

Chapter 19

Dam Construction Ethics in China

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Abstract Dam Construction in China has produced significant societal benefits. But in recent years, large dam construction has been strongly criticized both nationally and abroad. This chapter argues that the criteria for evaluating the construction of dams should include expanded perspectives from engineering ethics. It also briefly analyzes the ethical problems associated with large dam construction in China and points out divergent ethical assessments within the Chinese experience. Finally, the chapter argues that while there are certain ethical standards that universally apply in engineering, American as well as other foreign standards are not always appropriate in the Chinese context. When it comes to dam construction, China needs to establish its own ethical standards and engineering practices.

Keywords Engineering ethics • Dam construction • Engineering principles

Introduction: Dam Construction: To Be or Not to Be?

China benefits greatly from the construction of modern dams. They provide abundant and inexpensive water for public use as well as for agricultural irrigation and industrial or commercial application. Dams further aid in the management of floods and droughts. However, in recent years, a number of controversies have developed related to local economic and societal issues.

By the end of the twentieth century, there had developed intensive criticism of European and American dams and hydropower plants built during earlier parts of the century. As support for environmental and ecological protection grew, these

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concerns spread to China. As a result, China has witnessed its own rising ecological consciousness early in the twenty-first century. Arguments about merits and demerits of the Three Gorges and the protection of Dujiang Weir versus the development of the Nu River and Tiger Leaping Gorge hydropower became fierce. Advocates from the academic community as well as politicians, entrepreneurs, engineers, the media, environmental organizations, and the public presented views on whether or not various dams should be constructed. Arguments were not confined to scientific or engineering issues, but included many different ethical and cultural perspectives. To some extent, disapproval of the construction of dams affected hydropower and hydroelectricity policy in China, making the prospect of further dam construction uncertain.

Should China continue dam construction? Criteria for the building of dams are not only scientific and technical, but reference a complex set of environmental, ecological, economic, and social factors, all of which should be combined in a comprehensive evaluation of any proposed dam project.

Ethical Issues with Large Dams in China

There are a number of important issues related to dam construction in China today. These may be summarized in terms of four tensions:

1. Public expectations versus professional ethics among engineers. Engineers are often assumed to shoulder a higher degree of ethical responsibility than others involved in large-scale projects. However, an examination of the guidelines of the Chinese Hydraulic Engineering Society (CHES) and the construction regulations of Chinese National Committee on Large Dams (CHINCOLD) reveals no written professional code of ethics for hydraulic or dam engineers.

On the one hand, engineering is recognized as a professional discipline in which civil engineers focus on designing dams that control floods, generate power, irrigate farm land, and do not collapse. Their responsibility is to “do right” what they have been asked to do rather than to consider “what is the right thing to do.” Dam engineers seldom think their job includes considering ecological impacts, population relocation, or other factors. For example, during the development of hydropower in southwestern China, engineers focus almost exclusively on technological issues and ignore environmental impacts. For example, the Longtan Dam in Guangxi province, which was designed to maintain a normal reservoir water level of 378 m and a total capacity of 16.2 billion cubic meters, required extra modeling and hydraulic tests. After the project was finished, engineers took pride in how the project contributed to flood control, power generation, and economic efficiency. Their political propaganda concerning environmental benefits was limited to noting how it did not add to carbon dioxide emissions while those long-term geological, hydrological, and ecological effects which concerned the public were ignored.

On the other hand, in a feasibility study for Nu River hydropower development, it appears that engineers allowed special interests to influence their recommendations. Such behavior undermines the public trust in professional expertise.

2. Privileged government interests versus engineers. Large dam construction is an active process that involves society as a whole. “In addition to scientists and engineers, those involved include investors, policy makers, employees, managers, inspection experts, as well as end-users” (Zhu Baowei 2006). Different groups have different interests. This makes it crucial that others share access to the same knowledge base as engineers. Only when all parties are well-informed and are given opportunities to communicate their concerns can a holistic strategy for some particular dam project become possible. When some groups have more access to knowledge than others, this can distort the dam design and construction process.

In China, large dam construction is driven by strong government support and various pro-dam groups. China has long suffered from flooding, which causes water management to be a core concern of national development and stability. China’s government, which functions as both policy maker and dam builder, thus manifests a fundamental commitment to large-scale hydro projects. Since dam construction requires extended construction periods (typically 5–10 years) and massive social welfare efforts to relocate affected immigrants, it requires huge amounts of financial support from both central and local governments. Thus, it is reasonable that the government should have a final say in whether or not some particular dam construction takes place.

Since the national reforms initiated under Deng Xiaoping, China has shifted from a planned economy to a market economy. This has made the role of government at times unclear, allowing some problematic issues to be resolved by individuals but not others. This ambivalence is reflected in dam construction. For example, while large dam projects are approved by the National Development and Reform Commission, and small- to medium-sized reservoirs by the Ministry of Water Resources, the central government seeks to control the overall strategy for dam construction. However, during the hydropower boom in southwest China, large dam projects only needed to be approved by a provincial Development and Reform Commission.

At times, engineering decision-making can also be caught in a tug-of-war between the central, provincial, and municipal governments. One example was a dispute between the Shaanxi and Henan provinces over the fate of the Sanmenxia Reservoir since the south area of Wei River encountered Jumbo floods in 2004, which caused great loss to Shaanxi Province. The dispute went beyond the purely technical level and involved the political level, because the Shaanxi provinces even put forward the notion of abolishing the Sammenxia Reservoir to the National People’s Congress and Chinese People’s Political Consultative Conference. The dispute was thus beyond the scope of administrative mediation by the Ministry of Water Resources or the Yellow River Water Resources Commission. The core of the dispute was conflicting interests between the two provinces. Although technical experts were invited to contribute to the decision-making, they only played the role of “experts offering suggestions”. Government officials made the final decision and the influence of engineers remained relatively weak.

3. *Professional engineering ethics versus broader ethical issues.* large dams are altering the relationship between humans and nature in China. The exploitation, construction, and maintenance of dams involve the interests of engineers and developers. But dam development also affects the people and wildlife that inhabit the surrounding areas, as well as future generations. Dams transform ecological systems by destroying vegetation and flooding landscapes. Recognition of such broader impacts indicates a need to go beyond any consideration of short-term human interests to include broader social, environmental, and ecological issues related to long-term sustainability.

In many countries, laws requiring the assessment of the ecological impact of dam construction have been adopted and are being enforced to help manage concerns about the environment. China has followed and is applying its own ecological impact assessment law.

Furthermore, dam assessment also increasingly references sociological and anthropological perspectives that were absent until quite recently. In general, the interaction between engineering and society has increasingly become a theme for critical reflection. In the 1990s, for instance, social approval became a core component for the assessment of dam projects by the World Bank, Asian Development Bank, and other international institutions. In January 2002, the Chinese National Development and Reform Commission made societal concerns a top priority, requiring that all engineering projects, regardless of size, address societal issues.

All of the above point to an expanded scope for engineering ethics. To date, however, engineering ethics and engineering decision-making in China remain heavily influenced by technical and economic aspects at the expense of ecological and social impacts.

4. *International environmental versus domestic developmental concerns.* The international community currently holds a negative opinion of dam development in China. An “anti-dam” trend that originated in Europe and the United States has intensified and has spread to India, Pakistan, and other East Asian countries.

Several studies of dam construction have been organized by environmental protection agencies and related organizations. One example is the report *Dams and Development: A New Framework for Decision-Making* (2000) from the World Commission on Dams of the United Nations Environmental Programme. Another comes from Patrick McCully, campaigns director of the California-based International Rivers Network; in *Silenced Rivers: The Ecology and Politics of Large Dams* (McCully 1996), he claims that a belief in technological determinism along with a lack of ethical engineering has effectively allowed the short-term interests of policy makers and designers to dominate dam-related decision-making. Some environmental groups argue that dam construction constitutes an irreversible “ecological experiment” in which disruptions to geology, hydrology, and the habitats of migratory fish are inevitable.

China’s own environmental organizations tend to endorse such foreign concerns and are becoming more and more opposed to the building of dams nationally. But although dam construction in China will continue in order to promote economic development and provide increased welfare for the Chinese people, it is possible to make modifications to protect the environment as well.

Identifying the Sources of These Ethical Issues

The lack of well-developed engineering ethics standards in China makes determining ethical responsibility for projects difficult. As has been observed by philosophers Zhang Hengli and Hu Xinhe (2007), “There are concerns for the missing external engineering context, resulting in ethical problems in engineering practices. And a pluralism of ethics subjects leads to an unclear sense of responsibility and complex relationships in responsibilities in the engineering community.”

Different Traditions in Engineering Ethics

The development of engineering ethics in China has some parallels with, and has occasionally been influenced by, engineering ethics in the United States. At one time, engineering in both the USA and China emphasized obligations to clients or employers, with little attention paid to the general public. In the USA, this began to change in the 1950s with a rising concern for professional engineering autonomy and obligations to the protection of public safety, health, and welfare (Mitcham 1994). In China during the same period, the Chinese Communist Party often occupied the place of what in the West would have been termed the client or the public (Zhu Qin 2010). With the development of a more open society, Chinese engineers developed their own concerns for professional autonomy and became interested in engineering ethics discussions in the USA.

Since the 1990s, two new issues have become manifested in engineering ethics in the United States and other western countries. One is an argument that engineers have responsibilities not only to public safety, health, and welfare but also to the protection of the environment (Vesilind and Gunn 1998). Another is a shift from almost exclusive focus on individual or micro-ethical responsibilities of engineers to what has been termed macro-ethics or concern for the organizational frameworks within which engineers function (Herkert 2001). This second shift has been further supported by science, technology, and society (STS) studies.

By contrast, engineering ethics in China has largely continued to emphasize issues of individual responsibility associated with micro-ethics. In the early 1900s, Chinese scholars who had studied in the United States began introducing American engineering ethics guidelines into China. Indeed, the predecessor of the Chinese Institute of Engineers was actually founded there. Su Junbin and Cao Nanyan (2008) examined the 1933, 1941, and 1996 revisions of the ethical responsibilities of engineers in the “Chinese Engineer’s Creed” and concluded that the revisions conformed to a pattern of development outlined by Mitcham: from ideals of corporate loyalty through governance by experts to social responsibility. Engineers are also increasingly aware of their responsibilities to preserve the natural environment for future generations. In 1949, the Chinese Institute of Engineers was moved to Taipei. The “Chinese Engineers’ Creed” was revised for a second time in 1996 and adopted in Taiwan, but mainland China’s engineering community abandoned the

creed because of its ideological base. Professional engineers in the People's Republic of China (PRC) have chosen to pursue alternate models.

Currently in the PRC there is increasing concern among public, governmental, economic, and engineering interests to balance economic, social, and ecological perspectives on large-scale engineering projects. But although some large water conservation projects in China have adapted decision-making models found in other countries, the total situation is far from satisfactory. In general the engineering ethics education system remains somewhat weak. By contrast, since the 1970s in the United States, engineering ethics education has been increasingly strengthened; by the end of twentieth century, teaching and research in engineering ethics had evolved into a well-recognized field of discourse that included macro-ethical issues. In early twenty-first-century China, however, teaching and research in engineering ethics remained much less developed, and insofar as it is practiced, it remains largely focused on micro-ethical issues of individual responsibility to promote technical quality and safety.

The Importance of Macro-ethical Contexts

Engineering construction takes place in broad historical and material contexts. Deng Bo (2006), for instance, argues that “the intrinsic elements and endogenous factors of engineering activities consist of specific areas: topography, climatic environment, natural resources and other special natural factors, as well as the region's economic and industrial structure, infrastructure, political landscape, social structure, culture, customs, religions and other social factors.” The engineering context includes all such elements in interaction with each other as well as others factors specific to particular contexts. The study of engineering and engineering ethics should consider all contextual factors. Ignoring any of the following factors will give rise to incomplete ethical analyses:

1. Historical contexts. Industrialization and modernization constitute two highly controversial issues related to economic and social development in many countries. Different stages of development have produced different contexts in China and the West.

Dam construction began earlier in Europe and in America than in China. The Hoover Dam, which was begun in 1931 and completed in 1936 in the USA, is the world's first modern large dam; it marked the inception of the large dam construction era. Hoover and related dams made a profound impact in both design and management on the construction of dams in other countries. By the 1980s, however, such large dam construction had largely run its course in the United States and Europe. Not only had most large rivers been dammed, large-scale infrastructure construction and industrialization were being replaced by postindustrial economic developments in the service-oriented and information-based sectors. This enabled the negative social and environmental effects of dam construction to rise to prominence.

For 5,000 years, China has constructed remarkable hydraulic engineering works. One leading example is the Dujiang Weir (constructed during the Warring States Period, 475–221 BCE), which embodied the traditional ideal of harmony and made China for centuries a leader in hydraulic engineering. Since the 1800s, however, water and dam engineering in China has lagged behind that of industrialized countries. Now, in order to meet the needs of economic and social development, especially since the 1980s, the PRC has been rapidly designing and constructing large dams. At present, China has more than 80,000 reservoirs of varying sizes, with more large dams under construction than in any other country. At the beginning of the twenty-first century, however, Chinese dam construction has been increasingly subject to postmodern environmental criticism, sometimes allied with expanded notions of macro-approaches to engineering ethics.

Such criticism fails to appreciate the special historical context that exists in China today, which is not the same as that in the United States or Europe. Recognition of the historical differences can justify “dual standards” with regard to dam construction as well as in the assessment of many other engineering projects.

2. Geographical, social, and cultural differences. Geographical, social, and cultural differences between American, European, and Chinese contexts further justify the development of a distinctive approach to engineering ethics in China. Note, for instance, that China’s unique topography makes it prone to frequent floods and droughts that threaten people’s lives and security. In the earliest periods of Chinese history, water management was central to governing the country. Some scholars such as the German-American Marxist historian Karl Wittfogel (1957) even argue that China was driven to form a centralized political government in order to construct and manage large-scale water projects.

With regard to resulting social and cultural differences, it is reasonable to ask: Do countries with different social systems need to have different approaches to engineering ethics? Even if the answer is yes, there are further questions of who should be responsible for developing a different approach and what would a different approach look like. The World Commission on Dams report argued that all citizens have a right to decide whether or not dams should be built – and, further, if people object to a large dam construction project, it should not go forward.

Developed and developing countries can reasonably hold differing views on this issue. Developed countries generally agree that widespread public acceptance is required by the principles of social justice. By contrast, leaders in developing countries often argue that such an approach would, as is true today in developed countries, make it virtually impossible to build any more large dams.

But what is social justice? The argument of John Rawls’ *A Theory of Justice* (1971), which assumes a kind of atomistic individualism, is not the only way to answer this question. For instance, Robert Paul Wolff (1977) criticizes Rawls from a Marxist perspective as unable to address injustices structured into liberal capitalism. Differences between capitalism and socialism along with those between traditional and modern political decision-making should not be ignored.

Additionally, a careful interpretation of the WCD report reveals that it does not completely reject the construction of all dams. Because each country has its own

unique set of circumstances, there cannot be one standard engineering ethics but rather a variety of guidelines. Just as the Chinese Committee on Large Dams suggested, “The policy for dam construction should be based on each country’s own conditions and national strengths, and it is neither scientific nor practical to use uniform mandatory provisions to address problems in dam construction” (Xie Guxian et al. 2005).

Toward Chinese Guidelines for Dam Construction

With the growth of dam construction in China, there is a need for standardized engineering ethics. “As China shows its great power in engineering construction, there is a considerable gap between the development status of engineering ethics and the actual demands for it” (Guo Fei and Wang Xugang 2009). As China becomes more committed to meeting societal needs, Chinese engineers must take into account population and environment. But in the contemporary political, legal, and economic context, engineers alone cannot solve all problems. To achieve sustainable and sound engineering practices, it can reasonably be proposed that any engineering ethics relevant to large dam construction should take account of at least the following four factors:

1. *The need for national survival and development.* China must establish its own guidelines for engineering ethics. To this end, Chinese engineers need to free themselves of excessive subservience to western approaches. At the same time, they need to seek ways to manifest universal ethical values in a Chinese context.
2. *Quality of life.* The survival of a society depends on its quality of life. When reservoirs flood previously dry areas, they can lead to the relocation of large numbers of people and to basic changes in the natural environment. Large dam construction projects alter the distribution of benefits and risks among different groups of people. If not handled properly, this will also affect social harmony and stability. Ethics needs to reflect not only abstract moral principles but also the real needs of peoples affected by engineering projects.
3. *Demands for safety.* Contemporary engineering practices produce technological, ecological, and social risks. Engineering activities need to include the appropriate measures to avoid these risks. Dams, particularly ultrahigh dams, if they collapse, result in extreme loss of life and property. Therefore, dam design and construction must make safety and security a top priority.
4. *Environmental and sustainable developmental.* Economic growth, quality of life, and environmental protection should be equal concerns for China. While people have a right to improve their lives, national development is an irreversible process. By respecting its resources, China can contribute to the protection of the Earth’s ecological integrity and biological diversity.

General Approaches to Dam Construction Ethics in China

Taking these four factors into account, it is also reasonable to argue that engineering ethics in China should adapt and extend developments in macro engineering ethics. At the same time, this must not be done without full attention to China's distinctive historical, geographical, social, and cultural contexts. Reflecting the long historical tradition of the Chinese ideals of harmony found in various Daoist, Confucian, and Marxist traditions, engineering ethics in China should also promote a harmony in society and with nature in pursuit of a balance between economic development, social benefit, and environmental protection. Within such a general framework, the following further three specific actions deserve consideration:

1. *Seeking a balance between ethical responsibility and pluralism.* Engineering ethics must appreciate the ways that general responsibility is distributed throughout a diversified engineering community. Although one of the roles of the engineer is to be aware of and address risks, attention must also be given to the ethical responsibilities of multiple stakeholders in an engineering project.
2. *Coordinating responsibilities in different stages of a project.* During the decision-making stage of a project, government officials responsible for approval and oversight should consider the long-term impacts on the economy, society, and the environment. Engineers should carry out technical and design requirements as well as predict possible negative consequences, from the bidding process to the design work and construction. The business community must consider not only economic interests and profits, but also environmental and security issues. During the construction phase, the focus should be on responsibilities to state workers, including those who will ultimately be involved in dam operation and maintenance. And the public should share some responsibility for reporting their concerns to the engineering project community. The responsibilities involved in dam construction projects deserve to be shared by all stakeholders.
3. *Strengthening engineering ethics education.* Only with attention to China's national context can the ethical norms and guidelines of engineering ethics be established and improved. Engineering activities must be consistent with government statutes, societal needs, and environmental standards so that current ethical problems can be addressed. Specifically, we need to accelerate the development of engineering ethics education by developing courses related to engineering ethics, conducting training in ethics, and improving the ethical awareness of engineering students, thereby promoting the institutionalized development of an engineering ethics appropriate to the Chinese context and relevant in particular to large dam construction.

Conclusion

The establishment of sound ethical guidelines can help mediate the opposing perspectives of pro-dam and anti-dam advocates, balancing issues such as the needs of economic growth and environmental protection, as well as the interests of

all people whose lives are affected. At the same time, the future development of engineering ethics in China must be based on the Chinese context. By expanding the scope of ethical responsibility for engineers, actively paying attention to responsibility and obligations within different communities, we are likely to be able to offer better guidance in engineering practice.

We have much to learn from both the successful experiences and the lessons of failure since the founding of modern China. Linking outstanding teams of engineers with long-term planning, scientific decision-making, well-ordered ethical thinking, and citizen-oriented problem solving that focuses on issues such as immigration and ecology, dam projects in China will be able to contribute to national needs.

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