China’s 2003 Environmental Impact Assessment Law and Dams: How Effective Is It

The University of Guelph
School of Environmental Design and Rural Development
M.Sc. RPD

China’s 2003 Environmental Impact Assessment Law and Dams: How Effective Is It

A Major Research Paper
Presented to the Faculty of Graduate Studies
University of Guelph
By
Qian Zhang

Supervisors:
Professor Nonita Yap (Advisor)
Professor John FitzGibbon (Co Advisor)
FINAL READING APPROVAL

To the faculty of Rural Planning and Development in the School of Environmental Design and Rural Development

We the undersigned have read the Major Research Paper of:

QIAN ZHANG

Titled:

China’s 2003 Environmental Impact Assessment Law and Dams: How Effective Is It

in its final form and have found that it meets the standards of the Rural Planning and Development M.Sc. program in all respects.

___________________  ____________________________
Date                                                 Dr. Nonita T. Yap

___________________  ____________________________
Date                                                 Dr. John FitzGibbon

Approved for the School

________________________________

Director
School of Environmental Design and Rural Development
Abstract

This paper seeks to assess the effectiveness of Chinese current Environmental Impact Assessment law in preventing and mitigating the impacts of dams. In 1992, the Three Gorges Dam (TGD) project was approved and completed in 2006 in China, as the world’s largest dam; resulting in both benefits and negative impacts. In 2003 China passed new Environmental Impact Assessment (EIA) law. This paper asks the question: could China’s 2003 EIA law have minimized the negative consequences of the TGD project were it in force in 1992? And then to identify what changes would need to be made to the 2003 Chinese EIA Law to prevent or minimize such consequences, and finally reflect on potential mitigation measures.
Acknowledgements

First off, I would like to thank my advisor, Dr. Nonita T. Yap, for her constantly supporting and inspiring me both throughout this paper and over the past two years. I am sincerely grateful for all the times we have shared together. Also, I would thank Dr. John FitzGibbon, my co-advisor. He’s always been there to provide guidance during my graduate career and the writing of this paper.

Then, to my family. Thank you for always being there to support me and give me confidence through the writing of this paper, and this degree. Without you guys, I wouldn’t be where I am today.
# Table of Contents

1. Introduction 6

2. Problem Statement 7
   2.1 Research Statement 7
   2.2 Rationale 7

3. Review of the Literature on Large Dams 8
   3.1 Impacts of Large Dams 8
   3.2 Cases of Large Dams Worldwide 13
   3.3 The Role of Environmental Impact Assessment 16

4. Research Goals, Objectives and Methodology 19
   4.1 Goals 19
   4.2 Objectives 20
   4.3 Methodology 20

5. The Three Gorges Dam Project 21
   5.1 History 21
   5.2 10-20 years Impacts of the TGD 23
   5.3 Conclusion 29

6. Mitigation Measures of Three Gorges Project 30
   6.1 Skills training for relocated residents of the Three Gorges Project 30
   6.2 Cooperation with local industries for more migration job positions 32
   6.3 The Protection of Ecological Environment in Yangtze Reservoir 33
   6.4 The Prevention of Geological Disasters in Yangtze Reservoir 34
   6.5 Academic research from experts for the dam 35

7. China’s 2003 EIA 35
   7.1 EA Problems Clearer than Before 36
   7.2 The Easier Access to Information 37
   7.3 The Improved Public Awareness and influence of Environmental Protection 38
   7.4 Better Effectiveness of The Media 39
   7.5 The political influence 39

8. Comparison with EA Policy Canada 41
   8.1 Potential Proposed Mitigation Measures for Dams 41
   8.2 Changes Should Be Made to Improve the Effectiveness of China’s EIA 44

9. Limitations of the Study 49

10. Conclusion 50
    10.1 Areas for Further Research 52

11. References 53
1. Introduction

In recent years, there are as many as 48,000 dams over 15m high worldwide (World Commission on Dams, 2003). Originally, dams were built for multi-functional purposes, including irrigation, hydropower, flood control and navigation, but there were also a set of multi level negative consequences caused, such as degradation of ecosystem, soil erosion, landslides and relocation of countless people (WWF, 2007). This study aims to explore the effectiveness of the use of EA in managing the impacts of dams, looking in particular at the Three Gorges Dam in China.

Environmental Impact Assessment (EIA) Law is one of ten safeguard policies, intended to maintain ecosystem integrity and ensure environmental sustainability.

In China, there is a long history of dam construction. Dating back to ancient China, Dujiangyan irrigation project (219BC) in Sichuan Province is considered one of the most famous engineering works. The Three Gorges Dam Project (TGD) was approved in 1992. It attracted worldwide attention and was completed in Hubei Province in 2006 with the world’s largest hydropower station. It installed the capacity of 18,200 MW as well as peak flood discharge of 124,300m³/s, which made great economic benefits. However, a set of negative social and ecological impacts has been caused, such as river sediment, landslides, water pollution and relocation issues, etc. (Luo, 2013)

The concept of EIA was first introduced to China in 1973 during the conference of national environmental protection. Since 1979, it has been implemented and made some progress after that. On the 1st September 2003, the Environmental Impact Assessment Law of
the P.R. China (hereinafter China EIA law) was adopted, which becomes an important instrument for decision-making in development projects in China.

2. Problem Statement

2.1 Research Statement

In 2006, the Three Gorges Dam Project (TGD) was completed in China, as the world's largest dam ever. There were benefits to the Chinese economy but there were also a set of serious negative social and ecological impacts. The project was approved in 1992 in spite of controversies around the world, around concerns on sedimentation, landslides, water pollution, losses in biodiversity and relocation issues and population displacement (Liang, 2010).

In 2003 China passed new Environment Impact Assessment (EIA) law. This paper will assess if the 2003 EIA Law could have minimized the negative consequences of the Three Gorges Dam were it in force in 1992. If not, what changes would need to be made to the 2003 Chinese EIA Law to prevent or minimize such consequences, and finally reflect on potential mitigation measures.

2.2 Rationale for the Research

Environmental Assessment policy intends to maintain ecosystem integrity and ensure environmental sustainability, which is essential for the global development. Based on the Three Gorges Dam Project, some sustainability experts hold that China’s environmental policy largely failed to protect and preserve the sustainability and quality of the environment, as a result of which, many negative environmental impacts happened. (Alison, 2013)
In 1992, the Ministry of Environmental Protection of China approved the Three Gorges Dam construction. In 2003 China passed new Environment Impact Assessment (EIA) law.

In recent years, there have been some studies finding problems about Environmental impact assessment of projects in China (Yan et al, 2003). And some studies focused on comparing of the EIA policy of China and European (Chen, Zhang, & Ekroos, 2007). Assessing the current EIA Legislation with a specific example is of vital importance to determine what improvements can be made. This study tracks Chinese EIA Legislation and Process. It seeks to contribute to the literature on the effectiveness of EIA Law to protect environmental and social quality from similar projects in the future.

3. Review of the Literature on Large Dams

3.1 Impacts of Large Dams

Large dams were primarily considered as engineering structures in terms of their usefulness for generating hydropower and utilizing water resources. The World Bank primarily accepted cost/benefit analysis to be the standard criterion for the justification of large dams in less developed countries in the 1960s. Then until the 1970s and 1980s, more concerns emerged on the points of social and environmental impacts, which tend to be fundamental factors of dams operation. In recent years, there are as many as 48,000 dams worldwide (World Commission on Dams, 2003).

Large dam projects have brought social and economic development benefits to many countries and regions in the world, including providing expansion of generated hydropower,
irrigation for agriculture, residential and industrial water supply, pollution control, preventing floods, and improving people’s living standards, etc. (Bhatia, Cestti, Scatasta, & Malik, 2008)

However there are also a set of significant negative impacts caused besides the beneficial development of economy and industry. For example, the impacts, such as degradation of ecosystem, soil erosion, induced seismicity and psychological effects on amounts of displaced people, have occurred in many countries because of the construction of large dams (TAHMİ SCİOĞLU, Anul, EKMEKÇİ, & DURMUŞ, 2011). Specifically, this study aims to contribute to the discussion of improvement of EIA policy in China so that negative impacts of dams could be minimized in the future.

Identifying what impacts will come out of the large dams is important when preparing the water resources projects pre-dam building. Through this, the planners are likely to maximize their positive effects and meanwhile minimize their negative impacts. In the light of broad sense, there is a great deal of multi-level impacts as written in the following.

**The Positive Impacts of Large Dams**

Firstly, one of the most important original roles of dam construction is to utilize water resources since the old times. Dams are not only ordinary engineering but useful projects. Dams could manage the water to meet the demands under desired condition through the operation of their regime system. This could also be considered as an important function in the development of civilization. (TAHMİSCİOĞLU et al., 2011) Dams decrease the risks of flood in the downstream, supply drinking and irrigation water through the stored water in their reservoir.
Secondly, dams could generate power by harnessing the power of falling water to produce mechanical energy. In general, dams usually are constructed to supply electricity to residential, commercial and industrial customers in the close reservoir regions. This power is delivered with interconnected system of long transmission and distribution lines.

At the same time, as the clean resource, the generation of hydro power to some extent could save fossil fuel consumptions (McCartney & Sally, 2007). For the purposes of creating energy, many fossil fuels such as coal are burned. This is particularly obvious in some developing countries, which rely heavily on those traditional energy sources. The amount of carbon dioxide emitted can be decreased effectively through the generation of cleaner hydropower energy and decreased use of traditional types of fuels. Also dams could decrease the pollution impacts downstream.

What’s more, the formation of large reservoir might give rise to the changes of water temperature, salt and oxygen distribution in the vertical (International River Network, 2001). Those factors could help generate new living species easily in reservoir (Canadian Dam Association, 2001).

As to the atmosphere system, the construction of large dams would lead to the topography change. Large scaled surface of water will be developed with the storing water by large dams. These may, as a result, change the air moisture percentage, air temperature and air movements in its reservoir region. (TAHMİSÇİoğlu et al., 2011) Thus, the microclimate and even regional climate will be changed due to the different ecological condition. This seems not harmful for human health, but notable for plants and animals. In regard to the impacts of
China’s 2003 Environmental Impact Assessment Law and Dams: How Effective Is It

dams on the earthquakes, there has been no scientific evidence to prove their relationship despite some researcher argue the dam reservoirs have some seismic effects.

Another advantage of dams’ construction is to improve the living condition of the human life in reservoir area, close regions and even the whole country to meet basic living standards and stimulate the economic prosperity (TAHMİSCİOĞLU et al., 2011). Even though dams are not easily acceptable for people living or working in the project areas because of the potential risks of livelihood loss and environment destruction, dams projects could bring about some benefits on human life. For example, the generation of electricity could stimulate the development of related industries; the irrigation effects could improve the food production. And the construction and operation of dam could provide some employment opportunities for those people.

The Negative Impacts of Large Dams

As a result of large dams’ construction, the fast-flowing water turns to slow-moving water in the reservoir above the dam. This usually causes the sediment of the river dropping and settling behind the dam. This pressed an additional force for large dams to withstand besides numerous tons of storing water. Especially when the heap of the sediment builds up too high, the large dams might burst, overflow, and destroy settlement in the downstream, etc. Taking the Three Gorges Dam (TGD) on the Yangtze River in China for example, a recent report admitted that two-thirds of all sediment is being retained annually behind the dam, resulting in the erosion of the dam in Yangtze River downstream. (Luo, 2013)

Secondly, harm on natural cycles is likely to be caused by dams’ construction. Besides the
sedimentation, dams also hold back the debris, including leaves, branches and the remains of dead animals. They are in the bottom level of the food web. The life of organisms in the downstream depends on debris to get food and find habitat, like the fish. The constructions of large dams, however, prevent the flood, which results in the scarce debris downstream. And many animals have to be trapped there. As a consequence, it caused the loss of both nutrients and habitat for most animals. (Wang, 2006)

In addition, the ecosystem of the egg lying zone of fishes living in the stream is restricted, since the dams became the barrier to the normal animal passing way. The reproduction of migrating fishes is easily to be hindered as well, and thus the fish population decreases significantly (Stott & Smith, 2001). The fishes could be damaged while passing through the floodgates, turbines and pumps of large dams. The changes in the stream bed structures affect the living creatures negatively as a result of water accumulations.

Another negative impact is that many archaeological and historical sites are destroyed or inundated inevitably with the rise of upstream water level. Numerous beautiful geological places disappear after the construction of large dams, which is a huge loss of culture.

Then there might be some changes in the water quality because of the drainage water from irrigation, such as the increase in salt density. As a result, the water regime and the living species in the water may change. Additionally, the destruction of the nature in reservoir region would occur with unexpected floods and destroy the vegetation and natural structure in the riverbanks. (TAHMİSCİOĞLU et al., 2011)

Numerous other negative effects could also be added to this list, from different points of
environmental, social, cultural and economical effects to the reservoir region. One is the forced resettlement of people. The migration changes their living places, separates them with their primary communities, and even result in the loss of livelihoods. Those movements affect their psychology negatively under the pressure to adjust to new environment.

3.2 Cases of Large Dams Worldwide

The Narmada Dam in India

The Narmada Valley Project (NVP) in India is composed of two major components, including the Sardar Sarovar Project (SSP) in Gujarat and Narmada Sager Project (NSP) in Madhya Pradesh respectively. It is the largest single river project in India ever, involving the construction of a series of large irrigation and hydroelectric dams on the Narmada River. (Fisher, 2001)

The 115 m high dam is located about 100 km east of Vadodara. It was originally implemented by the government of Gujarat in 1979, with the purpose of increasing and providing irrigation and hydroelectricity. Overall, the Sardar Sarovar Dam (SSD) submerged 240 villages, as a result of which nearly 100 000 people have to be resettled. (Goyal, Sinha, Shah, & Panwar, 1999)

In terms of the benefits, firstly the water flowed from the SSP could utilize the water resources to cater to the demands of water. One of the most severe problems of Gujarat is the irregular monsoons, which leads to water shortages during most of the year. The SSP irrigates around 1.8 million ha of cultivable land and supplies drinking water to a number of villages during summer months (Goyal, Sinha, Shah, & Panwar, 1999). This has been impossible
before the project. In addition, the reliable supply of water has also resulted in the
development of agriculture and improved food production. Another important positive impact
is the moderation of recurrent floods in the river. The disaster of flood has caused heavy
losses to life and property before. Finally, the impoundment of water for hydropower
generation stimulates the economic development of the region and improves human welfare
there (Sabnis, 2001).

Besides the normal benefits, there are some undesired negative impacts of the SSP. To
begin with, the reduction of water flow downstream could lead to salinity intrusion and
eutrophication of the estuarine region. (Sabnis, 2001) On the other hand, increased discharge
of industrial and domestic wastewaters to downstream reaches added additional driving factor
to the pollution. Secondly, the submergence of forests caused considerable harm to the
ecosystem in that region, like loss of diversity. In respect to the social impacts, the SSP caused
the relocation of tens of thousands of people, the majority of whom are poor people (Fisher,
2001). As a result of the migration, the culture and indigenous knowledge of those tribes is
hard to preserve.

The Aswan Dam in Egypt

Another major example of large dams is the Aswan in Egypt. It was built primarily to
have more water released for the crops during the summer irrigation season. The construction
of the first Aswan dam was completed in 1902, with 1 million cubic meters. And then it was
heightened in 1913 and again in 1933. Aswan High Dam in Egypt was constructed during the
1960s and completed in 1970 at the cost of $1 billion (Osman, 1999).
From the perspective of the positive effects, The High Dam spurred urban growth, controlled the annual Nile flood and impounded the water for irrigation; supported fishing industry; generated amounts of hydroelectricity (Hurst, 1952). At first, the High Dam has installed capacity of 2,100 megawatts. According to the 1974 statistics, it generated approximately 53 percent of Egypt’s entire energy in 1974. (Osman, 1999) In addition, the generated electricity was not only provided to urban area and industries, but also contributed to the rural electrification. Secondly, the High Dam saved catastrophic economic losses from devastating floods, and avoided the damage to infrastructure and life. Thirdly, the irrigated agriculture has increased considerably. The dam almost doubled the previous population to be fed and provides nutrition to the population. Finally, there is another benefit following High Dam construction. It improved the navigation on Nile.

However, the Aswan Dam displaced approximately one million Egyptian peasants and Sudanese Nubians. Those people lost their homes, agricultural lands and also Nubian civilization, which is one of the oldest cultures in Africa (Bhatia et al., 2008). Additionally the vast sediment which carried by Nile river before the dam remain behind the Aswan dam. The rise of water table in Nile valley led to major erosion of ancient temples and monuments. Although UNESCO opened Nubia Museum in Aswan to display the monuments which were saved before the flooding of dam, the Lower Nubia was entirely drowned and the country no longer exists (Bhatia et al., 2008).

**The Sobradinho Dam in Brazil**

The Sobradinho Dam was constructed from 1973 to 1979 in Brazil. It aims to transform
the structure of that region's economy and society. With a surface of over 4,200 Km² and a water storage capacity of 34 billion m³, the reservoir contributed not only to stabilizing downstream flows for operation of hydropower, but also to provide water for large irrigation projects, which revolutionized agricultural production in that region. (Bhatia et al., 2008) And yet, despite the existence of a number of success stories in the region, with regards to social impacts, its resettlement resulted in migration to growing urban areas, which caused danger of increased urban violence and swelling of slums in. Some new conditions for those displaced population were inappropriate due to lack of consultation, especially for indigenous people. (Nishizawa & Uitto, 1995) It led to the social-economic vulnerability.

3.3 The Role of Environmental Impact Assessment

As stated above, besides the benefits in utilizing water resources and generating energy, large dams have a great deal of positive and negative effects on the environment. The ecological results are same no matter where the planner eventually chooses for the dams’ construction (TAHMİSCİOĞLU et al., 2011). Overall, these effects could be classified according to different criterions, including climate, social, cultural etc. In addition to their environmental, social and cultural benefits, it is of importance to minimize the negative effects of large dams on the environment regarding sustainable development.

To begin with, the adverse social impacts of large dams could become serious, including increasing political and environmental opposition without effective mitigation measures. In particular, these negative social impacts could be mitigated by governments through explicit resettlement policy, legislation, and financial resources, and by planners through resettlement
planning. In addition, the government should pay attention not only to the displacement of people, but also to resettle the wildlife if possible. (Word Bank, 1994) In some cases, the rare wildlife is hard to live and breed in new environment.

With regards to the water quality, shoreline erosion control, mechanical elimination of waste and wastewater treatment and prevention of excessive doses of fertilizers and pesticides in the watershed area could be the effective measures to increase water quality during construction and operation phases. (Trussart, Messier, Roquet, & Aki, 2002)

Concerning the modifications to hydrological regimes, the most effective mitigation measures would be the flow management by stakeholders, banks restoration techniques, fish habitat restoration programs and protection of coastal habitats. While for the barriers for fish migration, the effective ways to ensure movement are bypass channels, capture and transportation of fish, management of flow regime or spillway during downstream, installation of avoidance system upstream the power plant. (Trussart et al, 2002)

Secondly, some argue that EIA team should be away from the planning and design team (IEA, 2000). This is the old way, in which the EIA team prepares the EIA report. The report is usually reviewed by independent consent authorities, such as environment ministry. However, the independent review process is especially weak in less developed countries. As to the planning and design team, it would complete the design and work on environmental mitigation measures.

Others insist that the EIA team could incorporate with the planning and design team (IEA, 2000). It is much better to incorporate the environmental expertise into the planning and
design team from the start of the project, so that greatest positive influence might have. By this way, environmental assessment and mitigation of impacts would become an integral part of the project. Independence of EIA report review will be established by consent authorities or independent panel or experts (IEA, 2000).

Thirdly, the environmental management plan usually includes short and mid terms mitigation measures and capacity building to reduce the negative impacts on environment. Taking the Kainji dam in Nigeria as an example, the short term mitigation measures mainly focused on providing drinking water to the population there, control of water born disease, providing workers with safety equipments, installing alarm mechanism and conducting urgent maintenance activities con the dikes and dams (Niger Basin Authority, 2006). In terms of the midterm mitigation measures, they include developing a dangerous waste collection and disposal program, financing income generating support actions, developing basic infrastructural program and implementing reforestation sub-projects. (Niger Basin Authority, 2006) What is to note is that there are some mitigation measures of emergency training as well in the Kainji dam, which deserves the attention to learn from.

In summary, the environmental impacts of dams manifest in various amounts and in different degrees. It is difficult to fully identify what potential positive and negative effects beforehand. The only thing to know is that the estimation of impacts should depend on the different conditions of each dam and reservoir separately.

However, the effects should not be considered totally negatively as well. It is important to decide correctly who will do the assessments, and whose opinion should be taken into account,
such as fisherman, the industrialist or the farmer. The benefits and negative impacts could be made balanced through mitigation. In addition, it is suggested that the EA groups consist of experts in various areas, like biologists, engineers, hydrologists, social scientists and other profession experts. In this way, the decision will be made with all aspects factors into consideration. And the EA groups could then investigate whether there are other feasible alternatives in the estimation of project’s environmental effects. After this brief analysis of mitigation measures of dams, other effective mitigation measures for dams will be suggested in the paper below.

4. **Research Goals, Objectives and Methodology**

4.1 **Goals**

This study intends to contribute to the discussion of the effectiveness of Environmental Impact Assessment policy in China, in terms of minimizing the negatives impacts of dams with potential mitigation measures.

4.2 **Objectives**

1) Assess how effective the Chinese 2003 EIA Law is to prevent and minimize the negative consequences of project like the Three Gorges Dam.

2) Based on where Chinese current EIA Law doesn’t work effectively, recommend what changes could be made to improve it.

3) Determine potential mitigation measures for Three Gorges Dam, which could also be applied to the future and other dams around the world.
4.3 **Methodology**

Two main research methods techniques have been used: literature review and policy analysis. Although this research focused on the effectiveness of Chinese 2003 EIA law, some of the research lessons learned could also be transferable to other countries in similar conditions to China, especially the less developed countries.

Background research was done through literature review of academic journals and books, government and company reports. That firstly analyzed the impacts of large dams in the world, including the Narmada Dam, the Aswan Dam, and the Sobradinho Dam. Then the role of EIA could be identified through the mitigation measures which make positive influence to the dams’ effects. After that, the research mainly focused on the multiple impacts of TGD project having on the environment and surrounding communities in China, and Canadian or others countries’ similar cases to learn from effective mitigation measures which could be applied for the TGD or other dams in the future.

The document study provided detailed information of the experiences, expectations and understanding of related EIA policy. The advantages and weaknesses of the EIA law would be investigated through the literature review of academic journals, books and government reports. Through these literatures and documents, the research attempted to analyze various perspectives of the effects, challenges and effectiveness of Chinese EIA law, as well as the limitations of adopting new adjustment for Chinese EIA and how to enable it. Besides of those sources, policy analysis was conducted to compare the EIA policy of China and Canada as well. Through this, the research aims to find whether there is still weakness of Chinese EIA law on the dams’ projects. Finally, compared to the Canadian EIA law, the research intends to
make recommendations on what changes should be made to improve its effectiveness.

In summary, the researcher primarily conducted the literature review to investigate and analyze related points from secondary data use. This provided the researcher with insight into the effects the TGD project was and is having, the various EA practices of dams in China, and the understanding of the China EIA law. Then through policy analysis, the researcher tries to find the limitations of Chinese EIA law compared to that of Canada, and eventually how to enable the adoption of new adjustment.

5. The Three Gorges Dam Project

5.1 History

China is a country located in East Asia, covering an area of approximately 9.6 million square kilometers, with a population of over 1.35 billion. “Southern China is dominated by hills and low mountain ranges, while the central-east hosts the deltas of China’s two major rivers, the Yellow River and the Yangtze River. The Three Gorges Dam is a hydroelectric dam that spans the Yangtze River by the town of Sandouping, located in Yiling District, Yichang, Hubei province, China.” (Wikipedia, 2015a) A report from the World Bank shows that the estimated cost of the TGD project was $12.8 billion in 1993, with 56 percent for dam construction and 44 percent for migrant resettlement (Xinhua News Agency, 2003).

The original idea of constructing a large dam across the Yangtze River was raised from Sun Yat-sen in 1919 for electricity generating purposes (Yang, 2007). In The International Development of China, he asserted that a dam built in the downstream of the Three Gorges was possible to generate 30 million Hp. This idea was then revived by Mao Zedong, who
focused on the flood control of energy sources. In 1944, the chief design engineer, John L. Savage, conducted a survey in the Three Gorges area. Then he made a plan of Three Gorges Dam in an early form (Wolman, & Lyles, 1978). After the year of 1949, Mao Zedong supported that project, and began the Gezhouba Dam nearby first. The TGP was approved by the National People’s Congress in 1992. The government finally identified the TGP as for purposes of energy generation, flood control, and enhanced navigability of the Yangtze River. With strong support, the construction of the TGD was put into the agenda.

However, some opponents argued that a huge dam built on the Yangtze River would potentially pose harm to cities located downstream because of many reasons. To begin with, the large numbers of displaced people have to be moved and resettled afar, which would lead to social instability. Also, large areas will be submerged inevitably, including arable lands, forests, and some historical tourists and cultural sites. Furthermore, the pollution of Yangtze River water tends to become worse due to the human activities along the Yangtze River. Eventually, the TGP would destroy numerous sizeable natural habitats with the anticipated increased water level. A number of wildlife will be endangered without living and hiding places. (Richard, 2008)

After the final completion of TGP in 2006, there were benefits to China, i.e., flood control, hydropower generation, and navigation development. But there were also a set of serious negative social and ecological impacts, such as psychological depression of relocated people, wildlife disturbance in that area and soil erosion, etc. A number of quantitative and qualitative studies have been conducted to explore the multilevel impacts caused by TGD after the operation of the TGP (Liang, 2010).
5.2 10-20 years Impacts of the TGD

1) Relocation and Resettlement

The TGP flooded an area of 632 km² in total, including 14 thousand hectares of agricultural land. Two cities, ten counties, 114 towns, 1393 villages and 6945 groups of villager in both Hubei Province and 19 cities of Chongqing Autonomous Municipality, have been submerged after evacuation in order to establish the reservoir, including the major population centers of Fuling, Wanxian, and parts of Chongqing (China, 2011). Chongqing is the central municipality in the Three Gorges reservoir area and recently received approval to become a centrally administered municipality – only the fourth in the country after Beijing, Shanghai, and Tianjin.

In terms of social perspective, it caused the resettlement of at least 1.4 million people who lived below the 175 m above-sea-level from hundreds of villages and towns flooded by the project (World Bank, 2000). Many of the residents displaced have been given far too little in compensation (equivalent of $7 a month) or even received only half the land compensation promised (Hvinstendahl, 2008), which makes them even poorer through landlessness, joblessness and psychological depression (Gleick, 2009). Additionally, nearly 80% of the relocated people are rural population. The conflict of large population with relatively little arable land tends to be even acute. Those affected farmers were forced into occupations for which they have neither the skills nor the qualifications. The communities downstream are also affected by the pollution and face the pressures of migrant workers (World Bank, 2000).

Local government corruption posed early challenges to the resettlement of TGP. (Chao
A number of resettlement funds went to the pockets of government officials but not those displaced refugees. (Heggelund, 2006) On the other hand, the tensions between the resettled population and the host population were raised in Three Gorges reservoir. The local government seized the farmland from original population firstly, and then distributed those lands to new migrants for their livelihoods. (Heggelund, 2007). Also, it is suggested by recent research that women displaced are more likely to be affected, and less likely to find new work in new areas (Yan et al. 2005). Finally, forced migration is easily to cause psychological depression in new areas (Hwang et al. 2007).

2) Electricity Generation

In China, electricity comes from various sources, including conventional thermal (i.e., coal or natural gas), hydropower, and other renewable energy sources (i.e., nuclear). In 2006, Aden identifies that the availability of energy inputs is the most important factor shaping the environmental impact of energy usage in China. (Liang, 2010) Thus, thermal energy and hydropower are likely to become the principle two forms of electricity in China and shape China’s policy agenda, because of the extensive reserves of coal and generated hydropower.

In 2008, thermal energy accounted for approximately 81.28 percent of electricity in China, followed by 16.22 percent of hydropower. (Liang, 2010) The fossil fuel of coal is estimated remain at principle source, although the Chinese government has adopted policies to alleviate its dependence. According to the data of China’s Country Analysis Briefs, in 2006 hydropower of China merely constituted 6 percent out of the total. By the end of 2007, seven generators has been installed in south of TGP, creating power capacity to 14,800 megawatt
China’s 2003 Environmental Impact Assessment Law and Dams: How Effective Is It

(Government of China, 2006). In 2007, the turbines generated around 62 billion KWHR of electricity.

3) Environmental Impacts

In terms of environmental concerns, though it introduces cleaner technologies in resource efficiency, China still lags behind many counterparts in world. For China, a rapidly developing country, massive increase in energy is in urgent demand. But per capital CO₂ emissions have increased due to the presence of TGD. The TGD also greatly affects the biodiversity in the area. Large numbers of native species of animals and plants are under increasing risks because of flooding in some habitants and water diversion (Wu, Huang, Han, Xie, & Gao, 2003). Many of them are already endangered. Additionally the project makes three gorges reservoir area more vulnerable to soil erosion and landslides primarily because of drastic changes in reservoir water levels. Also it decrease the freshwater flow, which endangers fish population by more saltwater in the Yangtze River basin (Brain, 2006). Each year, around one billion tons of untreated wastewater from Chongqing was poured into the Three Gorges reservoir (Hodum, 2007).

Much of China’s electricity is produced by thermal power plants burning coal since the 1980s. It is estimated by the Chinese government that, if the electricity generated by the TGD project were produced instead with coal, 50 million more tons of coal would have to be burned annually. (Liang, 2010) This usage would lead to the production of up to 100 million tons of carbon dioxide (Xinhua, 2007a). However, in contrast to China’s optimistic expectations about CO₂ reduction from the dam, Adams disagreed that the TGD project would
reduce coal burning, at most, by three percent and carbon dioxide emissions by five percent (Liang, 2010).

4) Fisheries Impacts

The Yangtze River basin has more than 360 fish species, accounting for 36 percent of all freshwater fish species in China (Xie, 2003). There are 27 percent of China’s entire endangered freshwater fish in the basin, as well as 177 endemic fish species (Yue & Chen, 1998). However, fish populations would change because of the changes in water of Yangtze River, including the chemical in river, water temperature, the salinity of water, and food resources for fish. The TGD blocks the passing way of fish, which imposed the pressure for their migration and breeding, resulting in declining fish population.

Research in 2003 showed six species at high risks of extinction, with an uncertain future of another 14 species only survive in tributaries to the Yangtze (Park, Chang, Lek, Cao, & Brosses, 2003). According to the data released to a website of the TGD monitoring program, the commercial harvests of four species of carp are well below pre-dam levels. From 2003 to 2005, their annual harvest below the dam was 50–70% of that in 2002 (Xie et al., 2007).

5) River Sediment Flow

Another significant impact of the TGD is the effect on sediment loads in the Yangtze River basin. There are many driving factors, which could result in the change of sediment load. It includes the condition of annual climatic, the level of deforestation, and the reforestation in the upper watershed (Liang, 2010).

Traditionally, the Yangtze River carried a vast load of sediment from upper watershed to
the East China Sea, while the TGP led to a rapid and significant decrease in downstream sediment load after its completion. The reforestation and construction of dams beyond the Yangtze River result in the declination of sediment volumes since the late 1990s. As a consequence, the coastal erosion appears to be more severe and some changes occur to the ecological characteristics (Xu et al. 2006). According to the data of Yangtze River’s historical sediment budget and erosion, scientists estimate that the delta will be eroded further in the first five decades and then achieve a balance in the next five decades (Yang et al. 2006).

6) Flood Protection

One of the anticipated benefits of the TGD project is that the flood protection on the middle and lower reaches of the Yangtze River has been improved greatly. Historically, tremendous losses of infrastructure, property and life have been suffered from flooding by the people living along the Yangtze River, especially during the summer season. For example, 145,000 people were drowned and over 300,000 hectares of agricultural land were flooded in 1931 (Boyle 2007). In 1998, a flood in Yangtze River occurred again, resulting in the losses of more than two thousand km² of farmland and over 1,500 lives (CTGPC 2002). The economic damage equals to billions of dollars.

According to analysis by the Yangtze Three Gorges Project Development Office, the TGD project has prevented floods in late July 2007. The dam stored waters, which would have exceeded flood levels below the dam (People’s Daily Online 2007).

7) Shipping Benefits

The Yangtze River plays an important role in the development of upper river economy in
China. River navigation is the most cost-effective means of long-distance freight transportation there. But for Chongqing, navigation on the upper Yangtze River was much difficult in the past, with almost 90 percent of goods transported by water. However, the construction of the Three Gorges reservoir significantly increases the depth of water in the upstream and improves navigation with more than 600 kilometers upstream to Chongqing. (Liang, 2010)

8) Reservoir Induced Seismicity and Geological Instability

Seismic events and geological instability are easily caused by large reservoirs as they fill and as the pressure increases. There have been some predictions about such reservoir induced seismicity for the Three Gorges region, which indeed shows seismically active already. There has been an increase in reported seismic activity in the region after the construction of the TGD. (Liang, 2010)

Accompanied by the risk of increased seismic activity, landslides within the Three Gorges regions appear to increase as well. After the closing of the dam and the filling of the reservoir, a major landslide occurred very soon near the town of Qianjiangping in July 2003. 24 million cubic meters of rock and earth slid into the Qinggan River. It completely blocked the flow of Qinggan River, capsizing 22 boats and destroying four factories, 300 homes, and more than 67 hectares of farmland (Liang, 2010). According to the official report, 14 people were killed and 10 more were missing in this case (Wang et al, 2004). Then in 2007, 31 people died when another landslide crushed a bus in Hubei Province. (Stratton, 2007). The risk of such disruptions appears to be far more severe than anticipated, which leads to the expansion of
danger zones area. New inevitable resettlement has to be arranged concerning the safety of residents. In 2007, officials and experts duly admitted the TGD project had caused more frequent and severe landslides than before (Xinhua, 2007b).

5.3 Conclusion

The findings of the TGD impacts indicate that there are still several existing problems of the project in spite of the long time’s mitigation program. Firstly, with respect to the sedimentation, there is no safe and economic way to remove the sedimentation from behind the dam. Originally, the TGD on the Yangtze River in China was built with an eye to manage sedimentation. A recent report admitted that, however, two-thirds of all sediment has been retained behind the dam each year. As a consequence, the downstream of the dam is inevitably eroded and the Yangtze River’s delta is shrinking. Secondly, there are biodiversity risks in Yangtze River basin. Taking the ecological passage as the example, the issue is still not eliminated completely, though some research has been taken by university research institutions, as well as some practical measures. As a result, the population of some fish species has not increased, or even decreased rapidly, like the paddlefish (Wang, 2006). Furthermore, some researchers argue that the extreme climate has been improved along the Yangtze River basin. The increased water surface could partly alleviate the high temperature, especially during the hot summer. The temperature in Chongqing has been usually more than 40°C in August before the construction of the TGD. After its completion, the temperature in Chongqing tends to decline about 2°C in August than before (People’s Daily Online, 2007).

6. Mitigation Measures of Three Gorges Project
As is known to the world, the construction of the TGD project brings about many significant benefits to the development of China’s economy and industry, accompanied with a deal of negative impacts as well. After its completion, China’s Government released the follow-up work for the Three Gorges Project in 2011, which states the mitigation measures clearly in response to those impacts, including environmental and social mitigation measures, and geological hazard control. This paper will intend to talk about several important mitigation measures in the following.

6.1 Skills training for relocated residents of the Three Gorges Project

The migration of more than 1.4 million people caused serious negative economic and social consequences in China. With respect to social impacts, most of residents in this region were eventually forced to relocate to places afar due to the shortage of farmland (Tao, 1994). “The relocation not only uproots the migrants from their home for many generations, it also tears apart their close-knitted social networks (Hwang, Xi, Cao, Feng & Qiao, 2007).”

<table>
<thead>
<tr>
<th>Education Level</th>
<th>Illiteracy</th>
<th>Primary School</th>
<th>Middle School</th>
<th>High School</th>
<th>Secondary School</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immigrants</td>
<td>7%</td>
<td>24%</td>
<td>54%</td>
<td>12%</td>
<td>3%</td>
</tr>
<tr>
<td>National Sample</td>
<td>3%</td>
<td>10%</td>
<td>48%</td>
<td>27%</td>
<td>12%</td>
</tr>
</tbody>
</table>

Source: The Follow-up Work of the Three Gorges Dam Project

According to the data in table 1, the education level of 31% of migrants is primary school or lower. Only 15% of the migrants have attended high school or higher. The average education level of immigrants is much lower than the national average (as presented in sample data) and far below the market or industry requirements, causing difficulties in finding employment. The labor skills of most immigrants were concentrated on traditional agriculture.
and low technology content in the secondary and tertiary industries. Most immigrants are unable to adapt to changes of lifestyle after relocation. According to the investigation, the causes of the phenomenon are the backward awareness of migrants on education, lack of education funds and training for relocated people (Ba, 2010). The training for migrants has been ignored due to much attention to the movement and settlement of immigration.

As stated in the Follow-up Work of TGP (China, 2011), community consultations will be conducted in the three gorges reservoir area to pinpoint gaps of knowledge and job skills according the current industry structure to find out what skills needed for employment after the settlement of immigration. Then to design the training program from location selection, lesson plans, schedule setting, learning materials and charge standard, etc. 50 mentors and 20 staff will be recruited to serve the training program during the implementation. The program will last for 15 months with five sections. 800 migrant reps could be trained every three months within 20 classes, including one month theory course and two months practice. After every 20 class’s graduation, the training staff and mentors will get evaluation about the training efficiency, materials, methods and overall satisfaction from the students. (China, 2011)

This skills training program for relocated residents of the Three Gorges Project intends to improve migrants’ ability of working themselves, and then help develop the new creative structure of industry in reservoir area.

6.2 **Cooperation with local industries for more migration job positions**

Economically, most migrants displaced by TGP become landless and jobless, especially
the farmers. China is known for high agricultural density and labor intensive farming. The population density of the Three Gorges reservoir area is 359 people per km$^2$, which is 2.6 times of the national average. The cultivated land per capita is only 0.77 unit of area (=0.0667 hectares) after relocation, including land with 25% slope land. The infertile land causes low output. The average annual output value of planting is less than $200 per acre in recent three years. (China, 2011) Around 40% of the affected farmers were ousted from farms and were expected to be absorbed by non-farm industries as promised by the government (Yangtze Valley Water Resources Protection, 1999). But factory jobs are scarce in this hilly region despite the efforts of government to lure factories to the region (Li, 1998). Therefore, many displaced farmers have become jobless and survive on government allowances (Washington Post, 2006).

Concerning this issue, Chinese government starts the cooperation with local enterprises in that region for the migration employment (China, 2011). This mitigation measure could be achieved through some incentives provided to industries which have been located in the Yangtze River reservoir or have the intention to attract external investment and build industries there. Some policies have been formulated to support this measure. For instance, the industries could get tax reduction policy to some extent, if they offer a number of special job positions to displaced people. The extent of tax incentive will be based on how much efforts of industries contributed. In addition, China also indicates that the cooperated industries could enjoy the preferential policies when they need loan for financial investment in many banks.

6.3 The Protection of Ecological Environment in Yangtze Reservoir
With respect to the ecological problems, China’s government has responded to it by creating a new Ministry Environmental Protection. This new Ministry Environmental Protection strengthens Chinese environmental laws and regulations, and promotes renewable sources. Secondly, government officials also contributed to remove those polluting enterprises from the edge of the reservoir, and improved sewage treatment facilities to improve water quality in the Three Gorges reservoir region in spite of the continuous eutrophic conditions throughout the basin (People’s Daily Online, 2007). In addition, while massive funding has been committed to the dam itself, much of the proposed pollution control expanse has not yet occurred. The city of Chongqing alone releases nearly one billion tons of untreated wastewater into the Three Gorges reservoir annually (Hodum 2007).

Thirdly, many ecological problems in the Yangtze have not been improved by the project though these problems have been argued by member of the Chinese Academy of Sciences before the building of TGD. Limited scientific investigations have been conducted for assessment of flora and fauna, which were threatened or destroyed as a result of the TGD project. Until the late 2007, a formal comprehensive assessment of plant communities was initiated by the Chinese Academy of Sciences to maintain genetic stocks of rare plants (Xinhua, 2007).

Finally, the government takes soil and water conservation measure for some important tributaries. The Three Gorges reservoir region has been divided into 23 major areas, according to the population density, drinking water source and farmland area, etc. There are 10,300 km² soil erosion of the total of 22,500 km². (China, 2011) The government builds many of slope protection engineering, such as impounding reservoir, fence, forests planted for soil
conservation, etc.

6.4 The Prevention of Geological Disasters in Yangtze Reservoir

There are 355 areas in Three Gorges reservoir region in total, where landslides appear to occur. This mainly threatens 144,700 people who lived above the height of 177m. (China, 2011) Directed at those potential landslides areas, the government takes actions like building gravity retaining wall, anti-slide pile engineering, etc. Meanwhile, monitoring during test will be noticed to make sure the safety. Furthermore, the continuous monitoring for local climate, outstanding risks will be insisted in the following phase.

6.5 Academic research by dam experts

Another important mitigation measure is the academic research by experts for the TGD. Many academic research experts or university research institutions have contributed into the investigation of TGD from various perspectives. For example, the Tsinghua University have devoted to the hydraulic model research of ecological passage in Yangtze River reservoir. It minimized the negative impacts of TGD on the fish species in Yangtze River reservoir, though the issue of some decreased fish population has still not solved yet.

In summary, it is not surprising that mitigation of environmental impacts plays a central role of China’s EIA system. In accordance with the consistency, mitigation measures should be considered during scoping and action designing as a response to each likely adverse environmental impact. Also, the consideration of appropriate mitigation measures should be developed more in-depth in EA report. During the project operational phases, the Environmental Protection Bureaucracy (EPB) monitors the implementation of the mitigation
measures described in the report. The project could be suspended, and the developer can be fined up if the measures are not implemented effectively.

7. China’s 2003 EIA

The concept of EIA was firstly introduced to China in 1973 during the conference of national environmental protection. Since 1979, it has been implemented and made some progress after that. On the 1st September 2003, the *Environmental Impact Assessment Law of the P.R. China* (hereinafter China EIA law) was adopted, which becomes an important instrument for decision-making in development projects in China.

The content of China’s 2003 EIA law consists of five parts. Part one describes the general principles of China EIA. The second part highlights Strategic Environmental Assessment (SEA) for plans and programs, to be used for various types from local to central levels of the government. Part three provides EIA for construction projects based on the existing EIA system since 1970s. Part four covers various kinds of legal liabilities which are applicable for plans or programs of approval authorities, developers and licensed agencies. The last part deals with some supplementary provisions such as producing relevant EIA regulations by provincial and municipal level governments within their jurisdictions etc. (Yan et al., 2003) The EA legislation in the People’s Republic of China has several positive aspects, which will be analyzed on a basis of the information of literatures and policy analysis.

7.1 EA Problems Clearer than Before

As we know, the China 2003 EIA law unequivocally stipulates EIA as mandatory for
plans and construction projects. It states clearly what administrative and criminal sanctions would be taken in response to non-compliance or fraudulent implementation (China, 2003). Technical guidelines for the impacts on groundwater and ecosystem have also been issued in the past several years as assistance to the Chinese EIA system (Zhang et al., 2012). As a consequence, much of EA problems in China tend to be clearer and more obvious to the public than before. The construction projects or plans have been required to implement with less cost to the environment.

In addition, the China 2003 EIA law provides mechanisms for resolving jurisdictional disputes and avoiding duplication of EA. It improves the efficiency of China’s EA legislation greatly and make the potential problems clearer, not perplexed. This could be indicated from article 18.

“For the plan of an integrated construction project, an EIA for a construction project, not an EIA for a plan, shall be performed. For individual construction units may be simplifies”.

(Article 18, China 2003 EIA law)

Furthermore, the China 2003 EIA law defines the timeframe for decisions to be made, thus making the EA process more predictable. It seeks to control quality by stipulating who can undertake EA and what their responsibilities are during EA process. Post project monitoring measures are required. There is also a supplementary provision of article 36, allowing for an EIA requested of plans at the country level even if it is not required by the law.

“The people’s governments of provinces, autonomous regions and municipalities directly under the Central Government may, based on the actual situations of their territory regions, request EIAs for the plans prepared by the people’s governments at the county level. The detailed methods shall be formulated
China’s 2003 Environmental Impact Assessment Law and Dams: How Effective Is It

by the people's governments of provinces, autonomous regions and municipalities directly under the Central Government, referring to Chapter II of this Law.”

(Article 36, China 2003 EIA law)

7.2 The Easier Access to Information

In recent years, the information becomes more accessible to people due to the rapid development of high technologies in China. The way to get data has not limited to the sources of published books or the library any more. As is known, not only the government officials, but all the public could find most of the information they need or feel interested from online website.

Additionally, the government also tends to release data of various projects to the public. This could be achieved through ways, like government online website for public review, telephone customer service, community notice board and flyers. The easier access is provided to people, and information could be found no matter which way you use. The government tries to show transparency to achieve the goal of democracy, which is especially advanced in developed countries. China, as a country under fast developing condition, follows the step with no doubt.

7.3 The Improved Public Awareness and influence of Environmental Protection

The EIA Report is stipulated to be a basis for the government making decisions. The EIA Report could apply to public and private sector projects, including military facilities. As required in the China’s 2003 EIA law, the EA report is to include the comments and suggestions from the “relevant units, experts and the public”. An appropriate justification must be given, if the comments and suggestions are rejected. EIA is required of various land
use types, including general land use, water use and resource use plans, as well as construction projects. (Chen et al., 2007)

Along with the involvement of the public, the government conducts some training for people who lived within the area of EIA projects. Thus people will get to improve their awareness of what rights they have, what could influence the environment and what might help with the environmental protection. By this method, more people tend to participate in the process of EIA review and it plays an important role in China’s EIA decision-making, although not that significant. For instance, since the China 2003 EIA law, the Nu River Dams, Yuanmingyuan anti-seepage project and Panyu Garbage Incineration plant Projects were suspended because of the public rejection (Zhu, 2007). The influence of public participation indeed pose pressure to the government decision making due to the notable demand of environment protection.

7.4 Better Effectiveness of The Media

Nowadays, the media begin to play an important role in peoples’ lives in China. At first, more and more information has been released and reported by the media, due to the development of technology and the democratic characteristic of advanced society. People are easily accessible to the information, which whether refers to the political, social, cultural or environmental issues. Secondly, with more attention paid to the power of the public, the government has to take the influence of the public into account during the decision making process. Therefore, the media, inevitably, becomes a significant role, which could not be ignored. (Zhang et al., 2012) Furthermore, there appear to be much more types of the media
than before. The ways of media are not limited to the old types, like the radio, TV news, notice boards, etc. Online data becomes more popular in the public, which could be easily get by cell phone or laptop wherever you are and whenever you need.

All the factors above contribute to the better effectiveness of the media today. By this, projects will get more public attention and raise more concerns on the environmental protection in China than before.

7.5 **The political influence**

With the rapid development of China’s economy and society, the government has taken the long term issues into account during decision making. Many environmental protection issues have been put forward to the political mission to be solved, like the reduction of coal burning. Under the powerful political pressure, the EIA process tends to arrive at almost the peak of concern. The concerns on environmental protection could have better voice when faced the vast economic benefits. The 2003 Chinese EIA law strives to achieve a balance between conservation and development (China, 2003). The economic interests will not be the major purpose for projects any more.

In addition, many environmental problems should have been minimized in order to adjust to the national strategy. China aims to develop steadily from perspectives of society, culture, economy and environment, so that to achieve the goal of sustainable community.

**Conclusion**

As stated above, there are many advantages of China 2003 EIA law compared to the old one in spite of some existing weakness. It could be imagined that if the China 2003 EIA law
were in force in 1992, the TGD construction will absolutely be better than before, and the potential environmental issues will be clearer from the start of the project pre-dam building. Additionally, much more attention would be raised from both of the government and the public. The public influence will play a major role in some sub-decision making, which could be indicated from the suspended project of Nu River because of the public rejection. Especially for the relocation of people living in that region, it is likely to have more comprehensive resettlement policies in response to their psychological depression and livelihood pressure. The negative impacts would not be avoided, but could be reduced to some extent.

8. **Comparison of China’s EA legislation with that of Canada**

8.1 **Other Potential Effective Mitigation Measures for Dams**

In this section, the paper intends to identify what could be the potential mitigation measures for the TGD, which also might be applied to other dams around the world in the future. Some applicable mitigation measures will be found and analyzed through those already taken in other successful cases, including the Canada-Quebec Water Supply Expansion Program Dams (CQWSEP), the Sarney Dam and Water Supply System Project in Iran, and the Fortuna dam, etc.

Generally, mitigation measures could reduce negative impacts of dams by modification of its structure or operation, or by the changes to the catchment. Mitigation, a necessary part during the follow up process of project, has been the most widely used approach to reduce the negative effects of dams. It could be supported through the development of a wide range of
technical interventions, like making environmental flow releases to sustain downstream ecosystems. However, the understanding of complex processes and their interactions are required. Otherwise, the effectiveness of strategies will be limited. Some undesirable impacts will even be caused without detailed studies conducted primarily. (Agriculture of Canada, 2006) In specific, the following effective mitigation measures will be stated in terms of their purposes of protection.

**Mitigation Measures Specific to Protecting Wildlife and Sensitive Species**

With respect to the protection of wildlife and sensitive species, the mitigation measures of the Canada-Quebec Water Supply Expansion Program Dams are detailed in the following:

- *Avoid working during sensitive periods such as the breeding season or when migratory birds or other wild animals are present near the work site and may be bothered. Contact the competent authorities to find out about sensitive periods and avoid working at that time.*

- *Survey the work area to identify active nests, dens and burrows in order to avoid disturbing them during the course of the work.*

- *It may be necessary to consult Environment Canada (species at risk in Canada and migratory birds), to check whether sensitive species will be affected by the work.*

- *If aquatic species marked out as at risk (federal law) or marked out as endangered or vulnerable (provincial law) may be present within the work area, consult Fisheries and Oceans Canada or the ministère des Ressources naturelles et de la Faune du Québec experts to know the appropriate measures required to reduce the impacts.*

  *(Canada-Quebec Water Supply Expansion Program Dams, 2006)*

While responded to the reduced population of fish and terrestrial wildlife, introduction of Lake Species into reservoir has been used as an approach to minimize the negative effects of dams on fish population. It is a special measure, which could be an option in special condition. There have been more than 1.5 million fish (i.e. salmon, rainbow trout and brook trout)
introduced into the Williston Reservoir in British Columbia, Canada (IEA 2000).

**Mitigation Measures Related to Soil Erosion and Sedimentation**

In terms of the mitigation measures responded to soil erosion and sedimentation, the Canada-Quebec Water Supply Expansion Program Dams set out principles and details about how to avoid or minimize that effect.

- Avoid rejecting fine particles into the stream. Set up devices to retain sediments and materials that may end up in the stream (e.g. geotextiles, bales of hay). Ensure that the site is stabilized before removing sediment retention devices.
- Whenever practical, divert direct runoff water and drain water away from work areas and areas where soil is exposed or unstable.
- Ensure that sediment-filled water is evacuated on lands or in a sedimentation tank before returning to a stream or body of water (during construction phase, water pipe cleanup, etc.).
- Dispose of the excess of soil removed during levelling in order to prevent storm water from carrying fine particles into the stream.
- Quickly stabilize, as much as possible, the exposed areas within the receiving stream's buffer strip to avoid any risk of sediments being carried down to the aquatic environment.
- Restrict clearing, stripping, earthmoving, and ditch or stream levelling work and, as much as possible; complete it immediately before beginning the installation work.

(Canada-Quebec Water Supply Expansion Program Dams, 2006)

Besides of the measures above, another successful example is the Fortuna dam in Panama. Catchment management works successfully, as an effective mitigation measure, to limit the erosion and sedimentation. A 10 km2 reservoir is surrounded by a 160 km2 natural reserve. This limits erosion and reduces sediment deposition in the reservoir (Leibenthal 1997).

**Mitigation Measures Specific to Protecting Fish Habitat**

As to the protection of fish habitat, mitigation measures of the Canada-Quebec Water Supply Expansion Program Dams have been undertaken as stated in the below.
China’s 2003 Environmental Impact Assessment Law and Dams: How Effective Is It

- Complete work in an aquatic environment (receiving stream) so to avoid sensitive periods (spawning, egg incubation) for fish. When possible, work should ideally be completed during low flow periods. Minimize the duration of the work carried out in a water body.
- Avoid setting up facilities in a critical habitat for fish.
- Ensure facilities do not block the free passage of fish.
- If aquatic species marked out as at risk (federal law) or as endangered or vulnerable (provincial law) may be present within the work area, consult Fisheries and Oceans Canada or the ministère des Ressources naturelles et de la Faune experts to know the appropriate measures required to reduce the impacts.

*(Canada-Quebec Water Supply Expansion Program Dams, 2006)*

In addition, man-made spawning areas could try to create during mitigation process, or attempt the construction of shallow water habitat. For example, new spawning grounds were successfully created in the upgrading of the Riviere-des-Prairies project in Canada (IEA 2000).

**8.2 Changes Should Be Made to Improve the Effectiveness of China’s EIA**

With the experience in China’s EIA, the government of the People’s Republic of China adopts a new EIA Law in 2003, in which strategic environmental assessment (SEA) complements the project-oriented EIA process. Here in this section, the weaknesses of China’s EA will be analyzed through secondary literatures review and comparison with EA legislation of Canada. In this way, those weaknesses could be changed in the following future.

**Vague accountability**

The China’s 2003 EIA law shows many significant advantages than that of the old Chinese EA process. There are however several significant weaknesses. To begin with, the responsibilities of China’s EA are vague, which need to be made clear. *(Wang et al., 2003)* Compared to Canadian EA, there is considerable discretion of the “peoples’ government” in
China’s 2003 Environmental Impact Assessment Law and Dams: How Effective Is It

China’s 2003 EIA law. It designates that the “competent department” is authorized not only to “organize the review group” for the EA Report but also to develop the review methods. Besides of that, the final decision whether approving the project or plan or not also depends on the decision of the “people’s government”. (China, 2003) This is a very serious problem, which should be stipulated clearly in the EA law. The government could be divided into the state or municipal level according to the different type and location of project. But the people who will exactly make the final decision have not been indicated in the full text in 2003 China EIA law. This issue should be elaborated clearly to avoid the inconvenience.

In Canada, the responsible authority with respect to a designated project that is subject to an environmental assessment could be the Canadian Nuclear Safety Commission (for activities regulated concerning the Canadian nuclear safety issues), the National Energy Board (for activities linked to the Canadian oil, gas and other energy issues), the federal authority (performs regulatory functions), and the agency (activities linked to the agency as specified in the regulations). The responsible authority makes final decision or the Review Panel will make recommendations to Minister. (Canada, 2012)

In addition, another important issue faced by China and many other countries arises. How detailed and prescriptive should the EIA legislation be, and on the contrast, how much discretion should be given to the competent authorities (Wood, 2002). Current EIA regulations in China tend to be too universal, so that the actual requirements for individual EIAs, especially different types of projects, are not clear or are not covered at all. Finally, the “no go” option for plan or project is not stipulated nor implied in the EA legislation.
Decentralization

There are inevitable concerns about the consistency of EIA practice and quality from one region to another with the decentralized nature of the China’s EIA law (SEPA, 1998).

“The administration of EA is decentralized with the exception of nuclear facilities, projects spanning several provinces and projects of national interests, the decision-making power on EIA review and approval to the provincial and municipal level environmental protection units depending on the location of the project or plan.”

(Yap, 2005)

There are some recognized merits of decentralization. It allows for ensuring the relevance of the impact assessment to the detailed context of project. However it also carries potential risks. As a less developed country, there will be no sufficient resources, no adequate EA training of personnel and no enough public environmental awareness in many cases, especially in rural areas of China. Under these conditions, the environmental protection units in the local level will become extremely vulnerable to the pressure for job creation, as local government officials cater to employment creation by developers for their political influence (Yap, 2005). The China 2003 EA legislation states that the public is encouraged participating in the review process of EA. But there are no mechanisms stipulating on how the public is to be informed, encouraged to participate in the EA process, and how the public is to behave more effectively if they participate in the EA process. (China, 2003) While in Canada, the public participation is much more developed than developing countries. The right of involvement in EA process has been ensured by people’s high awareness of environment protection and more significantly, by the power of Canadian EA. It unequivocally stipulates when and how to be involved for the public.
Narrow historic focus on biophysical and economic issues

The scope of the Chinese EIA is exclusively biophysical and economic. With narrow historic emphasis on pollution prevention and control of air, water and soil, there is no requirement to examine social, cultural or health impacts of plans or projects, or to investigate project alternatives in China’s EA. The resulting system mainly focused on projects, rather than policies or programs, and has tended to be more concerned with direct impacts of projects, especially the pollution on air, water and soil. (Chen et al., 2007)

Social and ecological impacts, and indirect and cumulative impacts, have not generally been treated with same level of recognition. Therefore, it is suggested that some social and ecological policy and technical measure could be introduced into the China’s EIA legislation. For instance, the resettlement policies, a separated legislation in China, influence a lot to human being’s life. It is important to be considered, particularly when a project or plan involves the displacement of residents.

This issue is not helped by the tendency of independent working of environmental protection agencies. In China, the provincial, county and municipal environmental protection authorities work separately, but not incorporated. The duplication is inevitable and reduces their working effectiveness in this way. Actually, EIA could play a wider role to encourage sustainable development, but this requires a longer-term view and greater attention to the assessment of policies. The EIA projects also should not be limited to only the territory of China, so that the negative impacts to other countries could be managed. As stated in the Canadian Environmental Assessment Act (2012), it aims to ensure the projects, which are to
be carried out not only on federal lands but also those outside Canada in a careful and precautionary manner to avoid significant adverse environmental effects. (Canada, 2012)

Lack of consideration of alternatives in EIA process

The alternatives usually involve the content of location, scale of the project, processes and technology, site layout, operating criteria, and mitigation measures. The consideration of alternatives means early incorporation of environmental concerns into the design of project. It encourages more open decision making. There is also ‘no action option’ for alternatives. Overall, however, the consideration of alternatives is lacked in China’s EIA system. There are no legal provisions for the consideration of alternatives either during China’s EIA process or in the EA Report. (Yan et al., 2003)

In China, proposed construction projects would go through a set of planning phases. A major part of the first phase is the Project Proposal, determining the location of the project. Local Environmental Protection Bureaucracies will be required to conduct on-site inspection before EA review. Besides of that, a preliminary environmental evaluation will be conducted before project registration by the local planning authority, with their comments included. Frequently, EIAs are conducted after a site has been chosen and signed, removing the option of alternative sites. (Yan et al., 2003)

In regard to consideration of alternative technologies, it ensures all emissions and discharges from the project meet corresponding standards. However, in practice, most developers simply pass EA with an expanse of minimum cost solution. There is no further change in the current provision in China’s EIA procedure.
Lack of effective public participation

It is world widely agreed that the participation of potential affected parties is a core principle of good EIA (Wood, 2002). However, effective public involvement is largely missing from the current EIA system in China. Only short of operational rules for public participation was substantiated in practice. As stated in article 15, the China 2003 EIA require developers to consult relevant organizations and local people to include their comments in the EIR produced. This form of public participation is rather narrow, which does not indicate the way how to be involved in China’s EIA procedure.

“The process should provide appropriate opportunities to inform and involve the interested and affected publics, and their inputs and concerns should be addressed explicitly in the documentation and decision-making.”

(Article 15, China 2003 EIA law)

In the view of weak public involvement in China’s EIA, the reasons include the huge population in China, lack of budget, political unwillingness, and lack of environmental protection awareness by the public, et al. As a consequence, the government should include the wider community, not just one-sided representatives. And developers could do more than the minimum for purposes of project, but achieve a better EIA plan. (Yan et al., 2003)

With increasing income and living standards, public interests in environmental issues have been increased, and public awareness of environmental protection has been largely improved in China. More of China’s EIA experts begin to consider the public participation as a mechanism to improve the quality of EIRs, and monitor and ensure the effectiveness of EIA practices. However, it is noted that most of environmental protection agencies are being funded by development-oriented local government administrations in China, which is
weighted against the final EA decision. It is important to balance the relations and avoid the influence of fund on EIA decisions.

9. **Limitations of The Study**

The proposed study takes the case of Three Gorges Dam Project as example, which was undertaken within Yangtze reservoir area in China. The researcher expected to get more details of the TGD impacts and mitigation information through various sources of literatures. However, many villages were flooded and over 1.4 million residents were relocated, which caused difficulties for rich experiential data from communities in secondary data. The huge number of relocated residents moved afar posed a significant limitation to that area. It is impossible to find literatures, which contain the ideas from each person. As a result, the data used in this paper is on the basis of an overview of related academic journals and government reports. The results were limited to some extent, because the data is restricted from a small sample compared with the large number of people affected.

In addition, as the original communities have been relocated afar and some community members were even displaced separately with each other. This added to the difficulties for collecting related information of impacts from relocated communities. Therefore, it might lead to the incomprehensive secondary data.

10. **Conclusion**

The literature is analyzed into an overview of the impacts of the TGD project in China, the influence of China’s EIA law on dams and the challenges of effective mitigation measures.
In depth policy analysis compared to Canada helped the researcher understand some of the advantages and limitations, and then conclude changes to China’s 2003 EIA law.

The current EIA system was primarily designed as a pollution control procedure, although the last 10 years have seen attempts to address other issues of ecological, visual, and social impacts. The China 2003 EIA law does not contain further change for provisions to the project level EIA. Therefore, the pollution based model will still tend to dominate practice. (Stender et al., 2003)

As is stated in the paper earlier, without doubt, the China 2003 EIA law does indeed play a role in protection of environment, creating a voice for opposition to irresponsible dam practices, and driving some environmental and social responsible practices for mitigation. Initially, the EA problems are clearer to the public than before, which could not be ignored. Then people have easier access to information due to the development of technology. In particular, many developing countries try to achieve the democratic society through transparency of information. Thirdly, the awareness of the public on environmental protection has been improved under the training of basic EA knowledge. People understand more factors their interactions about projects. The public participation starts to play an important role in EA decision making. Furthermore, the media works well effectively than before and become the force taken into account by the government.

There are however several weaknesses of China 2003 EIA law and changes should be made correspondingly. The first issue is the vague accountability. Clear responsibilities of the power of whom and the decision of how to decide should be identified in the law. Secondly,
decentralized administration of EA in China leads to inevitable concerns about the consistency of EIA practice and quality from one region to another. Also, narrow historic focus on biophysical and economic issues should pay more attention to examine social, cultural or health impacts of plans or projects, or to investigate project alternatives. Weak public participation is still the significant problem of China’s EA in spite of some improvement in recent years. In particular, there is no statutory requirement for the full EIR to be made available to the public. And there is no apparent provisions about the “no go” option for project in China’s EIA law. The explicit requirements about what extent of the project should be rejected have not been implied.

10.1 Areas for Further Research

The effect of China’s 2003 EIA law to dams and its weaknesses is very contentious, and the researcher believes there are more areas that should be studied to gain a more comprehensive understanding. Future research could study the effective responsibility to be operated in both Canada and China. Originally the researcher was hoping to look at what responsibility could work effectively in China’s EIA process, but was unable to do so due to time constraints.
References


China, (2011). *Three Gorges follow up work plan.* [San Xia Gong Cheng Hou Xu Gui Hua, In Chinese]


Conservation Threat to the Indian Wild Ass. Biological Conservation.


Commission on Dams


World Commission on Dams. (2003). Dam Facts and Figures


