and operation of the Three Gorges Dam have had a profound impact on the ecological environment of the Yangtze River Basin. As one of the most famous hydraulic projects, it has provided ideas for the construction of other projects in the industry. In this context, the Three Gorges Dam project also has certain environmental impacts; the existence of the project is likely to be detrimental to the surrounding ecological environment, and at this time, measures to address these impacts must be considered. Based on the framework of engineering professionalism ethics, this study systematically analyzes the environmental response strategies and ethical practices of the Three Gorges Project from the perspectives of its functions and construction significance, the impact of the project on the environment, and the environmental challenges posed by the dam. Finally, the environmental response of the Three Gorges Project indicates that engineering professionalism ethics need to be integrated throughout the entire lifecycle of planning, construction, and operation. In the future, long-term monitoring and dynamic assessment of environmental impacts should be strengthened, the development of climate-resilient hydraulic technology promoted, and a cross-regional ecological compensation system improved, providing a reference for the ethical practice of large-scale infrastructure worldwide.

Keywords

Engineering ethics; Three Gorges Dam; Ecological environment.

1. Introduction

The impact of current engineering activities on the environment is increasingly significant. As the core guidelines guiding engineers' behavior, engineering professionalism and ethics still face numerous challenges in environmental response practices, leading most engineering projects to have to address this issue. This study aims to introduce the connotation of engineering professionalism and ethics, coupled with a further understanding of the status, functions, and construction significance of the Three Gorges Dam project. It then discusses the impact and challenges of engineering activities on the environment, highlights the insufficiency of existing professionalism and ethical measures, and explores how to more effectively integrate ethical principles into engineering practice to achieve sustainable engineering development, that is, how to respond to the environment. The investigation of the Three Gorges Dam example not only helps enhance engineers' professional quality and moral standards, alerting engineers to consider the environment as an important factor in construction projects, but also strengthens public trust and recognition of engineering activities, promotes technological progress and innovation in the engineering field, and achieves harmony between engineering and the environment.

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Engineering ethics constrains the moral standards of every engineer, and whether to follow them is entirely up to the engineers themselves. Yao believes that China has long been influenced by traditional ethics, and that adhering to various rules also requires the supplementation of moral thinking and ethical wisdom, which modern engineers lack[1]. Qin Shuyuan believes that engineers must bear the consequences of their designs, acting as guardians of ethical responsibility and social welfare, and must assume corresponding ethical responsibilities[2]. Cong Hangqing and Zhang Wanjie believe that regardless of cultural background or practical needs, the pursuit of excellence is an inherent moral goal of engineers, and engineers should possess excellent professional virtues[3]. Cao Sizhe proposes that engineering ethics is an important component of talent development, and this issue will increasingly become a focus of societal concern, serving as a supporting force for social and economic development[4]. Meanwhile, Zhou Huan, Ling Ran, Jing Tao, Xiang Yunxuan, Lei Tao, Miao Ronge, and Yang Milun believe that engineering ethics is the concrete manifestation of ethics in the field of engineering construction, and it has great developmental potential and deep understanding in China[5].

In fact, engineering ethics is important in various fields. In elderly care facilities, Xia Xiangyu and Zheng Zhiyu hope that the relevant government departments can provide more support on multiple levels, and they also hope to strengthen the professional capability training of practitioners. These measures are of great significance for improving supporting elderly care services in residential areas[6]. In the chemical industry, Zhang Peng found that the technical characteristics and hazardous features of hydrogenation units require engineers to elevate their considerations from technical to ethical levels, necessitating attention to ethical issues when engaging in the production technology management of hydrogenation units[7]. Regarding construction in the Yellow River Basin, Zhen Yuxin and Nie Yuhang proposed the enhancement of the establishment and optimization of laws, regulations, and industry standards related to engineering ethics in water conservancy projects, in order to reduce the hazards brought by relevant constructions in the Yellow River Basin, providing case support for other engineering projects[8]. Hu Shan analyzed the steel structure collapse accident of the Hupanli project and ultimately found that the loss of professional ethics among engineers can lead to a large number of accidents; therefore, all types of personnel need to cultivate engineering ethics awareness to prevent safety incidents[9] Jin Youping, Shan Ke, and Gu Kai believe that the chemical industry should pay attention to engineering ethics issues, which is of great significance for ensuring the safety and health of workers and surrounding residents, and is conducive to enterprises solving problems in a timely manner[10].

2. Basic Information about the Three Gorges Dam

2.1. Introduction to the Three Gorges Dam

The Three Gorges Dam began construction in 1994 and is located in Yichang City, Hubei Province, situated in the Xiling Gorge section of the Yangtze River main stream, at the eastern end of the Three Gorges Reservoir. It controls a drainage area of about 1 million square kilometers and has many functions. It is the main project of the Three Gorges Hydropower Station, the core landscape of the Three Gorges Dam Tourism Area, and one of the largest hydraulic engineering structures in the world today.

It mainly consists of the main dam for water retention and flood discharge, power generation buildings, navigation buildings, and other structures. The dam body is a concrete gravity dam, with a total concrete volume exceeding 16 million cubic meters and more than 590,000 tons of steel used. The dam axis is 2,309.47 meters long, with a total length of 2,335 meters; the crest elevation is 185 meters, with a maximum dam height of 181 meters; the normal water storage level is 175 meters, with a total reservoir capacity of 39.3 billion cubic meters, including 22.15

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billion cubic meters for flood control. The total installed power generation capacity is 22.5 million kilowatts, with an annual power generation of over 100 billion kilowatt-hours. The navigation buildings are located on the left bank, with permanent navigation structures including a dual-line, five-level continuous ship lock and a single-line, single-stage vertical ship lift.

The planning for the Three Gorges Project began in the early 20th century. In 1918, Sun Yat-sen first proposed the development concept in 'Plans for National Reconstruction', and systematic surveys started in the 1950s. On April 3, 1992, the Fifth Session of the Seventh National People's Congress passed the construction decision with 1,767 votes in favor, bringing the construction of the Three Gorges Dam gradually into public view. Two years later, in December 1994, the project finally began construction, with full-line completion in May 2006 and full completion in 2009, taking a total of 17 years.

2.2. Functions of the Three Gorges Dam

2.2.1. Flood control function

The Yangtze River is the mother river of the Chinese nation, nurturing much of Chinese civilization. At the same time, it is also a river prone to flooding. Since ancient times, this river has experienced countless flood disasters, causing China to suffer significant losses. From the perspective of flood control, the Three Gorges Project has a geographically advantageous location, situated at the end of the Yangtze River Gorge area, which allows it to effectively stop upstream floods from continuing downstream. Therefore, flood control has become the primary function of the Three Gorges Dam. It controls about 55% of the Yangtze River basin area and improves the flood control capacity of the lower Yangtze by reducing flood peaks through damming. In addition, the Three Gorges Reservoir has a capacity of 22.15 billion cubic meters, which can effectively raise the flood control standard of the Jingjiang River section from a ten-year flood to a hundred-year flood, greatly reducing the threat of floods to important cities such as Wuhan and Nanjing, as well as areas like the Jianghan Plain and the Dongting Lake region.

On the other hand, if floods occur in places such as the Han River, the Three Gorges Dam project can implement peak shifting, greatly enhancing the safety of the middle and lower reaches of the Yangtze and effectively relieving flood control pressure in these areas. During the flood season, the Three Gorges Dam can store floodwater and enhance the reliability and flexibility of flood control operations in the middle and lower Yangtze, providing sufficient evacuation time for people in flood diversion areas. The flood control function also brings significant social benefits to the Three Gorges Dam, helping to prevent China from suffering more economic losses due to floods.

2.2.2. Power generation function

The Three Gorges Dam is one of the largest hydroelectric power stations in the world, with a total installed capacity of 22.5 million kilowatts and an average annual power generation exceeding 88.2 billion kilowatt-hours, and sometimes even surpassing 100 billion kilowatt-hours. Due to its powerful generating capacity, the electricity generation of the Three Gorges Dam holds an important strategic position in China's energy layout.

The generating capacity of the Three Gorges Dam is reflected in four aspects. First, the enormous electricity generated by the Three Gorges Hydropower Station can be transmitted to many places, such as Hubei, Hunan, Henan, Jiangxi, Jiangsu, Zhejiang, and multiple other provinces. Since it began generating electricity, the Three Gorges Dam has been producing electricity in a stable and safe manner, alleviating power shortages in many regions. Second, due to the dam's unique geographical location, it occupies a central position in the national grid interconnection network. This allows it to fully utilize the benefits of peak-shifting,

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compensation and regulation among hydroelectric plants, and capacity exchange between hydro and thermal power plants, enhancing both grid safety and economic efficiency. Third, the Three Gorges Hydropower Station, in conjunction with the Gezhouba Hydropower Station, undertakes tasks such as peak regulation, frequency regulation, and emergency backup for the power system. While improving electricity supply issues in many areas, it also provides reliable assurance for the safe operation of the power system. Fourth, the revenue from electricity sales is one of the main sources of income for the Three Gorges Dam, and this function brings countless economic benefits to the dam.

2.2.3. Shipping function

The Three Gorges Dam has significantly improved the navigation conditions of the Yangtze River. Before the dam was built, navigation from Chongqing to Yichang was difficult and complicated, with 109 hazardous shoals, 34 one-way navigation sections, and 12 sections where winches had to be used to pull vessels through, which severely hindered the rapid economic development of the southwest region. With the Three Gorges Dam, the river channel below Chongqing has been fundamentally improved, and in 2011, the annual cargo throughput for the first time exceeded 100 million tons. More than 20 tributaries in the reservoir area, including the Wu River, Jialing River, and Xiangxi River, have successfully extended navigable channels upstream. The shallow river sections in the middle reaches of the Yangtze also saw significant improvement. By constructing a five-level ship lock and a vertical ship lift, ten-thousand-ton fleets can travel directly from Shanghai to Chongqing, greatly reducing shipping costs while significantly enhancing the value of the Yangtze's "Golden Waterway."

In addition, navigation safety has improved and shipping capacity has been greatly enhanced. On one hand, the construction of the Three Gorges Dam has significantly reduced marine accidents in the reservoir area, with a noticeable drop in the accident rate and grounding incidents becoming very rare. On the other hand, the towing capacity per kilowatt of vessels in the reservoir has been greatly increased, with reductions in average fuel consumption and transportation costs per unit, thus improving the economics and competitiveness of water transport.

2.2.4. Water resources utilization

The Three Gorges Dam is closely related to water, so making good use of water resources is also one of the functions realized by the Three Gorges Dam. Its functions are mainly reflected in the following four aspects.

First, during the annual dry season, the Three Gorges Dam project replenishes water to the middle and lower reaches of the Yangtze River. Before the construction of the Three Gorges Dam, the average flow during the dry season from November to early April of the following year in the middle and lower reaches of the Yangtze River was only 3,000 cubic meters per second, causing a severe shortage of water for industrial and agricultural production as well as for towns along the river. Many cities also faced water scarcity problems. The successful establishment of this project solved these problems, as the reservoir capacity of the Three Gorges Dam can store a large amount of water and supply it to areas in urgent need.

Second, it timely provides extraordinary water replenishment to drought-prone areas in the middle and lower reaches of the Yangtze River. In October 2009, severe drought occurred in the Dongting Lake and Poyang Lake regions. The Three Gorges Reservoir continuously increased its discharge, effectively alleviating the drought in the two lake regions. In 2011, the middle and lower reaches of the Yangtze River experienced an unusually continuous drought throughout autumn, winter, spring, and summer; the Three Gorges Dam also replenished water resources for these areas.

Third, it controls the discharged flow and implements emergency dispatch. With this function, the Three Gorges Dam was able to strongly support the rescue operation of the 'Eastern Star'

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cruise ship in the Jiangdu section downstream and successfully evacuate 838 ships stranded due to excessive flood flows.

Fourth, it ensures the normal operation of the South-to-North Water Diversion Middle Route Project. Relevant planning in the Yangtze River basin has deeply studied the impact and countermeasures of inter-basin water diversion projects and demonstrated the feasibility of diverting Yangtze River water into the Han River to supplement the flow of the main stream downstream of the Han River.

2.3. The significance of the construction of the Three Gorges Dam

2.3.1. Flood control and disaster reduction and energy supply

The Three Gorges Dam has achieved a significant reduction in flood peak flow by storing and regulating upstream water, effectively lowering flood levels in downstream river courses and greatly alleviating flood control pressure in the middle and lower reaches of the Yangtze River. The Three Gorges Project has built a solid defensive line for the safety of the lives and property of millions of people along the river. In addition, over the past 20 years, the Three Gorges Project has held back floods 53 times, with a total flood storage of over 210 billion cubic meters, preventing millions of military personnel and civilians from having to 'defend the embankments to the death.'

Besides flood control, it also provides a large amount of energy. As one of the largest hydropower stations in the world, the Three Gorges Dam has a total installed capacity of 22.5 million kilowatts and an annual power generation of over 100 billion kilowatt-hours, which is equivalent to reducing tens of millions of tons of coal burning each year, significantly cutting greenhouse gas emissions and making an important contribution to addressing climate change and achieving carbon neutrality goals. At the same time, clean and renewable hydropower resources provide stable and reliable energy support for the economic and social development of China, while also promoting the optimization and transformation of energy consumption structure, and are of great significance for the development of new energy in China.

2.3.2. Aviation Institute Improvement and Water Resources Regulation

The completion of the Three Gorges Dam has significantly improved the navigational conditions of the upper Yangtze River, eliminating dangerous rapids and currents upstream, allowing large ships to navigate smoothly. Its presence not only increases shipping efficiency and reduces transportation costs, but also promotes economic exchange and cooperation among the regions along the river, accelerating the integrated development of the regional economy.

At the same time, the powerful water resource regulation capability of the Three Gorges Dam can store and adjust water during the dry season and supply water to downstream areas, thereby improving navigational conditions and ensuring smooth shipping. During the flood season, it can release water to prevent downstream areas from flood damage. This flexible water resource management mechanism not only ensures the smooth operation of Yangtze River navigation, but also provides a stable and reliable water supply for industrial and agricultural production in the surrounding areas, promotes sustainable regional economic development, and ensures the safety of drinking water and irrigation water for the middle and lower reaches of the Yangtze River.

2.3.3. Economic development and social stability

The Three Gorges Dam has directly driven the development of industries such as steel, building materials, and machinery, creating millions of jobs. On one hand, it has reduced electricity prices in Central and East China, supporting the competitiveness of manufacturing while promoting the upgrade of tourism in surrounding areas, forming a cultural and tourism economic circle centered on the Three Gorges. On the other hand, the industrial support effects of the Three Gorges Dam are significant, leading to rapid economic growth. It has supported

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468,000 mu of ecological agricultural parks and cultivated a number of distinctive agricultural brands such as Zigui navel oranges and Fuling pickled vegetables.

Alongside rapid economic development, social stability is also very important. The Three Gorges Dam resettlement project involves the relocation of 1.3 million people, leading the government to explore a new model of 'development-oriented resettlement', which has promoted urbanization and industrial transformation in the reservoir area. This model has completed 1,193 assistance projects in resettlement areas, provided precise support to 801 resettlement villages, and ensured that over 95% of residents have access to safe drinking water, further improving the rural living environment in related regions. Additionally, public service facilities have been continuously improved and social security levels steadily enhanced. The Three Gorges Dam project has supported the construction of 135 primary and secondary schools, achieving full coverage for school-aged children to attend school, and has also newly built 23 hospitals and 58 cultural and sports facilities, making the public service system more comprehensive.

2.3.4. International Influence and Ecological Protection

The construction of the Three Gorges Dam has placed China among the ranks of global mega-engineering projects, demonstrating China's infrastructure strength and institutional advantages. The completion of the dam has not only enhanced China's international competitiveness in the field of water conservancy and hydropower but also provided valuable experience and technical support for the construction of water conservancy and hydropower projects worldwide. Therefore, the success of the Three Gorges Dam project has improved China's experience in hydropower construction while also elevating China's international status in related fields.

Although the functions of the Three Gorges Project are of utmost importance, ecological protection is also very significant. The Three Gorges Dam has successfully intercepted silt and suspended matter in the Yangtze River, reducing sedimentation in downstream areas and protecting the river channel and its surrounding ecological environment. At the same time, the Three Gorges Project also focuses on biodiversity protection, artificially breeding and releasing large numbers of various fish, thereby further optimizing the structure of aquatic communities.

3. Environmental Challenges of the Three Gorges Dam Project

3.1. The conflict between ecosystem destruction and protection responsibilities

The Three Gorges Dam has disrupted the natural hydrological rhythm of the Yangtze River, blocking the migration routes of migratory fish species such as the Chinese sturgeon, severely interfering with their spawning and reproductive cycles, and causing a significant decline in their populations. Despite measures such as artificial breeding and release, the ecological restoration effects are limited, and some endangered species still face the risk of extinction. Its construction has damaged the ecosystem in the areas near the dam, causing consequences to the ecological environment that are difficult to recover from. Therefore, seeking a balance between energy development needs and biodiversity conservation, as well as fully considering ecological compensation mechanisms in engineering design, is one of the current challenges.

In fact, it is not only the aquatic life in the surrounding waters that has been adversely affected; terrestrial life has also been negatively impacted. The reservoir area of the Three Gorges Dam submerged large amounts of original wetlands and forests, leading to vegetation degradation and accelerated soil erosion. Although attempts have been made to remedy this through the establishment of nature reserves and ecological restoration projects, the integrity of the ecosystem is difficult to fully restore, bringing devastating consequences to the ecosystem and

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prompting reflection on whether the engineering planning adhered to the principle of 'minimizing ecological damage' and whether the evaluation of the ecological value of the submerged area was sufficient.

3.2. Engineering Sustainability and Long-term Ecological Risks

As of 2024, the sediment accumulation in the Three Gorges Reservoir area has exceeded 1.8 billion tons. This situation could have a long-term impact on the reservoir capacity and flood control ability, and even threaten the safety of downstream navigation. Although techniques such as "water diversion to flush sediment" have been used to delay sedimentation, the problem of sediment remains irreversible and cannot be alleviated in the short term. Therefore, regarding the challenge of managing sediment accumulation, engineers and the government need to consider whether the engineering design underestimated the long-term impact of sediment issues, and whether the future management costs should be borne by future generations.

As mentioned earlier, reservoirs slow down water flow, which reduces the water's self-purification ability and causes the accumulation of pollutants. Despite the implementation of water quality monitoring and sewage treatment, eutrophication problems still exist in some local areas. If water quality cannot improve, it is easy to affect surrounding water bodies and even larger areas. So how can environmental protection measures be dynamically adjusted during the operation of the project? Should the safety of drinking water for downstream residents be prioritized? These are all issues that must be faced.

3.3. Ethical Considerations of Social Fairness and Immigrant Rights

The Three Gorges Project involves the relocation of nearly 1.4 million people, with over a million facing changes in their livelihoods and the disintegration of community structures. Although a "developing resettlement" model was implemented, supported by government investments of hundreds of billions to resettle the displaced, some migrants still face difficulties in livelihood transformation and cultural disconnection, and there are issues of income disparity and weak infrastructure. For example, at places like Shiyu in Fuling and Zhangfei Temple in Yunyang, cultural relics were submerged or relocated due to water storage. Although some relics were protected, the authenticity and integrity of the cultural heritage were still affected. Whether migrant resettlement truly achieves the goal of stable prosperity, and whether the decision-making process fully respects the migrants' right to choose, remains the primary issue to resolve.

The Three Gorges Project may improve localized effects like a more humid climate around the reservoir area, which could benefit drought-prone Northwest China, but it is also highly likely to lead to frequent upstream heavy rains, increasing geological disaster risks. Although the reservoir water can regulate local temperature and humidity—for instance, having a weak cooling effect in summer and a weak warming effect in winter—its influence is limited and cannot cover most areas. Additionally, water storage may trigger minor earthquakes; even if the magnitude is not high and does not exceed design expectations, it can still have serious consequences for various activities in surrounding areas. For instance, while the overall stability of the reservoir banks is good, there are still landslide risks in certain local sections. So, is the cross-regional sharing of ecological benefits fair? And how should potential losses in affected areas be compensated?

3.4. Practical Approaches and Future Directions of Engineering Ethics

By using digital twin technology, like the 'smart brain' of the Sanmenxia Dam, to monitor ecological changes in real time, the ability to provide early warnings for environmental risks can be enhanced, offering strong support for scientific decision-making. At the same time, it is necessary to establish collaborative mechanisms among the government, enterprises, research

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institutions, and the public, such as balancing various demands through ecological compensation funds and environmental hearings. Finally, under the 'dual-carbon' goals, the Three Gorges Project needs to shift from focusing solely on energy efficiency to comprehensive ecological value assessment, incorporating carbon sequestration potential and biodiversity protection into the benefit accounting system. Therefore, how to ensure transparency and public participation in technology application, how to achieve these goals, and how to find practical pathways and future directions for engineering ethics has become a top priority.

4. Environmental Response Measures of the Three Gorges Dam Project

4.1. Ethical Practice of Technical Measures and Ecological Restoration

To address the problem of sediment accumulation, engineering designs have tried to alleviate it through the "store clear water and discharge turbid water" technique, which involves opening the floodgates to release sediment during flood periods, and installing sediment discharge holes and flushing sluices, ultimately achieving good results. For example, the construction of hydropower stations on tributaries such as the upper Jinsha River has helped reduce sediment pressure, and by 2023, the sediment entering the reservoir had decreased to 20 million tons, demonstrating the effectiveness of technical measures. Sediment discharge must balance the ecological safety of downstream areas; excessive discharge may damage fish spawning habitats, so strategies need to be dynamically adjusted to achieve compatibility between ecology and engineering.

Because the Three Gorges Dam has blocked the migration routes of migratory fish such as the Chinese sturgeon, their populations have sharply declined. It has been proven that artificial propagation and release as a remedial measure have limited effectiveness in restoring disrupted natural reproductive chains. Therefore, in addition to these necessary remedial measures, future efforts should explore fishway designs or ecological scheduling to enhance biodiversity protection, such as implementing methods that simulate natural hydrological rhythms. After all, ensuring the natural ecological reproductive chain is very important, and efforts should be made to find a path that enriches species diversity.

Due to problems such as vegetation degradation and soil erosion caused by reservoir inundation, subsequent efforts should include returning farmland to forest and establishing ecological protection zones to increase forest area and reduce soil and water loss. It is worth noting that the cold water flow evaporation effect of the Three Gorges Reservoir may have improved the climate in the northwest region, such as accelerating the greening of the Loess Plateau and mitigating desertification. This phenomenon may also play a role in climate regulation, and on this basis, engineers should further seek ways to improve the climate and restore terrestrial ecosystems.

4.2. Ethical Protection of Social Equity and Immigrant Rights

The Three Gorges Project involved the relocation of 1.4 million people. The government attempted to invest hundreds of billions to resettle them, but the situation did not show significant improvement. Some migrants still struggle to find suitable livelihoods due to the inability to adapt to the new environment and culture. Based on this situation, the government needs to make more efforts to help the people overcome difficulties. For example, some migrants have shifted from traditional farming communities to urban employment, and due to the sudden relocation, they are not yet capable of adapting to such a drastically different environment. Therefore, the government needs to strengthen vocational skills training and cultural heritage protection to prevent imbalances in interest distribution.

The Three Gorges Project has changed the surrounding climate, with effects extending as far as the northwest region. At the same time, the risk of heavy rainfall upstream and geological

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disasters has increased. To address these challenges, the government also needs to balance the interests of the benefited and the affected areas through fiscal transfer payments and ecological compensation funds, both reflecting the principle of fairness and ensuring the normal life of the residents.

4.3. Technology Enablement and Long-term Risk Management

Drawing on the practical experience of the 'smart brain' of the Sanmenxia Dam mentioned earlier, the Three Gorges Dam project adopts an L3-level BIM model and 5,330 monitoring points to track dam deformation in real time, keeping vertical displacement within 26 millimeters. It also combines digital twin technology to achieve safety warnings and data transparency. For example, ecological scheduling plans can be proposed and publicly evaluated to balance hydropower benefits with ecological needs, enabling digital monitoring and early warning based on these technologies.

On the other hand, the Three Gorges Dam is designed with an estimated service life of 150 years, addressing long-term risks such as sediment accumulation and water quality deterioration through ongoing maintenance and technological upgrades. Of course, relevant maintenance has long been implemented; for instance, in 2023, water diversion and sand flushing cleared a storage capacity of 3.93 million cubic meters, thereby ensuring the stability of flood control and power generation functions, and achieving full lifecycle risk management.

4.4. The Institutionalization of Environmental Ethics

In response to the problem of declining self-purification capacity of water bodies in reservoir areas, there are also many corresponding solutions. For example, industrial and domestic sewage interception projects can be implemented, and relevant water quality monitoring systems can be established to carry out pollution control and water quality protection. The water quality of the main Yangtze River is still better than Class III standards, but some tributaries face eutrophication risks. Therefore, engineering departments must also focus on strengthening pollution source management to prevent the outflow of pollutants that could damage the environment.

In addition to the above measures, the '7+1' special plan can be applied, such as submerged area management and protection of drinking water sources in tributaries, along with the integration of government, enterprise, and community efforts. This not only promotes collaborative management among multiple stakeholders but also advances the construction of ecological buffer zones and pilot rural sewage interception projects, with the ultimate goal of enhancing environmental capacity.

5. Conclusion

In summary, this discussion mainly introduced engineering professionalism and engineering ethics, and also discussed the general situation of the Three Gorges Dam, such as an introduction to the dam, its functions, and the significance of the project. It then explained the environmental impact of the engineering project, identified the environmental challenges posed by the Three Gorges Dam based on the above, and proposed corresponding countermeasures. In fact, whether it is the Three Gorges Dam in this text or other projects, engineers and even the entire country should possess engineering professionalism and strictly adhere to engineering ethics. In this way, related projects will have more far-reaching benefits for the people and the environment, and fewer drawbacks.

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