Donald Bren School of Environmental Science & Management
University of California, Santa Barbara

ENVISIONING PERMANENT RIVER PROTECTION STRATEGIES FOR CHINA

A Group Project submitted in partial satisfaction of the requirement for the degree of Master's in Environmental Science and Management

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Date

March 2010

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We proudly submit this Group Project report for display on the Donald Bren School of Environmental Science and Management web site, such that the results of our research are available for all to read. Our signatures on the document signify our joint responsibility in fulfilling the archiving standards set by the Bren School.

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The Group Project is required of all students in the Master's of Environmental Science and Management (MESM) Problem. It is a four-quarter activity in which small groups of students conduct focused, interdisciplinary research on the scientific, management, and policy dimensions of a specific environmental issue. The Final Group Project Report is authored by MESM students and has been reviewed and approved by:

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Robert Wilkinson

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We are also thankful to Dr. Oran Young and Dr. Tom Dunne, who in the positions of our external advisors, challenged us to more critically address the institutional and political climate of China, as well as the environmental and social implications, both positive and negative, of a river protection system.

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Our clients, Dr. Kristen McDonald (China Rivers Project) and Attorney-at-Law Michael Gheleta (Brownstein Hyatt Farber Schreck) were the impetus behind this important project. Kristen's passion, as well as her familiarity with China and river protection, assured us that our work would benefit a client who was deeply invested in making a difference. Both Kristen and Michael have led and completed river runs on China's most magnificent rivers, and are connected with Chinese officials and environmentalists who are eager to receive our work. We were reminded of the usefulness and timeliness of our project whenever we were able to meet and talk with them.

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China Rivers Project

China Rivers Project, founded by Kristen McDonald and Travis Winn in 2007, is a project of Earth Island Institute. The China Rivers Project's mission is "to protect China's river heritage for people and wildlife and to foster river based recreation in China", mainly through educational river trips to China's grand canyons. The Project also conducts research on the benefits of river recreation and river conservation.

Kristen McDonald

Ms. McDonald earned a PhD from the University of California at Berkeley in Environmental Science, Policy and Management, researching rivers and river conservation in China. Ms. McDonald received her undergraduate degree from Yale University where she studied Environmental Studies. Prior to graduate school, she worked in Hunan, China for two years as an English teacher and directed the Wild and Scenic Rivers Program for the U.S. river conservation organization, American Rivers, in Washington, DC for four years. She has coordinated three expeditions in China and is a former raft guide. She also reads, writes, and speaks Chinese. Currently she consults on environmental issues in China and is the U.S. Director of the China Rivers Project.

Brownstein Hyatt Farber Schreck, LLP

Brownstein Hyatt Farber Schreck is a law and policy firm in the western U.S. with offices in Colorado, California, and a number of other states. The firm practices in the areas of corporate and business, government relations and public policy, litigation, natural resources and real estate.

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ABSTRACT

Water plays a key role in China's national identity. China has been managing its rivers for over 4,000 years; yet today, after several decades of impressive economic success, the country faces the challenge of balancing goals for natural resource utilization and environmental protection. Increasing economic growth and resource use in China has created a need for water resource development projects that generate electricity, increase water supply, and provide flood control. The majority of these projects include the rapid construction of dams and water diversions. River development has many positive impacts on society; however, rivers left in a free-flowing state also offer significant benefits that are lost when a river is altered from its natural state. China can maintain the benefits that free-flowing rivers offer by establishing a legally enforced river protection system that safeguards some rivers from development by permanently protecting entire rivers or river segments. Increased public and governmental interest in environmental protection has produced an opportune sociopolitical environment for the inception of a river protection system in China. This project examined the Wild and Scenic Rivers System of the United States, the Canadian Heritage Rivers System, the European Union Water Framework Directive, and Norway's river protection scheme. We identified effective approaches to the creation and management of river protection systems, as well as characteristics that enable their viability. An examination of the current environmental laws and institutions in China has enabled us to adapt our research findings from systems in other countries to the legal context and political setting in China. The potential environmental, social, and economic benefits of river protection identified in this project warrant the creation of a national river protection system. Based on our research and analysis, we have formulated recommendations for the design of a river protection system that Chinese decision-makers and stakeholders can use if a system is considered in China.

EXECUTIVE SUMMARY

China has a long and rich history of water management that has not only shaped the course of resource use in China today, but has also determined to some extent the Chinese philosophical view of man's relation with the natural world. Today, many of the same water-related challenges are faced by Chinese officials and resource managers, but governance must also take into account the largest human population in the world. 50,000 rivers form China's network of water bodies upon which the growing population relies; however, while the rate of economic growth has made China a world leader, the country's expansion has increased the use of natural resources, and significantly impacted the natural environment. Water, in particular, has become increasingly scarce in the North, and rivers that were once pristine are severely polluted. The same dilemma impacts a number of large nations, but China has made impressive strides to balance economic development with environmental conservation so that natural resources can be safeguarded for the future.

Project Purpose

The time is ripe for a river protection system in China

China's extensive network of rivers is relied upon for water supply, navigation, maintenance of biodiversity and ecosystems and for electricity generation. Development of many of these rivers has allowed the Chinese government to reduce dependence on coal for the generation of electricity; however, some of the unpreventable costs of dams, diversions and levees are the alteration and degradation of free-flowing rivers and their immediate environments. Only a handful of river protection systems have been established around the world, but these systems *do* preserve a number of rivers, along with the often overlooked values which rivers possess. A dialogue regarding approaches to river protection has begun between Chinese governmental officials, environmental experts, and the Chinese environmental NGO community. Chinese leaders have demonstrated their intent to perform comprehensive decision-making that ensures thorough environmental impact assessment before the inception of major dam projects so that rivers can be sustainably utilized, and so that the communities and ecosystems that depend upon them are not jeopardized. Officials have also expressed interest in looking at the river *protection* strategies that are employed by other nations, with the consideration of developing their own that will meet the needs of China's environment. Therefore, it is a propitious time for researchers and organizations, such as the China Rivers Project, to demonstrate to these officials the benefits of permanent river protection and cite examples of successful programs around the world.

Methodology

River protection systems around the world can be studied to understand how river protection is implemented

We studied the Wild and Scenic Rivers System of the United States, the Canadian River Heritage System, Norway's river protection scheme, the European Union Water Framework Directive, and a number of emerging river protection systems to identify the drivers of implementation, common features that are important to inception and functioning, and unique features that have enabled protection in various political and cultural contexts. We knew that replication of any one of these systems would not be best suited to China, as each operates within a different geographical, political, and social context. To better understand the concept of river protection and how it can be achieved, we developed a framework matrix to compare various features of each of the countries' protection systems. This matrix allowed us to distinguish the systems' similarities and differences in order to eventually make recommendations for river protection in China. The evaluation of the framework matrix ultimately guided our determination of the attributes and conditions that are necessary when designing an effective system for river protection.

Identification of the differences and commonalities of the systems has created a background from which to draw meaningful conclusions. We have concluded that efforts to improve water quality and protect free-flowing rivers drive the initiation of all river protection systems. We also found that a river protection system is most likely to commence when there is legal support behind the system, and government officials and agencies work together to establish a designation system and mechanisms for management. In addition, when comprehensive management plans and the infrastructure to support them exist, rivers are more likely to be effectively and permanently protected. Finally, when a diverse set of stakeholders, including the impacted public, have the opportunity to contribute their comments during study processes and development of management plans, the public is more likely to become stewards of the river.

River protection goals must be aligned with the institutional structures and environmental laws in place in China

In addition to our river protection systems research, we have become familiar with the operation of the Chinese legal system and the institutional structures for environmental protection in China, especially in relation to water and river management. This aspect of our research is imperative because although we have learned about a number of river protection systems, all of which operate within disparate legal and institutional contexts, we must also be certain that our recommendations are useful to Chinese decision-makers, who better

understand the likelihood of inception of all aspects of a river protection framework in China. Many of the laws that we studied pertain to water quality and pollution prevention or water supply and management. The existence and enforcement of these laws could help to support the designation/protection of rivers that would be managed for their drinking water quality, as an example. The goals set by the 11th Five-year Plan are likely to be met if some rivers, their ecosystems and surrounding habitats are protected. We have also concluded that public participation – which has growing legal and institutional support – will be essential to the establishment of a river protection system, and more importantly, to the perpetuity of river protection. The Measures on Open Environmental Information and Public Participation in the Environmental Impact Assessment indicates that environmental decisions in the future will be influenced by the public's needs and concerns.

ENVIRONMENTAL LAWS IN CHINA DISCUSSED IN THIS REPORT:

- Environmental Protection Law
- Water Law
- Water Pollution Prevention and Control Law
- Environmental Impact Assessment Law
- Regulations on Nature Reserves
- Renewable Energy Law
- Regulations for Registration and Management of Social Organizations
- Provisional Measures on Public Participation in the Environmental Impact Assessment
- Measures on Open Environmental Information
- 11th Five-year Plan

The infrastructure that supports all of the laws that we studied is critical to their strength and effectiveness. Most of the enactment and enforcement of these laws comes from the central government and from a variety of ministries with specific tasks and functions. River protection, as indicated from the global examples we have studied, can be achieved if a law or act is passed that specifically indicates to whom responsibilities will be given and how the system will be carried out. For China, this means that a river protection system will need to be established as a new law in addition to current laws, and it can be administered by authorities that are already in the practice of water management. The authorities that are best suited to this purpose are the Ministry of Water Resources, the Ministry of Environmental Protection and the National Development and Reform Commission.

Deliverables

Free-flowing rivers offer many benefits that are often overlooked by decision-makers

In order to demonstrate that river protection will be beneficial to China, our group project team has created this report which explains the various environmental, economic, and social benefits of rivers that are left in a free-flowing state or that are protected from new major development projects. An extensive literature review has provided a majority of the information necessary to accomplish this objective. Environmental benefits that result from the protection of rivers include a number of ecosystem services. Some of these include: regulation of flood levels, improved water quality both for drinking water and aquatic habitats, and sufficient nutrient and sediment transport. Rivers also provide rich and varied habitats that support biodiversity. Economic benefits include profits from fisheries, recreation, tourism, and the avoided costs of dam removal or repair. Social benefits include intact local communities, preserved cultural and spiritual practices, and continued livelihoods, as examples.

A preliminary river protection framework for China has been developed

After synthesis of our research about the values of free-flowing rivers, river protection systems and Chinese laws and institutions, we have provided specific recommendations for the design of a river protection system and its incorporation into the existing legal infrastructure in China. Our recommendations include a host of river protection measures that can be applied to near-pristine rivers and river segments, as well as to rivers that are already affected by some form of development. Designation of rivers based on current accessibility and values has been laid out, as have measures that address the nomination, study process, approval, administering authorities, management plans and monitoring – all of which are explained in detail in our specific recommendations.

A value assessment tool guides the study process

We have created a Value Assessment Tool for the Benefits of River Protection which can assist Chinese decision-makers in their consideration of protection of nominated rivers. The purpose of this tool is to highlight the benefits of river protection and the values that rivers possess which are often overlooked. Some of these include preservation of geologic structures and cultural relics, maintenance of riverside livelihoods and traditions, as well as pristine beauty that can be enjoyed by residents and by tourists who come to recreate. The results of this tool can eventually be balanced against the costs of protecting a river, which may be quantified in the form of recognized values such as hydropower, flood control, navigation, and water supply. This tool does not

perform a cost-benefit analysis, since costs are not included; rather, it serves as a reminder of the benefits of river protection. Analysis of benefits and costs can be undertaken by an interdisciplinary team with representatives from the administering authorities of the national river protection system in order to approve the protection of rivers.

Conclusions

China can continue to develop and prosper while retaining its environmental integrity, but this can be accomplished only if development projects continue to be preceded by comprehensive analysis of potential impacts of development of natural resources. New protection programs and management methods undertaken by the Chinese government may also be imperative to the successful preservation of these resources. A river protection system is just one avenue by which the balance between development and environmental protection can be attained. The utilization of rivers is vital to human survival, but their non-use values are closely tied to the social identity and history of China. Therefore, through the establishment of a river protection system, China can ensure the longevity of one of its most precious and vulnerable natural resources - its rivers. Our clients' plan is to translate our full report into Chinese to share with Chinese stakeholders. As a result of our deliverables, we hope that the China Rivers Project and decision-makers in China have the information necessary to demonstrate how a permanent river protection system can safeguard some of China's most precious waterways forever.

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ACRONYM LIST

CHRS –	Canadian Heritage Rivers System
CSO –	Civil Society Organization
DWR –	Department of Water Resources
EIA –	Environmental Impact Assessment
EIR –	Environmental Impact Report
ENGO –	Environmental Non-Governmental Organization
EPB –	Environmental Protection Bureau
EPL –	Environmental Protection Law
GONGO –	Government-Organized Non-Governmental Organization
IBAMA –	Brazilian Institute of the Environmental and the Renewable Natural Resources
IDAM –	Integrative Dam Assessment Modeling Tool
INGO –	International Non-Governmental Organization
MEP –	Ministry of Environmental Protection
MOC –	Ministry of Culture
MOJ –	Ministry of Justice
MWR –	Ministry of Water Resources
NEPA –	National Environmental Policy Act (United States)
NEPA –	National Environment Protection Agency (China)
NGO –	Non-Governmental Organization
NPC –	National People's Congress
NPO –	Not for Profit Organization
NRDC –	National Development and Reform Commission
NTA –	National Tourism Administration
PES –	Payment for Ecological Services (Costa Rica)
RBC –	River Basin Commission
SEA –	Strategic Environmental Assessment
SEPA –	State Environmental Protection Administration of China
SFA –	State Forest Administration
UNESCO –	United Nations Educational, Scientific and Cultural Organization
WCD –	World Commission on Dams
WFD –	Water Framework Directive (European Union)
WRB –	Water Resource Bureau
WSRA –	Wild and Scenic Rivers Act

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1. INTRODUCTION

Background

For over 4,000 years rivers have shaped a deep cultural history in China and played an integral role in sustaining China's livelihood and expanding economy. Ma Jun, an environmentalist, has stated that the Yangtze River and its tributaries directly support more than 400 million people. Yet today, at the turn of the 21st century, water supply and resource management issues have emerged as two of the nation's leading environmental concerns, as demand increases, supply becomes less secure, and water quality is threatened. These issues are not unique to China, however, as development of water resources has occurred worldwide to meet these needs; still, many nations face the challenge of balancing development with environmental protection. Only 40 years ago, the United States, partly in response to the polluted Cuyahoga River catching on fire, passed the Clean Water Act and a number of other environmental laws to address pollution and resource protection.

China Today

The emphasis on a harmonious society is a significant feature in Chinese culture (Abbott 1970; Washington Post 2006). China's Communist Party endorsed this political doctrine four years ago in order to shift the focus "from promoting all-out economic growth to solving worsening social tensions" (Washington Post 2006). A number of Chinese environmentalists have explained that it is important to not let economic growth interfere with living harmoniously with nature (Ma Jun 2004).

In response to the nation's rapid economic growth which has depleted natural resources, degraded major ecosystems, and polluted areas that extend beyond its borders, China is now promoting a circular economy led by the National Development and Reform Commission. A circular economy balances economic development with resource and environmental protection. China has implemented this policy to more successfully and more efficiently utilize resources, while also emitting less pollution. The circular economy is being implemented into areas such as enterprises and eco-industrial parks (Yong 2007). One important component for the implementation of a circular economy is natural flow management, as well as eco-efficiency.

China's Environmental Achievements

In 1978, an economic reform was initiated to modernize China's mainland economy. Initially, it was a challenge to motivate farmers and workers to produce larger surpluses, but it eventually helped lift millions out of poverty; in 1981 the poverty rate dropped from 53% to 12% (The World Bank 2010).

Not only has China focused on economic reform, but government programs have already been implemented to lead China into a more sustainable future. Since the middle of the last century, and particularly in the last decade, China has made great strides in protecting the environment and improving its environmental performance. For example, since the 1950's, China's Nature Reserve System has steadily increased from designation of less than 100 sites to almost 1,000 sites by 1998 (Harkness 1998). In addition, one of the most severe environmental issues in China is soil erosion. To address the problem, China's government implemented a 10-year reforestation project in 2002 to plant 76 million hectares of forest. This project is expected to minimize droughts and floods and stop deserts from expanding (Xinhua News Agency 2002). In many parts of China, desertification has become a major issue. 3.3 million hectares of grassland have disappeared along with a number of rare animal species. This severe problem warranted a strong solution; thus the largest reforestation project to date was begun (CIIC 2002).

The Grain for Green Program (GGP), implemented 9 years ago, set out to control soil erosion on sections of the Yangtze and Yellow River by converting farmland (on unsuitable land) into conservation land (forest or grassland). Farmers who participated in the program were given different types of compensation: grain, cash, or free seedlings to be used for afforestation. The program successfully decreased both sediment discharge and sediment concentrations in the Yangtze and Yellow Rivers and also decreased soil erosion (Saito et al. 2001).

Permanent Protection System for Rivers

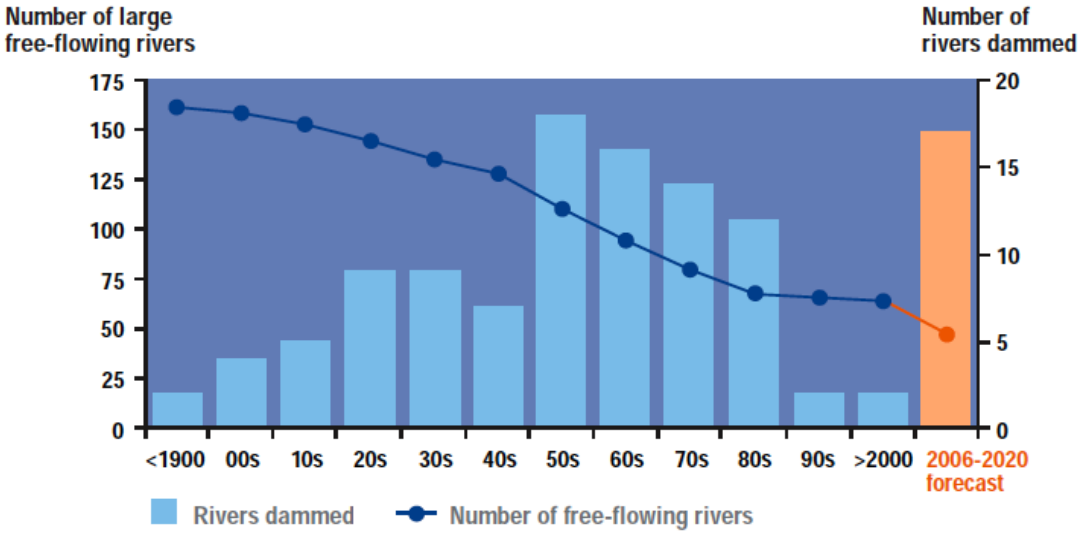
China has a 4,000-year history of river management and regulation (Dudgeon 1995); however a river protection system does not currently exist. Chinese leaders have the opportunity to safeguard some of China's free-flowing rivers or river segments so that these resources can exist for generations to come. With a river protection system, China can continue to develop and prosper while retaining environmental integrity. By protecting some of its rivers in their free-flowing state, China will be carrying out its goal of sustainable development.

The protection of rivers, particularly free-flowing rivers, has immense benefits for the environment and populations depending on those rivers – a free-flowing

river is defined as one that is undeveloped and flows from source to mouth undisturbed (WWF 2006). Few rivers remain in their natural or free-flowing state today; however, protection of river segments can provide environmental, social, and economic benefits.

Worldwide, there has been a growing increase in the recognition of values that free-flowing rivers possess. The United States, Canada, the European Union, and Norway have all created river or water protection systems that allow for stretches of a river to be protected to preserve a free-flowing state (WWF 2006).

FIGURE 1.1: RATES OF DAMMING OF FREE-FLOWING RIVERS.



Source: WWF 2006.
This figure shows the rate at which large free-flowing rivers have been lost. The decline in the number of free-flowing rivers began in the first half of the 20th century. Around the 1950s, 20% of the world's rivers had been dammed; more than half of those rivers dammed were in North America. Only 68 large free-flowing rivers were left in 1990.

As the values of free-flowing rivers are more widely recognized, the damaging effects of dams are also being acknowledged. All over the world dams are being decommissioned and rivers are being restored.

China has certainly made progress to address environmental problems; but efforts toward its rivers can be improved . With the pace of river development in China and growing demand for greater environmental protection, now is an opportune time to establish a river protection system with legal and institutional support. Dialogue regarding new approaches to river protection has already begun between Chinese governmental officials, environmental experts, and the NGO community. The Chinese government is also increasing their interaction with other nations, as they work to meet international environmental protection

targets and learn how protection systems can be both successful and sustainable.

Our Role

We have been asked by the China Rivers Project to provide recommendations for the design of a river protection system for China. A number of government officials, NGOs, and stakeholders have been in contact with the China Rivers Project and have asked for information regarding (1) how river protection systems operate in other countries and (2) what strategies from those systems might be applicable to China.

Project Significance

There are pressures on Chinese decision-makers to balance continued economic development with environmental sustainability. China has an opportunity to align its stated goals of environmental stewardship with economic growth (Lieberthal 1997), especially if leaders can demonstrate the economic, environmental and social benefits that result from the protection of natural resources, and specifically rivers.

Today there are a number of reasons why a river protection system might be applicable to the Chinese context. With the impressive growth of a legal system and body of environmental laws, China has the legal and institutional capacity to administer a river protection system. Currently, several ministries are involved in water management and conservation efforts that serve as an example of the government's capacity and commitment to water resource protection.

Deliverables

After synthesis of our research, we have provided recommendations for a river protection system to be incorporated into the existing institutional framework in China. Included are recommendations for the design and administration of a system. The river protection measures we detail can be applied to entire rivers or river segments, thereby affording many types of rivers consideration for protection. Decision-makers may find these suggestions useful to the creation of a river protection system for China. Additionally, a Value Assessment Tool (see Section 7.4) was created that allows decision-makers to assess the beneficial values rivers may possess and prioritize rivers for protection. As a result of our work, the China Rivers Group Project Team hopes that China Rivers Project, and perhaps decision-makers in China, will have the information necessary to demonstrate how a permanent river protection system can help China meet its resource protection goals.

2. RECOMMENDATIONS FOR THE DESIGN OF A RIVER PROTECTION SYSTEM FOR CHINA

River protection systems allow for the assured preservation of the many natural values that free flowing rivers provide human and natural communities. Identifying and preserving rivers that possess unique and outstanding values can provide a balance between development and conservation of natural resources. Our research of existing river protection systems, as well as the environmental, social, and economic benefits of river protection and the legal and institutional structure in China, have led us to form the following general recommendations for the design of a river protection system in China.

Through our research, we have identified a key set of values for which we think a river could be protected to maintain environmental resilience and social integrity, while also providing economic benefits to local communities and the country as a whole. The framework presented includes a Value Assessment Tool – detailed in Section 7.4 – to help decision-makers appraise the outstanding values of a river in an undeveloped state and prioritize rivers for protection.

Through careful consideration of the legal authority and functional roles of various administrative offices in China, we have developed an organizational structure for a river protection system that promotes cooperation between government agencies and various levels of government. This system provides clear functional roles for each administrative organ based on functions they already provide individually. Our recommendations for the design of a system outline the river nomination and selection process, provide a stratified designation scheme, identify the roles of key authorities (including management, monitoring, and public participation), and provide environmental and governmental guidelines for maintenance of river values.

IMPETUS FOR THE SYSTEM

Free-flowing rivers possess a number of environmental, social and economic values. Free-flowing rivers are dynamic systems which support natural habitats and unique biodiversity, as well as maintain water quality; they also provide opportunities for recreation and tourism. If rivers are protected, these benefits are sustained. Further, the preservation of cultural traditions, local livelihood, and national heritage of riverside communities is also likely guaranteed when rivers are protected.

Due to concern over the loss of free-flowing rivers, especially as a result of the increase in development of hydropower projects to meet a growing demand for electricity, a national river protection system is recommended to the People's Republic of China. While a river protection system alone will not create the necessary balance between development goals and efforts to protect the environment, it will create the impetus for full-cost accounting of all relevant values that rivers offer in the decision-making process. Rivers possess a number of values in addition to the recognized utility of hydropower, flood control, navigation, and water supply. A river protection system would prohibit harmful development on, or along, an entire river or river segment which possess an outstanding value(s). The establishment of such a system can ensure the preservation of river values and the benefits derived from these values in perpetuity.

PURPOSE OF THE SYSTEM

Implementation of this river protection system has two main objectives:

- the **preservation** of rivers in their free-flowing state
- the **protection** of rivers and their adjacent lands from new development that may degrade the values for which a river has been protected

EXTENT OF PROTECTION

An effective national river protection system should protect rivers and their immediate environments (as an example, the United States Wild and Scenic Rivers Act protects "related adjacent land" within ¼ miles of each of the river banks) from any additional development which negatively impacts the values for which the river was designated. Under this system, either an entire river or segment of river can be protected; however, riverside residents will not be prohibited from continued use of the river in accordance with protection management plans. The official boundaries of protection, both on the river and its immediate environment, will be determined and reported during the study process and included in the study plan submitted for final protection approval.

VALUES FOR WHICH A RIVER CAN BE PROTECTED

A river that is eligible to be included in the system is a free-flowing river or river segment, along with its immediate environment; the river or segment should possess one or more listed outstanding value, for which it will be managed. These values fall into specific categories including: scenery, recreation, tourism,

biodiversity, habitat, fishery, wildlife, geology, historic, culture, or other outstanding values.

Some of the rivers in China that exhibit one or more of these outstanding values are listed below:

TABLE 2.1: POSSIBLE RIVERS FOR PRIORITY PROTECTION.

River & Location	Value(s)
Heilong River, Heilongjiang Province, NE China	scenic, wildlife, fishery, water quality
Tongtian River, Tibet	cultural, scenic, habitat, religious
Chishui River, Sichuan/Guizhou provinces	scenic, water quality
Tiger Leaping Gorge and the Great Bend of the Yangtze, Yunnan Province	scenic, cultural, geologic, historical, recreation
Nu River Grand Canyon, Tibet/Yunnan Province	biodiversity, cultural, recreation, scenic, geologic, fishery
Li River, Guangxi Province	scenic, tourism, cultural, fishery
Yarlung Tsangpo Grand Canyon, Tibet	scenic, geologic, ecologic/habitat, biodiversity
Mekong River (Lancang) Meili Gorge, Moon Gorge	scenic and biodiversity
Shanxi-Shaanxi Gorge on the Yellow River	scenic and historic
Taihang Gorges, Juma, Hutuo, Zhanghe, and Qinhe rivers, Henan Province	scenic, geologic
Guichun River, Guangxi province (Detian waterfall section)	scenic, historic, cultural, recreation
Jiulong River, eastern Yunnan	scenic, geologic (unusual waterfall)
Dabang River, Guizhou	scenic, geologic

Source: McDonald 2009, unpublished.

SURVEY OF RIVERS IN CHINA

Prior to opening the nomination process, the government of the People's Republic of China, aided by environmental NGOs and scientific experts, should

conduct a survey of China's rivers to provide baseline data, a list of potential rivers to be considered for protection, and identification of the observed outstanding values possessed by rivers. Special attention should be given to documenting rivers that remain free-flowing (or largely free-flowing), and that may have outstanding values. Although many rivers will possess a number of unique values, the approval of permanent protection for a river will depend on other considerations as well, such as proposed development projects and other economic and social circumstances.

A nation-wide water conservancy survey will be conducted by the government of the People's Republic of China over the next two years according to published reports (Yang 2010). China will attempt to quantify its water availability, the demand for water, and how pollution impacts its water supply (Oster 2010). The survey will focus on "the numbers of lakes and rivers, the conditions of water conservancy projects and the protection of rivers and lakes" (Yang 2010). The results will likely be important to the direction of water development projects (Oster 2010). Data compiled in this survey can provide baseline data for a survey that will look specifically at rivers that might be considered for protection.

PROCESS OF INCLUSION INTO THE SYSTEM

Nomination → Study Process → Administering Agency Approval → *Review*

NOMINATION

A river can be nominated for inclusion in the protection system by government administrations at various levels (such as local and central), Chinese NGOs, and citizens. Nominators should indicate the possible values that the river may possess. While nomination can be made by various parties, designation should be conducted by an official from the lead administering authority of the national river protection system.

STUDY PROCESS, REPORT AND PROTECTION APPROVAL

In response to a submitted nomination, a study process should be carried out by an authority responsible for administering the river protection system (*See 'Administering Authority' and 'Management' for a more detailed description*). The ministries which comprise the administering authorities should consider forming an interdisciplinary team to conduct a study of the nominated rivers to determine the characteristics and any unique values the rivers possess. A river should be determined as being eligible and suitable for protection prior to inclusion into the system.

Eligibility and suitability for protection can be affirmed if the nominated river:

- (1) is in a free-flowing state, (2) possesses a listed value(s) and (3) demonstrates sufficient measures for the long-term protection of the river (i.e., adequate funding, staff, enforcement and monitoring capacity)

A flexible ***Value Assessment Tool for the Benefits of River Protection*** (see Section 7.4) has been developed to aid in the study process. This tool can be used to evaluate the benefits of protection, which can eventually be weighed and balanced against the benefits of utilizing the river for hydropower, flood control, navigation, and water supply (i.e. an alternative analysis). Decision-making at this stage should be informed by scientific information and should take into account the environmental, economic, and social benefits and impacts of protection.

The information gained through the study process should be compiled in a study report.

Information contained in the study report should include:

- Assessment of eligibility/suitability
- Evaluation of benefits of protection
- Alternatives analysis (evaluation of alternative utilization of the river)
- Identification of the boundaries of protection (including the water body and immediate environment)

The lead administering authority can evaluate the study report and determine if the river should be approved for inclusion into the permanent river protection system.

REVIEW

If the administering authority determines that a particular river will not be accepted into the protection system, the original nominator(s) can request the review of the decision, at which time different experts within the ministry can re-evaluate the nominated river.

DESIGNATION/CLASSIFICATION SCHEME

Once a river is approved for protection, it should be assigned a level of designation, or category, based on its current accessibility and permitted uses on or near the protected river. A potential classification scheme that can be used to provide different levels of protection is explained below.

ACCESS

- Level 1 – limited access
- Level 2 – relatively accessible
- Level 3 – readily accessible

PERMITTED USES

- Level 1 – most limited use

  Local populations living near and/or are reliant upon the river for basic needs and survival should be permitted continue use and interaction with the river. The construction of new infrastructure near the river should not be permitted, however exceptions can be made for dwellings of the local population, but not for dwellings designed to house tourists.

- Level 2 – moderate use

  Recreational activities such as rafting, swimming, and fishing, which are minimally impactful, can be allowed on these rivers. Utilization of small-scale fisheries can also be permitted. Construction of structures to house tourists within the protected land adjacent to the river however, should be restricted.

- Level 3 – most uses permitted

  Ecotourism is encouraged within this level, therefore construction of facilities and basic lodging for tourists would be permitted. Additionally, more impactful river-based recreation such as boating, rafting, and sightseeing cruises, as well as large-scale fisheries could also be allowed. However, permitted uses and activities on Level 3 Rivers should not adversely impact the values for which the river was protected.

Note: A river can be afforded a higher protection level if it is determined that the river's ecological values are highly sensitive and susceptible to degradation.

ADMINISTERING AUTHORITY

Our analysis of Chinese laws and institutions indicates that a river protection system should be the responsibility of an existing national governmental authority or authorities involved in water management. We recommend that a river protection system be jointly administered by **the Ministry of Water Resources (MWR), the National Development and Reform Commission (NDRC), and the Ministry of Environmental Protection (MEP)**. Collaboration

between these agencies, all of which have different responsibilities, can allow for interagency support and oversight to ensure that the values and goals of the river protection system are being achieved.

The MWR is a strong candidate to serve as the lead agency for a river protection system, especially since it currently directs water resource management in China, with oversight in resource development and preservation. The Department of Water Resources (DWR), known as the National Water Conservation Office, under the MWR can also be delegated administrative authority and responsibilities. The DWR's main functions are to "take charge of management, allocation, conservation and protection of water resources; organize survey, assessment and monitoring of water resources; organize drafting and implementing national water resources plans…formulate protection plan for water resources, and direct water function zoning of water bodies; guide protection of drinking water sources and ecosystem". With the recognition of these existing functions, a river protection system appears to lie within the expertise of the MWR and DWR.

In addition, a river protection system may be enabled by the support of both the Ministry of Environmental Protection (MEP) and the National Development and Reform Commission (NDRC), whose current responsibilities and experienced staff can contribute to the operation of a river protection system.

The MEP has taken an active role in promoting and facilitating public participation, a feature that is noted to have been instrumental in the effectiveness of other river protection systems. Efforts to incorporate the input of numerous river stakeholders could be administered by this agency. The MEP also participates in in-depth study processes that precede environmental decision-making, so it could be tasked to collect baseline scientific information on rivers with potential for protection. Lastly, the MEP currently conducts environmental monitoring of existing protected areas in the country and could provide oversight to ensure adherence to river management regulations.

The NDRC is responsible for the licensing of development projects as well as the coordination of national, social, and economic development plans. The NDRC's involvement in the river protection system can be a coordination role because it can communicate with the proper agencies to determine and ensure that development projects will not be licensed on protected rivers.

MANAGEMENT

Management of protected rivers and segments can be delegated to **local government agencies**, such as local water resource bureaus (WRBs) or local environment protection bureaus (EPBs). Specific management assignment and management efforts may be determined by the values for which a river was designated. For example, an EPB may be best suited to manage river protection for a river with excellent water quality, while a WRB might be equipped to manage for values such as scenery, geology or recreation.

Local agencies may be responsible for the day-to-day administration of the river's protection including enforcement and monitoring.

The study process for a nominated river can also be assigned to the local agency under whose jurisdiction the river is located if adequate funding and personnel is available, otherwise the MEP can conduct the study.

In the event that a nominated or protected river crosses more than one jurisdiction, joint management by the local agencies or a River Basin Authority may be appropriate. National management may also be appropriate if the coordination of local agencies in the management of the river would be inefficient or less effective.

River protection management is likely to be successful if a training program is provided for future river managers. An understanding of the experiences of those who have already implemented and enforced river protection will aid those tasked to do the same in China.

MANAGEMENT PLANS

To provide a clear strategy for river management, the authority responsible for a river's protection should devise a river protection management plan. In the case of locally managed rivers, the local water bureau could be responsible for this effort. In the case of nationally/centrally managed rivers, the MWR or river basin authorities in consultation with the NDRC could be responsible for this effort.

Based on strategies employed in other successful systems, we recommend that a comprehensive river protection management plan be developed within one year of the inclusion of the river into the protection system, and reviewed and renewed every five years. Changes should be made to management plans when necessary to comply with the system requirements, especially the non-degradation requirement (*see below*). Each iteration of the plan should involve

public stakeholder interaction to maintain public connection with the process and to ensure that the values of the river maintain public visibility.

Management plans should be designed to ensure the maintenance of the values for which the river was designated. Managers should have the authority to limit certain actions from a protected area if they are deemed a threat to the maintenance of a river's protected values, even if the activity is deemed appropriate at a similarly protected river elsewhere. Riverside dwellers and their livelihoods should be also taken into account in the formation of management plans to ensure that their concerns are addressed and that their lifestyles, livelihoods are not compromised by the protection efforts of the river.

MONITORING

A regular monitoring program should be developed to ensure that the management plan is being followed, and that restricted activities are not occurring on protected rivers. Such a monitoring program could include the use of remote sensing, periodic onsite visits and inspections, online informational networks, and audits of river protection funding.

Ideally, monitoring should be conducted by a different agency or entity than the agency responsible for river management. Suitable candidates for such monitoring activities include the Ministry of Environmental Protection, local government bureaus such as EPBs or WRBs (depending on the designated management authority), or NGOs.

During the first ten years of the establishment of the system, monitoring should be conducted to observe and record the functioning of river protection throughout China. A national-level body, such as the MEP, should be responsible for the monitoring of river protection.

FUNDING AND ENFORCEMENT MECHANISMS

Funding for a river protection system should be allocated and maintained in order to ensure the protection of rivers and their surrounding environments. Administration and enforcement of the protection system require funding for trained personnel to conduct studies, the development of management plans, opportunities for holding public hearings, consultation with stakeholders, and the administering of on-site inspections and investigations.

Since the budgets of individual local agencies vary throughout China, the establishment of an online monitoring program is recommended for agencies with fewer available funds so that personnel will not have to conduct onsite

monitoring in order to maintain current information about protected rivers. Online monitoring in the form of remote sensing to determine river development, and the installation of computerized gages to monitor river flow are ways that agencies can decrease the administrative burden and provide the opportunity for reliable monitoring without hiring extra staff to manually conduct inspections. Additionally, an online database of this information would be useful to authorities responsible for river protection.

Public Involvement and Stakeholder Outreach

Once a river is nominated, the nomination should be reviewed by the lead agency. If the river nomination is accepted, a study process can begin and public notice of the river's nomination given.

The MEP can be assigned responsibility for providing online and written notice to the public and educating the public about the reasons for possible protection (i.e. potential values). Nominators may contribute to the educational process, especially via government-endorsed literature and forums. Over a period of 30–90 days, comments can be received, and education may be provided and public hearings may be held. The exact window of time for comment and hearings will be negotiable based upon the urgency of protection for each designated river.

The administering agencies should also identify groups that may have interest in a nominated or designated river's protection. The administering agencies may also develop a strategy for the involvement and consultation with interest groups and communities who are interested in understanding how river protection will impact their communities, and who are eager to voice their concerns. In addition, the administering agencies should be available to meet with stakeholder groups if a meeting is requested.

Once a river is designated as protected and a river protection management plan is developed, the public should be notified and given adequate time to comment. Any comments received should be reviewed by an administering agency, and necessary changes to the management plan should be made. Even if actions are not taken to respond to every concern, all comments should be noted so that their receipt and review is recorded.

Interagency and Government Coordination

Government authorities are encouraged to work with one another in the management and enforcement of protected rivers. For those rivers that cross jurisdictional boundaries, coordination between impacted provinces and cities is essential to the success of the river protection system. Information sharing

among government agencies and levels of government is also imperative. Study reports, management plans, scientific research, stakeholder and public comments are examples of the kinds of information that should be shared among government agencies to facilitate more informed, efficient and comprehensive river management.

INCENTIVES FOR NOMINATION

As an incentive for government nominations, a reward could be given to a government agency if a nominated river is selected for inclusion into the river protection system. The incentive can be in the form of improved reputation and special recognition by bestowing titles such as “Modern City”, “Ecological City”, “Circular Economy”, etc., or in the form of a monetary reward such as increased agency funds.

MOTIVATION FOR NOMINATION

Besides the incentives described above, there are many benefits to the protection of rivers whether they run through a province, municipality, prefecture, city, county, or township’s jurisdiction. Regions stand to improve their local economy with revenue from ecotourism to protected rivers and river sites, and many regions may also benefit from the preservation of the ecosystem services that rivers provide, such as water purification. In addition, protected rivers than run through cities and urban environments can also serve as efforts for urban restoration.

RESTRICTIONS ON GOVERNMENT ACTIONS

Government authorities or entities should be discouraged from funding and permitting actions that would directly and/or adversely affect the value or values for which the river was protected. Current environmental planning laws however, should safeguard protected rivers from degradation via newly proposed development projects. For example, during the EIA process the protected status of rivers would be exposed.

NON-DEGRADATION REQUIREMENT

Once a river is protected, its state should be maintained or enhanced, but it should not be degraded. Existing fish and wildlife populations and any legal protections afforded should also be maintained or enhanced. This requirement ensures that once a river is granted protection, it is managed and monitored so that activities that degrade a river’s values are not permitted. The requirement

also ensures that any status of environmental protection afforded to a land area or specific species in or around the river, such as a fish reserve, continues in addition to, or in replacement of river protection.

It should be recognized that some natural variability of river systems can be expected and that correcting for natural disturbance or perturbations is not the intent of this section.

LAND USE RESTRICTIONS

New mining, forestry, industry, and large agricultural activities can be prohibited within a defined distance from a protected river. Development related to eco-tourism can be undertaken only within the limitations set by the Key Protection Zones of China (identified in the 11th Five-year Plan).

ADEQUATE FLOW REQUIREMENT

Adequate flow should be maintained in a protected river to sustain healthy fish and wildlife populations and healthy river functions. Agencies should consider regulating upstream hydropower operations to adjust their release amounts/timing if necessary to meet this requirement. Legally protected minimum flows may be established based on values that are being protected (i.e. spawning, recreation, hydropower needs, etc.). This requirement should not be used to justify river restoration activities, since the river protection system aims to maintain the *existing state* of a river *at the time of inclusion* into the system. Any river restoration activity can be considered in a separate process by the appropriate government agencies.

Note: Any effect this requirement would have on hydropower operations is likely to be included in the alternative analysis performed as part of the study report before the decision to protect is made.

MANAGEMENT SCALE

Whereas multi-tier ecological zoning defines the boundaries of geological areas, the metric of functional water zones, as determined by the Ministry of Water Resources (Water Law 2002), may be applied to management of protected rivers. Therefore, smaller rivers can be managed by local authorities; all other rivers designated as protected can be managed based on zoning according to the Water Law.

FUTURE ELEMENTS OF A RIVER PROTECTION SYSTEM TO BE CONSIDERED

INTERIM PROTECTION

If the administering authority determines that a river is eligible and suitable for protection, interim protection status should be afforded to the river while final and formal approval is made. This status ensures the river is not degraded by a development project or other activity. Interim protection will be guaranteed with adequate funding and attentive enforcement.

CONSIDERATION OF ADDITIONAL PROTECTION STATUSES

If a protected river runs through land suitable for land-protection status, such as a nature reserve, consideration of the adoption of such status should occur. If a river that is nominated for protection runs through an area of land that has protected status, the river should be prioritized for protection. The rationale for these considerations is that since it has already been acknowledged that a river or area of land has sensitive or valuable environments worthy of protection, the protection of the land surrounding the river or river within a reserve can increase the success of the original protection.

3. LEGAL FRAMEWORKS

Often when a nation is considering the creation of a new law, policy, or management strategy, it can be helpful to examine those used in other nations, which may serve as a model or at least an example from which one's own law, policy, or strategy can be developed. With this in mind, we have examined established river and water protection frameworks, as well as emerging river protection systems to understand how the systems are planned and initiated, and what factors are important to their inception and sustained operation. Each of the systems described in this section can serve as an example of institutional efforts to protect the free-flowing nature of rivers. The frameworks examined in this report include: the Wild and Scenic Rivers Act of the United States, the Canadian Heritage Rivers System, the European Union Water Framework Directive, and Norway's river protection scheme. Three additional case studies of emerging systems, in Costa Rica, Australia, and Brazil, are also incorporated into this section.

A matrix that compares the four established frameworks and gives a concise overview of each system's characteristics and defining traits is also included in this section. The matrix serves as a tool to identify the commonalities and differences in the design and substance of each system. Through the research conducted on these systems and subsequent creation of the framework matrix, we were able to identify the drivers of origination, common features that were present in most, if not all, as well as a few unique features that were possessed by individual frameworks that bolster their effectiveness. We found that all systems were driven primarily by strong public demand for greater protection of either water quality or rivers in their free-flowing state. We also identified flexibility in nomination and designation of rivers and river segments, mandatory study processes, comprehensive management plans, requirements for government agency coordination, and strong public participation and stakeholder consultation interaction to be common among most if not all of the systems.

With the knowledge of the systems that was gained through our research, we were able to construct a design for a river protection system to fit the Chinese legal and institutional context. No existing or emerging river protection system will be a perfect fit for China since the systems reviewed are in countries with varying forms of government, populations, geography, and political climates. However, by looking closely at the each system to gain an understanding of why they had been formed, what enables protection, and how they are operated and managed, we were better positioned to offer suggestions for a system that may be useful to decision-makers if a river protection system is developed for China.

3.1 WILD AND SCENIC RIVERS SYSTEM OF THE UNITED STATES

INTRODUCTION

The Wild and Scenic Rivers Act (WSRA) was passed by Congress in 1968. Concern over the loss of free-flowing rivers prompted Congress to pass legislation that would give rivers and their immediate environments legal protection (IWSRCC 1998). By creating a national policy of river protection, rivers were recognized for values other than their use for hydroelectricity, increased water supply and other development. The WSRA has two primary purposes: (1) to preserve designated rivers possessing extraordinary scenic, recreation, fishery, or wildlife values and (2) to prohibit new water impoundments on designated rivers. Under the system, entire rivers or river segments can be designated. Originally, eight rivers were selected for inclusion under the WSRA protection system. Today, over 12,000 miles of 203 rivers in 39 states are protected under the Act (National Wild & Scenic Rivers 2009b), which amounts to about a quarter of 1% of the nation's rivers (National Wild & Scenic Rivers 2009a).

ADDITIONS TO THE SYSTEM

Rivers can be added to the system either by an act of Congress or by the initiative of states. Before Congress can authorize the inclusion of a river into the system, the river is examined according to a study process funded by Congress. This study process is conducted by the Secretary of the Interior or the Secretary of Agriculture if the river lies within a National Forest. A river can be added to the system on the initiative of a state, after the Governor makes a request to the Secretary. If the Secretary concludes that the river meets the criteria for inclusion, its incorporation is finalized by an act of the state legislature (Section 2, Wild and Scenic Rivers Act 1968).

STUDY PROCESS AND REPORT

The study process to determine a river's inclusion used by federal agencies consists of two basic steps. First, the agency must determine the *eligibility* of a river for Wild & Scenic status. To qualify for inclusion into the system, a river or river segment must (1) be in a free-flowing condition and (2) be deemed to have one or more "outstanding remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar value" which is unique, rare, or exemplary (IWSRCC 1998). Once a river is determined eligible, the agency provides interim protection of the river's free-flowing character and outstanding values. Second, a determination of *suitability* is made. This includes an assessment and weighing of the benefits and impacts of designation and non-designation. The agency then creates a study report to be reviewed by affected federal agency heads, the President, and Congress (IWSRCC 1999).

The study report includes (IWSRCC 1999):

- the area (river corridor) included within the report
- characteristics which indicate worthiness for addition
- the reasonably foreseeable potential uses of the land and water which may be enhanced, foreclosed, or curtailed if the area was included
- the Federal agency to be charged with the administration of the area
- the extent to which administration can be shared with State or local agencies
- the estimated cost of acquiring necessary lands and interests and of administering the area

If the agency determines the river suitable for designation, a formal recommendation is made to Congress and interim protection is applied by the agency until Congress acts on the recommendation. Congress reviews requests for inclusion based on the "comprehensive technical data" included in the report. Although a formal economic analysis, such as cost-benefit analysis, is not used in the study determination of suitability, economic considerations are taken into account (IWSRCC 1999).

DESIGNATION AND CLASSIFICATION

When rivers are designated for protection, they are classified as "wild", "scenic", or "recreational" based on the level of existing development. The definitions of these classifications are (Section 2(b), Wild and Scenic Rivers Act 1968):

> Wild – inaccessible except by trail, free of impoundments, primitive
>
> Scenic – accessible in places by roads, free of impoundments, largely primitive and undeveloped
>
> Recreational – readily accessible, some development along shoreline, undergone impoundment in the past

These classifications are important because they have a direct effect on how the river is administered and what activities are permitted on federally owned land. A single river could have several designated sections with differing classifications. The actual listing of rivers and river segments are very detailed based on topographical, infrastructural, or hydrological marking such as dams, bridges, intersections of rivers, river mouths, forks, junctions and confluences.

RIVER CORRIDOR AND MANAGEMENT PLAN

One of the most important features of the WSRA is the protection of the immediate

environment adjacent to the river. When rivers are added to the system, up to approximately a ¼ mile area on each side of the riverbank, called a river corridor, can be protected (Section 4(d), Wild and Scenic Rivers Act 1968). The agency in charge of administering the river is tasked with defining the exact legal boundary of the river corridor (Section 3(b), Wild and Scenic Rivers Act 1968). This area can be an average of, but not more than, 320 acres per mile of land on each side of the river (Section 3(b), 4(b), Wild and Scenic Rivers Act 1968). Another important feature of the WSRA is the creation of management plans, called a Comprehensive River Management Plan (CRMP) within three years of a river's designation (Section 3(d), Wild and Scenic Rivers Act 1968). The administering federal agency creates a plan for the protection of the river's free-flowing characters and outstanding value(s) and includes the management of the land in the river corridor.

POWERS OF THE WSRA

In order to carry out the WSRA, certain powers are granted to the administering Secretary and federal agency to fulfill the purposes of the Act. The WSRA also affects government operation by placing a few restrictions and requirements on the other federal agencies. The WSRA places restrictions on the government, including prohibition of federal support for actions which would have a direct or adverse effect on the values of a designated river (Section 7(a), Wild and Scenic Rivers Act 1968). In addition, the Act requires federal agencies to identify potential Wild & Scenic Rivers in all land, water, and resource planning programs (Section 5(d)(1), Wild and Scenic Rivers Act 1968). The Act also limits how much land the federal government is allowed to acquire from willing sellers (i.e. private land-owners) (Section 6, Wild and Scenic Rivers Act 1968). The federal government is given a water right in the amount and flow level necessary to fulfill the purposes of the Act (Section 13(c), Wild and Scenic Rivers Act 1968). The Secretary can grant easements and rights-of-way on private property to allow access for the public (Section 13(g), Wild and Scenic Rivers Act 1968). The Secretary can subject mining and mineral leases to the regulations of the Act if such leases have not been perfected (Section 9(a)(i), Wild and Scenic Rivers Act 1968). There are some land-use restrictions that the Secretary can choose to exercise, including designating zones where, during certain periods, no hunting is permitted (Section 13(a), Wild and Scenic Rivers Act 1968). The Secretary can also withdraw minerals from appropriation and operation of mineral leasing law if part of the bed or bank is within ¼ mile of the bank (Section 9(a)(iii), Wild and Scenic Rivers Act 1968).

Although the WSRA gives the Secretary and administering agency the powers listed above, the Act does not permit or affect several activities and rights. The Act does not affect existing water rights or the existing jurisdiction of states (Section 13(b), Wild and Scenic Rivers Act 1968). It does not permit the taking of private property for public uses without just compensation (Section 6, Wild and Scenic Rivers Act 1968). The jurisdiction or responsibilities of the State with respect to fish and

wildlife is also not affected (Section 13(a), Wild and Scenic Rivers Act 1968). Finally, it does not affect the right-of-access (Section 13(f), Wild and Scenic Rivers Act 1968).

PUBLIC INVOLVEMENT AND INTERAGENCY COORDINATION

The Act encourages a high degree of federal cooperation and coordination with states and other stakeholder groups. Federal river managers can "assist and cooperate with states or their political subdivisions, landowners, private organizations, or individuals to plan, protect, and manage river resources" (Section 11(b)(1), Wild and Scenic Rivers Act 1968). The administering Secretary or department head can enter into written cooperative agreements with a State or local official, including the Governor or head of any State agency (Section 12(a), Wild and Scenic Rivers Act 1968). The Act also directs the administrating bodies to cooperate with other environmental agencies (i.e. EPA) and adhere to environmental standards (i.e. water quality) (Section 12(c), Wild and Scenic Rivers Act 1968).

A notable emphasis is placed on public involvement and stakeholder outreach in the Wild and Scenic Rivers Act and accompanying guidance documents. In the guidelines for the contents of the CRMP, agencies are tasked to identify possible stewardship groups to help protect and enhance river values. Special consideration should be given to groups who advocate for the designation of a river. Agencies are also charged with developing a public involvement strategy. The strategy should identify communities of interest, such as private landowners, nonprofit organizations, local and state agencies, other federal agencies, and tribal governments. The strategy should also include the engagement of the public in data collection for baseline condition assessment (IWSRCC. n.d.).

Requirement for public notice and comment can be found in the study report which is merged with the National Environmental Policy Act (NEPA). The public is also consulted before management plans are finalized. Additionally, information is readily available and made accessible to the public. All applications and determinations are published in the Federal Register (Section 3(b), 4(c), Wild and Scenic Rivers Act 1968). Also, a map of all boundaries and classifications are available for public inspection at convenient locations (Section 3(c), Wild and Scenic Rivers Act 1968).

POTENTIAL PROBLEMS AND LOOPHOLES

There are several potential problems or issues that could arise due to the discretion language of this Act gives to the Secretary. First, Section 9 which deals with mining and mineral leasing and Section 14(a), which allows the Secretary to lease federally owned land within the boundaries of any component, give the Secretary of Interior

and Secretary of Agriculture wide discretion regarding land-use issues and leasing of federal lands (Wild and Scenic Rivers Act 1968). This could lead to conflicts of interest, whereby environmentally destructive activities, such as mining, are allowed to occur on or within WSR components due to the Secretary's judgment. Secondly, Section 7, which deals with Federal Power Commission licensing and construction of dams and other projects, gives the Secretary of Interior and Agriculture discretion to permit such activities if it is determined that such activities would have not "direct or adverse effect" on the values of a designated component (Wild and Scenic Rivers Act 1968). Also, this section allows developments below or above a WSR that will "not invade the area or unreasonably diminish…values present" (Wild and Scenic Rivers Act 1968). Once again the Secretary has the discretion to make a determination.

STRENGTHS AND WEAKNESSES OF THE WSRA

The federal reserved water right is a very powerful tool. The term "federal reserved water right" refers to the Act's allowance of the government to claim unappropriated – meaning not owned or titled – water in amounts and flow necessary to fulfill the purposes of the Act (Gray 1988). The ability of the federal government to maintain an adequate flow in a designated river is notable because state's could otherwise decide to appropriate water in a manner that reduces the river flow to designated segments to levels that do not protect the value for which the river was designated, such as recreation and fish (Gray 1988). States face the dilemma of allocating water to various, and many times competing, uses. Thus the ability of the federal government to maintain an adequate flow of water and the values for which the river was protected is critical to the fulfillment of the Act's goals.

The flexibility afforded to the protection of rivers with the ability to designate into one of three categories is also a strong point of the Act since all rivers are not created equal. Rivers have different values and may be eligible for protection for different reasons. A variety of a river's physical and situational characteristics may suit it for different levels of interaction and use by the public, such as its proximity to urban centers, accessibility by roads, and topographical or hydrological situation.

Unfortunately, there are a few weaknesses and criticisms the WSRA has experienced in practice. Many of the rivers designated under the Act are due to strong citizen advocacy and can be considered the "low hanging fruit" (Kristen McDonald, personal communication, October 23, 2009). Therefore, designated rivers are not necessarily representative of values (Kristen McDonald, personal communication, October 23, 2009). The determination of suitability for nomination a river undergoes during the study process can be criticized for its generous discretion. Although there are specific guidelines for a determination of eligibility, there are none for suitability. Instead the study team is charged with the task of weighing the

costs and benefits of designation and non-designation. The study team can take into account several listed factors, but are not obligated to consider these factors and may take into account other factors of their choosing. Therefore, this determination relies heavily on the preferences and judgment of the team members in both their choice of factors to consider and the weight of each factor. The size of the river corridor may also be criticized for being too small to effectively protect river values. For example, clear-cutting a forest in the area ¼ mile from the river will still have a very adverse affect on the river. Consequences could include increased sediment and nutrient load and flooding. Additional weaknesses of the Act include lack of funding for management plans and enforcement which relies largely on citizen watchdogs (Kristen McDonald, personal communication, October 23, 2009).

TABLE 3.1.1: DIFFERENCES BETWEEN THE U.S. & CALIFORNIA WILD AND SCENIC RIVERS ACTS AND RECOMMENDATIONS FOR A RIVER PROTECTION SYSTEM IN CHINA.

	U.S.	California	Recommendation for China
Definition of a River	Broad: "a flowing body of water or estuary or a section, portion, or tributary thereof, including rivers, streams, creeks, runs, kills, rills, and small lakes"	Specific: "the water, bed, and shoreline of rivers, streams, channels, lakes, bays, estuaries, marshes, wetlands, and lagoons, up to the first line of permanently established riparian vegetation"	Broad
Boundaries of Protection	¼ mile river corridor	Up to first line of riparian vegetation	River corridor
Designating Authorities	Act of Legislature and upon recommendation of a state Governor & approval by Secretary of Interior	Act of State Legislature and upon recommendation of Secretary of Natural Resources & approval by Legislature	Act of Congress and by recommendation of multiple levels of government with approval by Ministry of the Environment
Land Use Restrictions	Potential restrictions on hunting and mining	Special Treatment Areas which prohibit timber harvesting	Restrictions on hunting, mining, and timber harvesting (with special exceptions for indigenous peoples)
Exceptions for Dams or Other Infrastructure	None explicitly stated	Yes, two exceptions: temporary flood storage and recreational impoundments.	None
Requirement for a Management Plan	Yes	No	Yes
Requirement for Stakeholder Participation	Yes, stated in language of Act.	No, not stated in language of Act.	Yes

References: Wild and Scenic Rivers Act 1968; California Wild and Scenic Rivers Act 1972.

TABLE 3.1.2: ELEMENTS OF A RIVER PROTECTION LAW FOR CHINA: *Attributes drawn from U.S. Wild and Scenic Rivers Act.*

Attributes	Significance for China
Statement of policy	No national policy on rivers in China
Recognition of alternative river values	Hydropower, flood control, navigation are well established but other values, such as recreation, cultural, scenic, and biodiversity need greater consideration
Goal of nondegradation and enhancement of values	Important for long-term sustainability and future generations
Permanent protection and administration	Ensures the long-term protection and management of free-flowing rivers
Protection of immediate environment (river corridor)	Protects against degradation of river from harmful activities (timber harvesting, mining, etc.)
Study process & reports	Promotes science and thorough evaluation
Management plan	Provides structure to management process and promotes comprehensive planning
Ability to designate an entire river or segments of a river	River segments will likely be most appropriate for China since there are few completely free-flowing rivers
Ability to have multiple classifications on one river	Gives flexibility; River systems are long and flow through varied contexts including geographic, hydrologic, and intensity of human development
Nomination Process	Largely bottom-up in U.S.; more likely to be a top-down process in China. However, all levels of government including central, local and provincial should recommend rivers for protection to optimize the amount of designated rivers
Public and stakeholder involvement	Important to get local communities involved in decision-making process; aids in administration of the protection system and legitimacy of the process
Administration	Management assignment to an agency requires strict monitoring and adequate funding

Interagency coordination and cooperation (federal, state, local)	Coordination and cooperation between central, provincial, local governments in China will be necessary in the administration of a river protection system since rivers cross jurisdictional boundaries
Information sharing [1]	Important for other agencies to be aware of and educated on data contained in study reports so that work is not duplicated and optimal and efficient decision-making occurs
Deference to one authority if overlapping (i.e. National Forests)	Many rivers may be located in or run through nature reserves; deference to one management authority may be more efficient
Monitoring	Key component for success of a river protection system; frequent status reports (i.e. biannually or annually) can combat inefficiency and/or noncompliance
Restrictions on Federal Actions [2]	Ensures an action by another government agency does not violate laws set forth in river protection system
Transfer of lands [3]	Potential to increase nature reserves and other protected areas in China if a protected river is located within an area suitable for land protection status
Planning requirements [4]	Keeps government agencies accountable and focused on alternative uses of rivers

[1] Study reports are shared and reviewed with all affected agencies. These agencies have the ability to make comments and recommendations. These comments must be given due weight by the Secretary before study report is finalized.
[2] The Federal Power Commission (FPC) cannot license the construction any development on or directly affecting a designated river. No department or agency of the government can assist (by loan, grant, license, etc.) any construction project that would have a direct or adverse affect on the values of a designated river.
[3] Lands acquired or transferred to the Secretary of Agriculture because within or adjacent to a National Forest become National Forest lands.
[4] In all planning for the use and development of water and land resources, Federal agencies are required to consider wild, scenic, and recreational river areas as a potential alternative use of water and land resources and in study reports discuss potential additions.

References: Wild and Scenic Rivers Act 1968.

3.2 CANADIAN HERITAGE RIVERS SYSTEM

INTRODUCTION

The Canadian Heritage Rivers System (CHRS) was established on January 18th 1984 (CHRS 2009), with the vision to "ensure that rivers in Canada flow into the future, pure and unfettered as they have since the melting of the great Pleistocene ice sheets" (CHRS 2009). Parks Canada was designated as the lead federal agency (CHRS Charter 1997). The CHRS is responsible for managing the public trust, advocated for by local citizens (Aboriginal Peoples, communities, and other stakeholders) (CHRS Charter 1997; CHRS 2009).

Parks Canada shares responsibility with a board of government-appointed members who determine which rivers are admitted into the system. CHRS aims to protect Canada's natural resources from the negative impacts of development, dams, and pollution. The system also ensures long-term management and conservation of natural, cultural, and recreational values. Most importantly, CHRS strives to integrate both economic and environmental values into river conservation through two main goals. First, CHRS strives to manage and protect heritage features of rivers for which they were included into the System; activities such as timber harvesting, mining, and other industrial activities can continue so long as they do not affect those heritage features. Second, CHRS strives to ensure sustainability requires that resources are conserved, protected, and managed for future generations.

According to CHRS, a river can be classified as an entire river (from source to ocean), or as a segment of a river in between the source and ocean (CHRS 2009). Approximately 11,000 km of rivers or river segments (41 rivers total) have been designated as Heritage Rivers; out of those 41 rivers, 36 have accompanying management plans to provide continued protection (CHRS Strategic Plan 2008). This is outstanding achievement because participation, partnership, cooperation, and community involvement is entirely voluntary (CHRS 2009).

"It is within the spirit of trust and goodwill that governments pledge to work in partnership with the public and one another to build a system that truly reflects the diversity and beauty of Canada's rivers. Governments retain their traditional jurisdictional powers and management responsibilities throughout this process"

-Canadian Heritage Rivers

NOMINATION AND DESIGNATION PROCESS

A river's inclusion into the CHRS is a two-step process of nomination and designation (CHRS n.d.). First, proponents of a river's protection must assess whether a river is a candidate for protection by preparing a background study detailing the rivers values and suitability for management.

To be a candidate for the CHRS, the river must be identified as having:

- Outstanding natural, cultural and/ or recreational values
- A high level of public support (public consultation and consensus)
- Demonstration that sufficient measures will be put in place to ensure that those values will be maintained

Next, proponents must prepare a nomination document that clearly states the river's merits as a Canadian Heritage River. This document goes through a review and discussion by the CHRS Board. The members of the Board are appointed by federal, provincial, and territorial governments, and the Board is governed by a Charter (CHRS n.d.). If the Board accepts the document, it makes a recommendation for the approval of nomination to the Minister of the host government and Minister of Parks Canada. If approved by both parties, the nomination is finalized (CHRS n.d.).

The second step to becoming a Canadian Heritage River is designation. In order to be officially designated into the system, the river must have an approved management plan, often referred to as a heritage strategy (CHRS 2001). A plan is first approved by the host government then sent before the Board (Finkelstein 2004). The Board Chair gives a recommendation for designation to the Minister of Parks Canada (Finkelstein 2004). This process normally takes one to three years, but can take significantly longer (Finkelstein 2004).

After a river is designated, the Board works with the stakeholders of the river (i.e. residents, local governments, landowners, businesses, aboriginal groups and other interested parties) to carry out specific actions presented in the management plan (CSHR n.d.). The process of preparing a management strategy and then implementing it requires that stakeholders along the river are consulted (CHRS n.d.). Public involvement allows planners to hear people's concerns, and gives stakeholders a real voice in the future of the river. It also helps develop a sense of ownership, responsibility and community among those whose lives are dependent upon the river. These processes are important to maintaining the effectiveness of the program given that CHRS does not have any legislative authority to enforce the protected status of the river or river segments (CHRS 2001). In other words, Canadian Heritage River designation does not create a statutory obligation to protect or conserve the river (Finkelstein 2004).

NATURAL VALUES FRAMEWORK

The Framework for the Natural Values of Canadian Heritage Rivers was published in order to offer "a balanced representation of Canada's natural river heritage for its future management and interpretation from a national perspective" (CHRS 2001). The framework is used to assess possible nominations, asses the state of the System, identify gaps in the System, define management priorities, and create effective

monitoring studies. Rivers that are designated are monitored and managed to ensure the maintenance or improvement of the water quality and surrounding ecosystem (CHRS 2009).

TABLE 3.2.1: NATURAL VALUES FRAMEWORK THEMES OF THE CHRS.

Hydrology	Physiography	River Morphology	Biotic Environments	Vegetation	Fauna
Drainage Basins	Physiographic Region	Valley Types	Aquatic Ecosystems	Significant Plant Communities	Significant Animal
Seasonal Vegetation	Geological Processes	Channel Patterns	Terrestrial Ecosystems	Rare Plant Species	Rare Animal Species
Water Content	Hydrogeology	Channel Profile		Environmental Regulation	
River Size	Topography	Fluvial Landforms			

CULTURAL FRAMEWORK

The Cultural Framework for the Canadian Heritage Rivers System was published under the authority of the Minister of the Department of Canadian Heritage. It "is intended to be used as a tool with which to recognize and classify river-related human heritage. However, it does not address the various means of commemoration, protection or management of rivers, nor does it address any actual rivers, sites and resources that may represent its themes" (CHRS 2000). It is important to note a limitation – all elements in the Framework do not have equal weight, and therefore it is a challenging decision-making process.

TABLE 3.2.2: CULTURAL FRAMEWORK THEMES OF THE CHRS.

Resource Harvesting	Water Transport	Riparian Settlement	Culture and Recreation	Jurisdictional Uses
Fishing	Commercial Transportation	Siting of Dwellings	Spiritual Associations	Conflict and Military Associations
Shoreline Resource Harvesting	Transportation Services	River-based Communities	Cultural Expression	Boundaries
Extraction of water	Exploration and Surveying	River-influenced Transportation	Early Recreation	Environmental Regulation

STRATEGIC PLAN

In order to set future goals and objectives for the system, a ten-year strategic plan is prepared, and reviewed annually. In 2008, a ten-year strategic plan was approved

by the Canadian Parks Council. This plan represents a commitment to the CHRS, and all individuals to be part of the "journey to build the best river conservation program" (CHRS Strategic Plan 2008). There are seven main principles that are important for the implementation of the strategic plan: recognition of valuable rivers, respect for stakeholders, voluntary participation, leadership (federal, provincial, and territorial governments), collaboration and partnership (e.g. education and awareness), integrity of designated rivers, and sustainability of ecological, economic, and social benefits for present and future generations.

The plan puts forth four main priorities:

(1) Build a comprehensive and representative system that recognizes Canada's river heritage
(2) Conserve natural, cultural, and recreational values and integrity
(3) Engage partners to maximize the full range of benefits associated with the Canadian Heritage Rivers program
(4) Foster excellence in river management

By 2018, the CHRS aims to have a comprehensive system representing the full range of natural, cultural, and recreational values. The System should also have the capability to actively and effectively monitor and manage all designated rivers, be supported by a range of partnerships that advance the program resulting in environmental and societal benefits associated with responsible river management, and play a role in promotion and support of river management for sustainable living (CHRS Strategic Plan 2008).

RELEVANCE TO CHINA

The Canadian Heritage Rivers System aims to protect natural recourses, but also emphasizes the preservation of cultural values – this is similar to what a river protection system might emphasize in China. Both the Natural Values and Cultural Frameworks provide valuable themes that can be applied to any river protection system. This is especially true for a nation like China where much of their cultural history has been tied to the nation's river systems. Baseline data for each theme and sub-theme helps to characterize rivers, potentially designate a river or segment, and holistically manage them.

Key aspects of the CHRS are found in the criteria for river consideration: natural, cultural, and/or recreational value, public support, and a future management plan. The combination of these three components can be used to build a baseline for a river protection system in China. Additionally, strong recommendations for a river protection system include the incorporation of public opinion, as well as stakeholder knowledge.

3.3 NORWAY'S RIVER PROTECTION SYSTEM

Hydropower is Norway's dominant energy source. As of 2008, hydropower constituted about 96% of Norway's power production capacity. Historically, this percentage hovered near 99% until two gas-fired power plants came online in 2007 (Ministry of Petroleum and Energy 2008). The concept of protecting rivers did not emerge in Norway until the 1960's. Up until that point, watercourses were considered an unlimited resource for power production (Smith-Meyer 2004). A river's sole utility was the generation of electricity.

The development of rivers and production of hydropower led to economic growth and prosperity for the country. However, around the 1960s, a growing number of scientists, environmental groups, and the general public began to voice concern over the rapid development of river systems and the alteration of the landscape. Conflicts grew between hydropower developers and environmental interest groups throughout the decade (Huse 1987).

The government began to recognize the need to find a balance between development and environmental protection. In the 1960s the idea of national river protection scheme was conceived which would identify rivers that should set aside in their pristine state (Huse 1987). By 1973, 95 river systems were permanently protected from hydropower development in the first protection plan adopted by Parliament (Lafferty and Rudd 2008). This protection plan began a legacy of legislation on watercourse protection and management that is still expanding to this day.

The efforts of the government on river protection were very successful. Today, 40% of Norway's river basin area is protected from hydropower development (Stensby and Pedersen 2007). More than 14% of Norway's land area is a protected area either as a national park, protected landscape, nature reserve, or other protection mechanism (Table 3.3.1; Statistics Norway 2009).

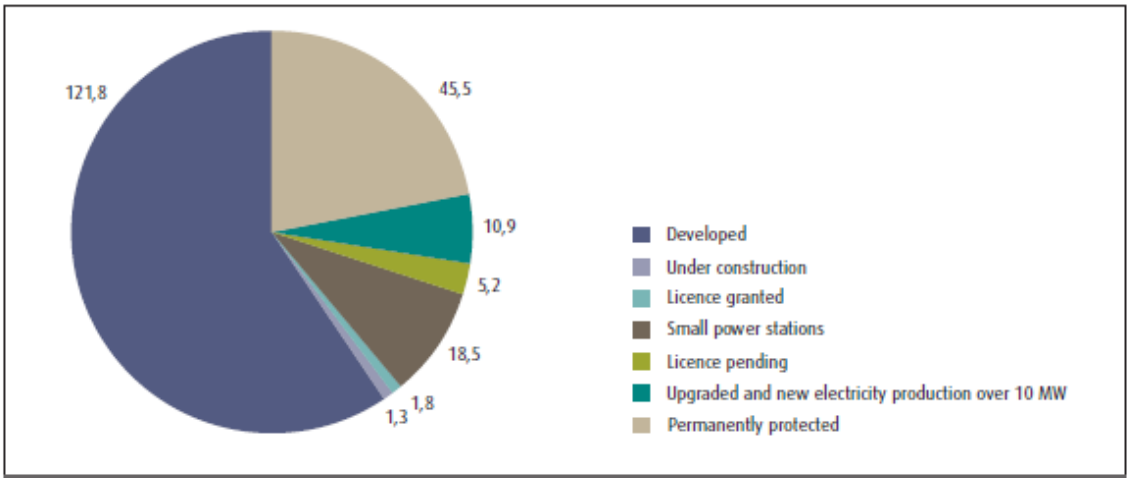
TABLE 3.3.1: PROTECTED AREAS BY CONSERVATION FORM IN NORWAY. 31 DECEMBER 2008.

	Number of Protected Areas	Area (including freshwater), km²	Percent of Norway
National Parks	29	26774	8.3
Landscape Protected Areas	184	15217	4.7
Nature Reserves	1872	4726	1.5
Other Protections	406	427	0.1
Total	**2491**	**47144**	**14.6**

Source: Statistics Norway, 2009.

Of Norway's 205 TWh/yr hydropower potential, 59% is already developed and 22% is permanently protected from development (Ministry of Petroleum and Energy 2008). This amounts to 45.5 TWh/yr that has been protected and 121.8 TWh/yr that is developed in Norway (Figure 3.3.1).

FIGURE 3.3.1: NORWAY'S HYDROPOWER POTENTIAL ON 1 JANUARY 2008. TWH/YEAR.



Source: Norweign Water Resources and Energy Directorate (NVE).

Water management and hydropower development has a special legal framework. There are three main pieces of legislation that deal with river protection and development including the Water Resources Act, Protection Plan for Watercourses, and The Master Plan for Watercourses. The governmental authorities most frequently involved in the management of water resources are the Storting (the Parliament), the Government, the Ministry of Petroleum and Energy, and the Norwegian Water Resources and Energy Directorate (NVE) (Ministry of Petroleum and Energy 2008).

PROTECTION PLAN FOR WATERCOURSES

The aim of the Protection Plan was to protect a representative section of river systems and scenery of Norway (Smith-Meyer 2004). Creation of the plan involved inventory of the values affected by hydropower development. Natural values, landscape values, cultural heritage, recreation and other land uses are some of the values that are used as the basis for selection of a river system for protection (Smith-Meyer 2004). Basically, protection plans are an effort to set aside a number of river systems for purposes other than hydropower (Huse 1987).

When the idea of protection plans for river systems came about in the 1960s, a committee was established to create a plan proposal. In 1973, the Parliament accepted the proposal which became the first Protection Plan. Three other Protection Plans have been accepted since in 1980, 1986, and 1993. In 2005, a

supplement to the Protection Plan was also accepted. Together these plans are referred to as the Protection Plan for Watercourses (I-IV) (Ministry of Petroleum and Energy 2008). Estimates of the exact number of river systems protected under these plans vary in the literature, but the number is around 380 river systems. The rivers set aside in the first three Protection Plans had a calculated development value of over US $150 million (Huse 1987). Therefore, in the context of decision-making, the conservation value of each protected river was at least equal to the economic development potential (Huse 1987).

It is important to note that river systems protected under a Protection Plan may have an existing hydropower facility that can continue to operate. Permanent protection only precludes additional hydropower development. In addition, existing hydropower operations may be granted a license for new installations or rebuilding if the interest of conservation value does not weigh against it. When making such a decision, the interest of the conservation value shall be given preponderant weight (Act No. 82 of 24 November 2000 'Water Resources Act'). The 2005 supplement to the Protection Plan for Watercourses states that large hydropower projects are no long viable (Lafferty 2008). Therefore, the focus is being shifted to smaller projects and refurbishment of existing projects.

An often cited weakness of the Protection Plans for Watercourses is that the plan only prohibits hydropower development in protected watercourses but does not protect against other developments and encroachments along the river which may have serious impacts (Smith-Meyer 2004). However, the Water Resources Act corrects this potential conflict by mandating that a license be obtained for all developments in watercourses, not just hydropower.

THE MASTER PLAN FOR WATERCOURSES

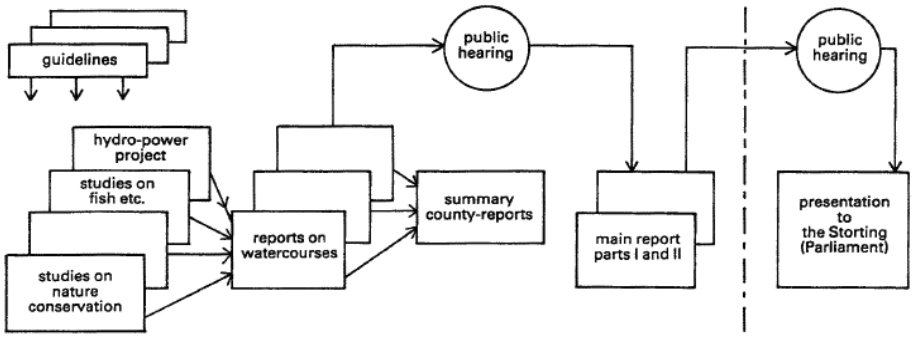
With the passage of the first Protection Plan in 1973, many river systems were permanently protected from hydropower development. In 1980, the government wanted to go a step further and create a master plan for the Norway's water resources. Up until this time, hydropower projects were considered on a project-by-project basis. The Master Plan changes this strategy by establishing a national coordinated plan for the management of watercourses. It is based on a set of economic, social, and environmental considerations. The main objective of the Master Plan was to build a foundation for decision-making on the utilization of watercourses by categorizing which watercourses could be used for power production and which could be set aside for other uses (Halvorsen 1988). The Master Plan should ideally include all economically exploitable watercourses for hydropower that are not permanently protected under the Protection Plans or already developed.

Essentially, the Master Plan prioritizes hydropower projects based on the consideration of economic, social, and environmental interests. Projects that have a high economic potential and low environmental and social impact are given priority over projects with low economic potential and high environmental and social impact. By ranking hydropower projects and taking all interests into account, the government can be more confident that its decision-making on hydropower development will be in the best interest of the nation and involve less conflict.

The Master Plan for Watercourses placed all remaining hydropower projects into two main categories. Projects in Category I were recommended to be approved for licensing and Category II projects were recommended to be side aside for the time being. In all, 310 watercourses and 460 hydropower projects were considered in the Master Plan (Halvorsen 1988).

The process by which the Master Plan was created is a useful template for water resource planning and management (Figure 3.3.2). First, the Government – including the Ministry of Environment in cooperation with Ministry of Petroleum and Energy and Directorate of Water Resources – surveyed a large number of watercourses. For each watercourse, a hydropower project was considered. Second, an impact analysis was completed for each watercourse. Various user interests and the impacts on these interests were looked at during the impact analysis. Upon completion of the individual impact analyses, the results of the impact analyses and hydropower projects were presented in individual reports on the watercourse. Next, a summary of all the individual reports from one county was compiled and presented in a county-report. Comment and professional evaluations were then solicited. After receipt and consideration of comments, a main report was prepared. The main report was the document presented to Parliament for their acceptance. In the spring of 1985, the Master Plan was approved by Parliament.

FIGURE 3.3.2: THE MASTER PLAN, PHASES OF REPORTING.



Source: Halvorsen 1988.

The theory behind creating such a Master Plan is that there are uses for watercourses than just power generation which the public places value and has

considerable interest in. For example, the scenic nature of watercourses is a characteristic feature of Norway which attracts tourists and is a part of the national identity of the country. In addition, an increasing need for recreation was developed in Norway. In all, sixteen different user interests and/or topics of study were considered in the creation of the Master Plan.

The 16 user interests/topics for study defined in the Master Plan were:

- Hydropower
- Nature conservation
- Outdoor recreation
- Wildlife
- Fishing
- Water supply
- Protection against water pollution
- Preservation of ancient monuments
- Agriculture and forestry
- Reindeer cultivation
- Prevention of flooding and erosion
- Transport
- Formation of ice and the temperature of the water
- Climate
- Mapping and data
- Regional economy

IMPACT ANALYSIS

For each relevant use interest, the impact of hydropower development on that interest was determined using qualitative terms such as small, great, very great, etc. and also quantitatively using a scale ranging from -4 to +4, with -4 denoting a very serious negative impact and +4 denoting a very large positive impact. Hydropower projects were also valued using cost estimates. With these two parameters – impact and cost – projects could now be evaluated individually and against one another.

REPORTS

Each individual report on a watercourse contained five chapters:

1. Natural resources and society
2. Uses and interest connected with the watercourse
3. Hydropower projects
4. Effects of development
5. Conclusions and statement of impact

Public participation was a key component of the creation of the Master Plan. All affected parties, including municipalities, local interest organizations and developers, were given the opportunity to read and submit comments on both individual watercourse reports and the Master Plan itself.

CATEGORIZATION

The impact analyses allowed the different user interests affected by a hydropower project to be evaluated and weighed. With this information, a total evaluation of all projects could be undertaken. To begin to prioritize projects, all projects were placed in an impact class ranging from 1 to 8 and an economy class ranging from 1 to 6. Next, projects were placed into 16 priority groups, which were then divided into 3 categories.

> Category 1: Projects that can be considered for a license immediately (Groups 1-5).
>
> Category 2: Projects that can be utilized for hydropower or utilized for other purposes (i.e. on reserve) (Groups 6-8).
>
> Category 3: Projects not appropriate for hydropower development because of large degree of conflict with other uses and/or has high costs associated (Groups 9-16).

WATER RESOURCES ACT

PURPOSE AND OBJECTIVES

The main policy governing the use of water resources in Norway is the Water Resources Act of 2000. The Act serves as an update to the Watercourse Regulation act of 1940 which had served as the primary legislation on watercourses. The intent of the Water Resources Act is to ensure that river systems and groundwater are managed in accordance with the interests of the community. The Act states that its purpose is "to ensure socially proper use of river system and groundwater" (Act No. 82 of 24 November 2000 'Water Resources Act'). It stipulates that "care shall be taken by all to avoid harm or nuisance to public or private interest". Interests are defined broadly and may include nature conservation, outdoor recreation, the landscape, fish stocks, economic activity and local communities (Ministry of Petroleum and Energy 2008). Hence, the Act takes a balanced view of natural resources and users, but it is more resource-oriented than previous legislation governing watercourses (Ministry of Petroleum and Energy 2008). According to the Ministry of Petroleum and Energy (2008):

> "The main objectives of the Water Resources Act are to promote sustainable development and to maintain biological diversity and natural processes in river systems. The intrinsic value of river systems, both as landscape elements and as habitats for plants and animals, is of central importance."

LICENSING REQUIREMENTS

Since the 20th century, Norway has had special licensing systems for development in watercourses to ensure that each proposed project receives an individual assessment and license before initiation of that project. Prior to the Water Resources Act, licenses were generally only required for hydropower development. The Act expands the requirement to obtain a license to apply to all types of development which may cause significant damage or nuisance to community interests (Ministry of Petroleum and Energy 2008).

PUBLIC PARTICIPATION AND STAKEHOLDER CONSULTATION

The Act includes detailed provisions on administrative procedures for license applications. Public notice and comment are necessary in the application process. The application is a public document which the applicant must notify the public of the application. Before the licensing authority (the NVE) makes a recommendation on the acceptance of the application, the application is subjected to public consultation and a consultation process involving affect local authorities, county councils, and other relevant ministries. Only after public notice, comment, and the consultation processes are complete will the NVE issue an approval or denial of a license application. The decision by the NVE can be appealed to the Ministry of Petroleum and Energy, as it is a superior ministry. The decision by the Ministry of Petroleum and Energy can then be appealed to the King in Council where a final determination is made (Ministry of Petroleum and Energy 2008).

An important component of the Act is the official codification the protection of river systems in Chapter 5 Section 32-35 that makes protection a legally binding and statuary requirement (Act No. 82 of 24 November 2000 'Water Resources Act'). Several special provisions relating to the management of protected watercourses are also detailed. One of the more significant provisions is a statutory principle that dictates that when a decision relating to a protected watercourse is made, considerable weight must be given to the conservation value (Ministry of Petroleum and Energy 2008). Since Protection Plans only protect watercourses from hydropower development, this provision seeks to defend these river systems from other development threats which may significantly reduce their conservation value.

3.4 EUROPEAN UNION WATER FRAMEWORK DIRECTIVE

INTRODUCTION

The European Union (EU) Water Framework Directive (WFD) came into force on December 22, 2000. It provides guidelines for water resource management throughout the European Union. The general objective of the WFD is to achieve 'good status' for all waters by 2015. 'Good status' includes both 'good ecological status' and 'good chemical status'. By expanding water protection to all waters, the WFD aims to ensure long-term sustainable use of water resources in Europe. The Directive begins by stating that "Water is not a commercial product like any other but, rather, a heritage which must be protected, defended and treated as such" ("Directive 2000/60/EC").

The Water Framework Directive is designed to be an operational tool which sets objectives for water protection (Europa 2009b). The WFD was created due to an increasing demand by citizens and environmental organizations for cleaner water (Europa 2009b). Recognizing this demand, the European Commission made water protection one of its priorities (Europa 2009b). To meet the objectives outlined in the WFD, citizens and citizen groups are called upon to play a crucial role (Europa 2009b).

BACKGROUND

European water legislation has undergone several phases. The first wave of legislation began in the mid-1970s into the 1980s when standards and quality targets for drinking water and other water bodies, such as fish, shellfish, bathing, and ground waters, were established. The second wave, from the late 1980s into the 1990s, focused on sources of pollution and created legislation on secondary biological waste water treatment, nitrates from agriculture, stricter drinking water standards, and pollution from large industrial installations. Even with development of several water policies, by the mid-1990s, pressure for a fundamental rethinking of water policy with a more global approach came to a head (European Commission 2008c).

POLICY DEVELOPMENT PROCESS

The process to develop the new European water policy is an interesting case-study for creating legislation. Efforts to create the WFD involved not only the European Parliament's environmental committee and Council of environment ministers but also other non-governmental actors. The new policy was developed in an open consultation process involving all interested parties. Comments from parties include local and regional authorities, water users and non-governmental organizations (NGOs), other organizations, and individuals. A two day Water Conference followed

this open process. Present at the conferences were 250 delegates from EU Member States, regional and local authorizes, enforcement agencies, water providers, industry, agriculture, consumers, and environmentalists. The main conclusion made by the parties was that the current water policy framework was fragmented and there was a need for a single piece of framework legislation (Europa 2009b).

The Proposal for a Water Framework Directive presented to the Commission included several key aims outlined below (Europa 2009b):

- Expanding the scope of water protection to all waters (surface and groundwater)
- Achieving "good status" for all waters by a set deadline
- Water management based on river basins
- Closer citizen involvement
- Streamlining legislation

OBJECTIVES

The general objective of the WFD is 'good water status' by 2015. There are several other objectives that protect water quality including:

- General protection of the aquatic ecology
- Specific protection of unique and valuable habitats
- Protection of drinking water resources
- Protection of bathing water

Although, the latter three objectives will only apply to specific water bodies, the first objective applies to all water bodies as it is a central requirement of the WFD that the environment is protected to a high level in its entirety (Europa 2009b).

For the objectives that apply to specific areas, a specific protection zone can be designated within a river basin in order to meet the objectives. Protection zones can also be established when an area warrants more stringent requirements with high objectives due the specific uses occurring within the area (Europa 2009b).

In the event that a use is occurring that negatively affects the status of a water body but is deemed necessary, there are permitted variances from the 'good status' requirement, although mitigation measures are mandated. Uses that may merit an exception are flood protection, drinking water supply, navigation, and power generation. In order for the exception to be granted however, the use must pass one of three tests: (1) the alternatives are technically impossible, (2) alternatives are prohibitively expensive, or (3) the alternative produced a worse environmental result (Europa 2009b).

ENVIRONMENTAL OBJECTIVES

The core article in the WFD, Article 4, defines the environmental objectives of the framework. Member States are charged with protecting, enhancing, and restoring all bodies of surface waters ("Directive 2000/60/EC"). Not only does the article call for all water bodies to meet the WFD general objective of good status by 2015, but it also mandates the prevention of any further deterioration of status ("Directive 2000/60/EC"). Ecosystem health is a new objective for European water policy (European Commission 2008b). When measuring the health of surface water ecosystems, four common quality elements are used: phytoplankton, other aquatic flora, benthic invertebrate fauna, and fish fauna.

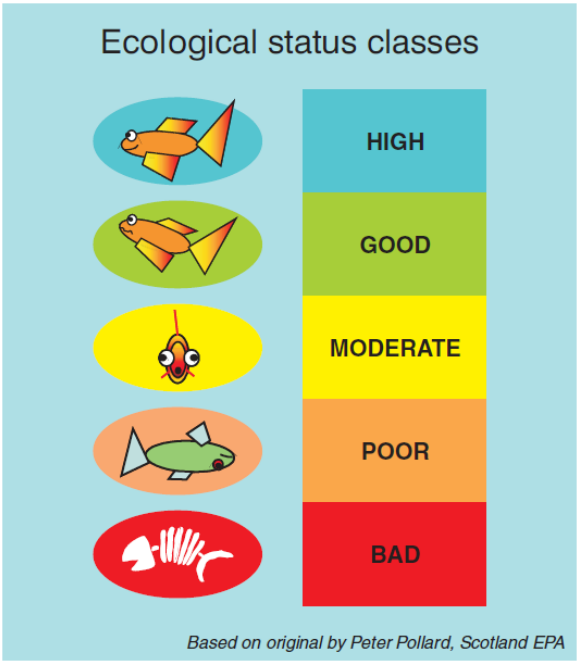
CLASSIFICATION SCHEME

The assessment of water status is based on a classification scheme of water quality (Figure 1). The scheme includes five status categories of high, good, moderate, poor, and bad (Europa 2009a). The 'high status' serves as the benchmark or 'reference condition' and is determined by the biological, chemical and morphological conditions associated with no or very low human pressure (Europa 2009a). The reference condition is type-specific, meaning it is different for different types of waters since there are varied ecological regions in the EU (Europa 2009a). When assessing water quality, the deviation from the reference condition denotes the status of the water body (Europa 2009a). For example, 'good status' indicates 'slight deviation' and 'moderate status' indicates 'moderate deviation' (Europa 2009a). There are a set of procedures for identifying and achieving an ecological status. In addition, a system for ensuring that each Member States interprets the procedure in a consistent manner is also available (Europa 2009b).

To develop the reference conditions for the various ecosystems, almost 1,500 sites in rivers, lakes and coastal and transitional waters were identified and studied. Species of fish, invertebrates and plant composition differ widely across Europe therefore experts set up 14 different regional categorization groups called Geographical Intercalibration Groups. Within these groups types of waters with district ecological characteristics are identified (European Commission 2008b).

The goal of defining groups is not to create a common assessment system for all Member States to follow. Instead, Member States are given the flexibility to choose their own methods of assessment which are consistent with the provisions of the WFD. While the methods of assessment may vary, results from different national systems will have comparability (European Commission 2008b).

FIGURE 3.4.1: ECOLOGICAL STATUS CLASSES IN EU WFD.



Source: Europa 2009a.

CLASSIFICATION OF ARTIFICIAL OR HEAVILY MODIFIED WATER BODIES

Europe's waters have served as an economic resource; rivers and other waterways have been altered for services such as navigation, flood control, power generation, and water supply. With this reality in mind, the WFD provides a mechanism to reconcile economic activity with environmental goals. Member States are allowed to classify water bodies as artificial or heavily modified. With this classification, these river bodies will not need to meet the same quality criteria, 'good ecological status', as other water bodies. Instead criteria of 'good ecological potential' will be necessary. It is important to note that specific sections of a water body can be designated as heavily modified since some water bodies may only be modified in certain regions while other sections exist in a natural state. In order to qualify for either designation status, two tests are imposed: first, whether the water body is able to meet the objective of 'good ecological status' by 2015, and second, whether the beneficial objectives of the artificial or modified water body could be met in other ways. As of 2005, 15% of EU surface water bodies were designated as heavily modified and 4% as artificial. Percentage varies greatly however among Member States. While the Netherlands has identified over 90% of its water bodies as either heavily modified or artificial, Latvia and Ireland have less than 2% (European Commission 2008a).

RIVER BASIN MANAGEMENT AND MANAGEMENT PLAN

The WFD chose for to manage water systems according to river basins (Europa 2009b). River basins are the natural geographical and hydrological unit for water management (Europa 2009b). Previously, water was managed according to administrative or political boundary which usually does not match the scale to which a water management problem must be addressed. Due to the river basin scale, administration of the WFD will be independent of city, county, state, or national borders. Under the WFD, EU Member States establish river basin districts with a designated administrative unit, usually called water councils (WaterWiki 2009). International river basin districts are created when a river basin crosses Member States or EU boundaries ("Directive 2000/60/EC"). Each river basin district (national and international) is charged with the preparation of a river basin management plan to be updated every six years ("Directive 2000/60/EC").

The plan must include the following elements ("Directive 2000/60/EC"):

- Analysis of a river basin's characteristics (including the location and boundaries, ecoregions, and reference conditions of water body types)
- Review of the impact of human activity on the status of waters in the basin
- Economic analysis of water use within the river basin
- Identification and mapping of protected areas
- Map of monitoring networks
- List of environmental objectives
- Programs or measures adopted and ways objectives are to be achieved
- Measures required to implement other water protection legislation
- Public information and consultation measures taken (including their results and changes made)
- List of competent authorities

The intent of including the economic analysis is to facilitate a rational discussion on the cost-effectiveness of proposed measures which is likely to occur due to the requirement for public participation (Europa 2009b).

PUBLIC PARTICIPATION

Public participation in the formation of management plans is a crucial component to the process for two reasons. First, since many water management decisions involve several, often conflicting, interest groups, an open process subject to scrutiny from all sides imparts legitimacy to a final decision. Second, keeping with the first reason, an open and transparent process correlates to greater enforceability of the objectives agreed upon. In order to facilitate public participation there are several requirements established in the WFD. River basin management plans must be issued in a draft with accessible background documentation on the basis of decision-

making. In addition, a biannual conference is held to exchange implementation experiences and information (Europa 2009b).

DISCUSSION OF COSTS AND BENEFITS

In order to support the judgment made on an exemption from an objective of the WFD, an analysis of the costs and benefits of measures to achieve objectives may be necessary. Information used in this analysis should include an appropriate mix of qualitative, quantitative, and monetized information. Data transparency is important during the analysis; work for assessments and calculations made should be shown (European Commission 2009).

The achievement of the environmental objectives in the WFD will result in numerous benefits and socio-economic gains for the present and future generations. The identification and consideration of these benefits is essential for an accurate weighing of the costs and benefits associated with achieving an objective. Some of the benefits that may be incorporated are (European Commission 2009):

- Protection and enhancement of health and biodiversity of the aquatic ecosystem
- Protection of human health through water-related exposure
- Lower cost for water uses
- Improvement of efficiency and effectiveness of water policy based on the "polluter-pays-principle"
- Increased cost-effectiveness of water management
- Integrated river basin management which maximizes the economic and social benefits of water resources in an equitable manner
- Improvement to the quality of life by increasing the amenity value of surface waters
- Mitigation of impacts from climate change and security of water supplies
- Mechanisms to address conflicts and regional disadvantages by balancing the interests of water users
- Promotion of sustainable uses thus creation of new jobs

While some of these benefits can lend themselves to monetization, others are more difficult to place a monetary value on. For values that cannot be easily monetized or cannot be monetized at all, these benefits can be assessed using qualitative information, and a qualitative assessment can be done. In other cases, application of the precautionary principle may be appropriate (European Commission 2009).

3.5 River Protection System Comparison Matrix

Country	United States	Canada	Norway	Europe
Enabling Legislation	Wild and Scenic Rivers Act	Canadian Heritage River System Charter	Protection Plan for Watercourses I-IV, Water Resources Act, Master Plan for Water Resources	European Union Water Framework Directive
Purpose (Mission Statement)	"Preserve selected rivers or sections thereof in their free-flowing condition to protect water quality of such rivers and to fulfill other vital national conservation purposes"	"To recognize, protect and manage, in a sustainable manner, Canada's important rivers and their natural heritage, human (cultural/ historical) heritage and recreational values"	"To ensure socially proper use and management of river systems and groundwater" (WRA)	"Establish a framework for the protection of inland surface waters, transitional waters, and groundwater"
Drivers for Origination	Loss of free-flowing rivers associated natural values	Concern over negative impacts over dams, development, and pollution	Conflicts between hydropower development and environmental interests	Created due to citizen demand for clean water
Main Features	• Mandatory Comprehensive River Management Plan • Classification scheme • Protection of adjacent environment • Identification of and management for values of river	• Emphasis on preservation of culture and heritage • Review criteria • 10 year report • Stakeholder involvement • Monitoring and management of water and surrounding environments	• Master Plan to categorize and prioritize river development and protection • Impact analysis • Consideration of natural, landscape, cultural, and other values	• Classification scheme based on water quality and environmental parameters • Management on river basin scale • River basin management plan every 6 years • Protects surface and groundwater
River Selection Mechanism	• Act of Congress • Initiative of the State • Study by USFS, NPS, FWS, or BLM	• Nomination by citizens, groups, and participating governments • Board review based on	• Protection Plan for Water Courses • Approved by parliament	• No specific mechanism, all rivers are monitored

		• environmental, cultural, and recreational values • Recommended to the responsible ministry		
Management Scale	• Individual rivers and segments • Federally managed	• Individual rivers and segments • Management by Canadian Heritage Rivers Board	• Individual rivers and segments • Managed on ministry level	• Zones of water quality • River basin management
Management Plan	Yes	Yes	No Data	Yes
Study Process	Yes	Yes (Informal)	Yes	Yes
Public Participation Requirement	Yes	Yes	Yes	Yes
Stakeholder Consultation Requirement	Yes	Yes	Yes	Yes
Government Agency Coordination	Yes	N/A	Yes	Yes
Potential Weakness(es)	• Potential for development above and below protected segments • Federal lease of land for environmentally destructive activities	• No legal authority	• No protection of land along river banks	• No protection for individual rivers • No direct regulation of development

3.6 EMERGING SYSTEMS

3.6.1 COSTA RICA

Costa Rica is an example of a country which could benefit greatly from a river protection system. Discussion of implementing such a system has begun, and although Costa Rica is a very small country in comparison to China, some of the recommendations offered could be applied in China as well.

The number of dams is increasing on many tropical rivers, especially as demands for electricity continue to grow (Pringle et al. 2000). As human populations and economies expand and as access to electricity improves, growth in per capita electricity consumption in tropical, developing countries, such as Costa Rica, is expected to double over the period of 2005–2025 (Goldemberg 2000). Dam builders and hydropower proponents are especially enthusiastic about construction within tropical countries since a large amount of the "world's remaining hydropower potential" is found in these places (McCully 2001).

Hydropower is the major source of electricity for the 4 million residents in Costa Rica (Anderson et al. 2006). As construction of dams continues to increase, the free-flowing tropical rivers are quickly vanishing from the landscape. These rivers are extremely valuable not only to citizens, but to Costa Rica's thriving eco-tourism industry. Currently, Costa Rica's hydropower production is below their hydrological potential; thus, the pressure to increase hydroelectric output is growing (Anderson et al. 2006).

Large-scale hydropower production in Costa Rica has a number of benefits often overshadowed by those who oppose major dams. An estimated 98% of Costa Rica's residents have access to electricity, and nearly 80% of this is generated by hydropower (CEPAL 2005). Where hydropower plants have been constructed in rural areas, the quality of roads has been improved. Also, some of these plants irrigate croplands with water from the reservoirs (Anderson et al. 2006). Finally, Costa Rica's dependence on hydropower generation, as opposed to thermoelectric generation, is environmentally beneficial. Fewer fossil fuels are burned for electricity generation; hence, less greenhouse gases are released into the atmosphere.

An unexpected result of hydropower construction in Costa Rica is the protection of forests. Several hydropower companies have actually been willing to voluntarily pay for environmental services via Payment for Ecosystem Services (PES) programs through the Costa Rican government's National Forestry Fund. Payments are used to provide economic incentives to landowners for forest protection in upstream catchments of the watersheds in which the forests exist (Anderson et al. 2006). Companies are willing to make these payments because they recognize that natural

forests provide environmental services such as the capture and retention of water and the prevention of excessive soil erosion in areas with steep slopes (Anderson et al. 2006).

While the protection of forests via PES programs is a positive step forward, the impact of dams can still be negatively felt. Besides effects on fisheries and river flows, stream de-watering is one of the more serious ecological consequences of small "run-of-river" dams (those for which the natural flow and elevation drop of a river are utilized to generate electricity) that are created by their operations. The operation of most run-of-river hydropower plants results in significant flow reductions between the diversion site and the powerhouse (Anderson et al. 2006).

Although in the early 1970s Costa Rica made a historic decision to set aside a substantial amount of forests for conservation, the same steps have not yet been fully undertaken for rivers. National forest protection has decreased the amount of hydropower dams that are built, or at least force them to participate in the maintenance of the National Forest Fund. More encouraging, however, is talk of the development of a designation system for rivers similar to that of the U.S. Wild and Scenic Rivers Act of 1968. Since water resources in Costa Rica are publicly owned, opportunities exist for the government to incorporate protection of rivers into land-use planning (Anderson et al. 2006).

There are a couple of recommendations that have been developed by researchers who are interested in knowing what a river protection system might look like in Costa Rica (Anderson et al. 2006). Some of these might be applicable to the Chinese context, too.

- **Protection categories developed for rivers**: Priorities would be set for individual rivers based on their biological, social and economic values. Rivers with high biological diversity and low economic value could be designated as those of national importance, and not eligible for development projects. Rivers that already have significant sections that lie within protected areas could be further protected by imposing restrictions on the sections outside the protected areas. Rivers of both biological and socio-economic importance could fall into a different category, with some uses permissible and others restricted.

    - Application for China: A major river (such as the Nu) could provide such an example. A river that draws in tourists for river-related recreation or visits to cultural sites might also be one in which a high degree of biodiversity is present. It might be against national interest to dam such a river because damming would harm the river and namely, the local economies of riverside communities that depend upon its free-flowing state to encourage tourism.

- **Protection of rivers that are already dammed**: Some communities might be interested in declaring certain rivers or river segments "natural", or "historic monuments" in order to halt further dam construction.

    - Application for China: Hydropower projects could continue to function while downstream segments are protected from further development.

3.6.2 AUSTRALIA: THE MURRAY-DARLING BASIN

BACKGROUND

Australia's Murray-Darling Basin comprises roughly 14% of the total area of Australia. With the three longest rivers, the Murray River, the Darling River, and Murrumbidgee River, flowing into the Basin, the region is a prime location for agriculture and food production (Discover Murray 2009b). These rivers flow along very low gradients creating extensive floodplains (Lake and Bond 2007). The Basin has functioned as the bread basket of the country and a major food supplier to other countries around the world. More than 40% of all farms in Australia lie within the Basin where one third of the country's food supply is produced (Discover Murray 2009b).

The Murray-Darling Basin

Source: Circle of Blue

The Basin is more than just an agricultural and economic asset for Australia; it also has importance to the cultural heritage of Australia as it contains a number of natural heritage features. Additionally, a large and diverse number of plants and animals are supported by the Basin including the Australian Pelican, Golden Perch, Azure Kingfisher, and Darling Lily (Discover Murray 2009b).

DRIVERS OF DEGRADATION

Australians realized the agricultural potential of the Basin centuries ago, and began to transform the Basin to support agricultural activities. From the 1880s to 1980s, infrastructure, including dams, reservoirs, dikes, weirs, and channels, was constructed to control the Basin's rivers (Schneider 2009). The natural free-flowing rivers that had historically run into floodplains, wetlands, billabongs, and lakes were forever altered by development (Schneider 2009). Today, the Murray River and its tributaries are highly regulated and controlled by dams, weirs and water diversion works which run across the Basin plains (Discover Murray 2009a). Australia has

around 450 large dams, and the Murray-Darling Basin alone has over 200 major storage dams (Ball et al. 2001). This extensive development has resulted in the extraction of 79% of the mean annual flow of the Basin's river system (MDBMC 1995). For the Basin, the free-flowing rivers that once existed served as a lifeline to aquatic systems throughout their regular flooding and in response to seasonal flow variability (Schneider 2009). In addition to the transformation of rivers throughout the Basin, the land area has also been transformed. Native vegetation and riparian habitats have been cleared across the Basin plains and river banks to enable crop and livestock production (Discover Murray 2009a; Lake and Bond 2007).

Unfortunately the transformation of the Basin's waterways and land area has resulted in serious environmental degradation. The clearing of vegetation and forest coupled with heavy irrigation has lead to water logging and salinization of the soil. The regulation of rivers has reduced natural floodwaters needed to sustain forests. Levees and channels built to protect against floods have isolated wetlands and floodplains from their rivers. The fish and waterfowl that depend on these systems are in danger due to habitat loss. Nutrient and sewage runoff into waterbodies from farms and towns has lead to algal blooms and sediment contamination, which has also led to bioaccumulation of toxics in fish (Discover Murray 2009a).

This environmental degradation has led to the ecological collapse of many systems. Across the Basin, Australia's iconic Red Gum trees are dying and most frogs, snakes, and small mammals are gone due to drought, salinity, and loss of spring flood associated with river regulation (MDBC 2003; Schneider 2009). It has been reported that 90% of basin wetlands are gone or seriously damaged (Schneider 2009). Moreover, the Commonwealth Scientific and Industrial Research Organization (CSIRO) has not made positive ecological and climatic predictions for the future, and has forecasted that the worst environment devastation is yet to come (CSIRO 2008).

Since 1997, much of Australia has been experiencing drought conditions (Australian Government 2010). Global climate change is expected to only exacerbate water scarcity issues in Australia, as warmer and drier weather is projected to be the norm (CSIRO 2008). Natural systems have already been stressed due to over withdrawal of surface and groundwater; with the added pressure of climate change, damage to systems will only increase. River hydrology and ecology are under especially serious threat. Four out of ten days the Murray River does not have enough flow to reach its mouth. Marshes in the upper reaches of the Darling River are drying up, eliminating breeding ground for birds and fish (Schneider 2009). The reduction in the frequency and extent of flooding on floodplains has resulted in a considerable loss of aquatic and terrestrial biodiversity (Davies et al. 2003; Ballinger et al. 2005).

Australians have begun to experience firsthand the consequences of destroying the dynamics of natural systems, including its rivers. The long-term impacts of centuries of water development have lead to severe and large-scale ecological disruptions,

such as salinity problems, across the continent (Lake and Bond 2007). Water scarcity problems are imposing limits on economic growth on some cities and regions (Lake and Bond 2007). Although immense damage has already occurred, the government has taken steps to address the country's water uses and alleviate the environmental crisis. The need for planning for the sustainable use in water resource development and protection to control the ecological impacts of water use has been recognized by the government and the public (Lake and Bond 2007). With the passage of the Water Act 2007, a new governance arrangement to address water management in the Murray-Darling Basin was finally put in motion.

WATER ACT 2007

Prior to the development and implementation of the Water Act 2007, management of the Basin was conducted on a state-by-state basis. Now, water planning will consider the Basin as a whole using a management strategy centered on the integration and sustainability of water resources in the Basin (Australian Government 2009). The Commonwealth Water Act 2007 commenced in March of 2008. The purpose of the Act is to make provisions for the management of water resources in the Murray-Darling Basin (Water Act 2007 Act No. 137 of 2007). First, the Act establishes an independent authority, the Murray-Darling Basin Authority, with functions and powers, including enforcement powers, to manage the Basin's water resources. Second, the Act requires the preparation of a Basin Plan, a strategic plan for management of water resources in the Murray-Darling Basin. Third, the Act establishes a Commonwealth Environmental Water Holder to manage environmental water and protect and restore environmental assets of the Basin (Australian Government 2010).

MURRAY-DARLING BASIN AUTHORITY

The Murray-Darling Basin Authority (MDBA) is a single body responsible for overseeing water resource planning in the Basin. The key functions of the Authority are: preparing the Basin Plan, setting sustainable limits on water withdrawal from surface and groundwater, advising accreditation of state water resource plans, measuring and monitoring water resources, researching and gathering information, and expanding community engagement and outreach (Australian Government 2009).

When developing the Basin Plan, the MDBA must consider a number of factors using a socioeconomic analysis that includes the social, cultural, indigenous, and public benefits issues associated with Basin communities. Since these communities depend upon water resources, the possible reduction in sustainable limits on water withdrawal or requirements for environmental flows will affect people of the Basin. However, sustainable limits will be set high enough to allow for the conveyance of

water for meeting critical human needs (MBDA 2008). Irrigation practices will most likely be most affected by withdrawal limits.

THE BASIN PLAN

The Basin Plan serves as a single, legally enforceable document that manages water resources in the Basin as a whole. As previously mentioned, the Basin Plan is prepared by the Murray-Darling Basin Authority. During its preparation, states and communities will be consulted. States are also tasked with preparing individual water resource plans that serve as a complement to the Basin Plan. Upon completion of the Plan, it is presented to the Commonwealth Minister for approval and recording by the Australian Parliament. Content of the Basin Plan is mandated in the Water Act 2007. Some of this content includes (MDBA 2008):

- Limits on the amount of water that can be sustainability taken from the Basin
- Identification of risks to the Basin
- Compliance requirements for state water resource plans
- Environmental watering plan
- Water quality and salinity management plan
- Water right trading rules

An important element of the Basin Plan is its mandatory requirement for the development of a monitoring and evaluation program that will track the effectiveness of the plan in meeting its purpose, objectives, and outcomes. A framework to assess the current condition of water resources and then evaluate compliance and progress of various plan elements is part of the requirements. Reporting will be made to the Commonwealth and states. In addition, an independent audit of the Basin Plan will be done every 5 years with results being reported to the Commonwealth Minister (MDBA 2008).

The Plan's objectives involve more than water management. The restoration of the river system is also a central theme. Through protection and restoration of key environmental assets, such as rivers, streams, wetlands, forests, and floodplains, and key ecosystem functions of the river and land, the goals is to return the Murray-Darling to a healthy state. The Plan recognizes that a healthy Basin environment is essential to the life of the rivers, surrounding habitat, human activities, and cultural values of the Basin (MDBA 2008). The long-term outcomes of the actions set forth include water security, natural flow regimes of rivers, habitat and species restoration, improved water quality, sustainable industries, and vibrant river communities (MDBA 2008).

CONCLUSION

Although, the Water Act 2007 and corresponding institutional structures is not designed as a river protection system, there is recognition that rivers and water resources as more than consumptive assets. Conservation and restoration of environmental values and waterways is clearly a major priority of the Australian Government and goal in the Water Act 2007. One example of the government's prioritization of environmental protection occurred recently with the proposal of a dam for water supply generation on the Mary River. In November of 2009, the Federal Environmental Minister Peter Garrett, blocked the proposed $1.8 billion Traveston Dam in Queensland due to its "unacceptable impacts on matters of national environmental significance" (Pottinger 2009). If built, the dam would have threatened several endangered species, including a prehistoric lungfish species, flood farmland, and dewatered miles of the Mary River (Pottinger 2009). In this situation, the ecological values of the river were recognized, and protection of those values was made a priority by the government. The government is now looking into alternative approaches their water supply needs, including desalination (Pottinger 2009).

3.6.3 BRAZIL

Although Brazil has not yet created a comprehensive river protection plan, the evolution of water resource management throughout the country has created inroads to and opportunities for the implementation of such a system. In our analysis of river protection worldwide, we aimed to look at established systems, and also at burgeoning river protection schemes or locations in which there is movement toward such a system. Brazil serves as an example of the latter.

Brazil has a population of nearly 200 million people, and is characterized by extensive land and abundant water resources (CIA 2009). There is an abundance of natural resources prized across the world, however, development goals have not always been aligned with environmental protection in Brazil. As is also the case in China, some of Brazil's major rivers are impaired, and dam proposals have implications for the continued existence of those that have been left in a free-flowing state. While Brazilian law states that the water from rivers is a public good, goals for development make it difficult to protect these precious resources (Mendes 2009).

In the late 1970s and 1980s, Brazil was influenced by France's environmental management schemes and began to look at rivers from a watershed management perspective. Prior to this, only rivers were managed. The concept of sustainable development began to be discussed in Brazil, and policies were implemented that aligned with these goals. The National Policy of Water Resources (Lei 9.433/97), a law based on the French model of water resource management, was adopted and was characterized by three major principles. Human water consumption was prioritized, management was decentralized, and the definition of a hydrographic watershed as a geographic unit of planning was introduced. This movement in policy led to the formation of the Committee of Hydrographic Watersheds (Mendes 2009). Among the diverse array of stakeholders are fishermen, owners of hydroelectric companies, those who live within the watersheds and river residing community members. This committee is responsible for the orientation of decision-making on the preservation of rivers, and on the healthiness of entire watersheds.

Each major watershed in Brazil is governed by a committee. The municipality which occupies the watershed has the most influence in decision-making within the committee. In the southeast, the numerous residents and active economy are very dependent upon the river, but the potential for pollution is high in this region. Therefore, there is strong emphasis on protection within these municipalities, and protection enforcement is paramount. In the Amazon region, however, protection enforcement is somewhat weak. Federal laws about rivers are based within the watershed laws, thus decision making takes place on that level, and enforcement measures are prioritized less (Mendes 2009). A river protection system that granted responsibility to water committees might be easy to implement since the

management structure is already in place. Monitoring protection efforts by the central government officials might encourage watershed committees within the Amazon to more closely follow protection regulations.

River protection in Brazil is most successful in areas of conservation. In accordance with laws pertaining to conservation, vegetative cover cannot be removed, and there is a minimum distance from these areas in which agriculture production can be conducted. There are even stated repercussions for not respecting these laws in protected areas. Deforestation of margins of a river is strictly prohibited. Although it is rare that political action is taken in response to violations since most are minor, (Mendes 2009), a river protection system with similar regulations to those designed for protected areas might be taken into consideration by the Brazilian government.

There are also river basin committees throughout the country, which function as courts of decision within the sphere of action of each river basin. Committees consist of users, municipal authorities, the organized civil society, and other governmental officials (the States and the Union). Each committee acts as the "parliament of the waters" of the basin (Ministry of the Environment, Brazil 2008) and can be as meticulous as they choose when making decisions that will protect rivers from development. As a result, there are a number of rivers that are undeveloped and truly free-flowing in Brazil.

When a development project is proposed on a river in Brazil, an environmental impact study is conducted by experts on behalf of the business that proposes the project prior to its inception. These experts are key actors in the approval process of dam planning, and policy is often based on what may be biased research and conclusions. Social costs should also be included in evaluation of projects that will impact rivers and riverside communities (McCormick 2007). IBAMA, the Brazilian Institute of the Environmental and the Renewable Natural Resources, is responsible for reading the study and assuring its adequacy so that the correct techniques of intervention in nature are encouraged, if carried out at all. The Brazilian government must also confirm the study, especially if it will finance the project (Ministry of the Environment, Brazil 2008). This interaction between environmental experts and the government is indicative of the coordination that would be imperative to the success of a river protection system.

Brazil has a very vocal anti-dam movement that began with the First International Meeting of People Affected by Dams in Curitiba in 1997. Representatives from 20 countries and organizations of dam-affected people and of opponents of destructive dams came together to share ideas and draft the Declaration of Curitiba. They wrote:

> "Our struggles are one because everywhere dams force people from their homes, submerge fertile farmlands, forests and sacred places, destroy

> fisheries and supplies of clean water, and cause the social and cultural disintegration and economic impoverishment of our communities… Our struggles are one because everywhere the people who suffer most from dams are excluded from decision-making…Our common struggles convince us that it is both necessary and possible to bring an end to the era of destructive dams. It is also both necessary and possible to implement alternative ways of providing energy and managing our freshwaters which are equitable, sustainable and effective" (International Rivers 1997).

Today, concerns are raised when public hearings take place – and even when they don't. Public hearings usually last for only four or five hours, and the public may or may not have been offered much information about the proposed project. Communities that will be impacted may not ever be informed of the changes that will occur after a dam is built. Environmental impacts tend to be accounted for only after a site has already been selected, and those affected sometimes miss the opportunity to protest (McCormick 2007). Riverside communities may be very supportive of a river protection system, and their participation in environmental dialogues would contribute to the success of such a system.

As is the case in China, conflicting goals can complicate the decision-making process. As Brazil aims to "progress," it also does not want to ignore the potential negative impacts of projects. While steps are taken to encourage environmental sustainability, decision-makers naturally confront difficult trade-offs (Mendes 2009). Currently, more than 600 dams are functional in Brazil and have displaced thousands of people and disrupted fragile habitats. Thorough evaluations of projects that will have lasting impacts on natural resources such as rivers must then be conducted if Brazilians wish to safeguard the beauty and utility of rivers for future generations.

4. ENVIRONMENTAL INSTITUTIONS AND LAWS OF THE PEOPLE'S REPUBLIC OF CHINA

4.1 INSTITUTIONS AND THEIR RELATION TO RIVER PROTECTION

This section illuminates some of the roles of and interactions between the major institutional structures in China. The functions and responsibilities of key agencies are explained, and we identify how each can have a role in the development and management of a river protection system.

4.1.1 BASIC INSTITUTIONAL STRUCTURE

The People's Republic of China is a Socialist Republic with an authoritative hierarchical governance system. The organizational structure of authority establishes a hierarchy of government power from the Central Government to smaller geographic offices in provincial, autonomous regions, to prefectural level municipalities, and then to local levels of government (Figure 1; Ma and Ortolano 2000). Each office in the hierarchy operates within a different administrative rank that reflects power and status (Ma and Ortolano 2000). A functional system of specialized commissions and ministries also falls under the authority of the National People's Congress and the State Council (figure 2). Under the State Council, the commissions, such as the National Development and Reform Commission, are the highest ranking organizations, followed by the ministries, which share rankings with provincial level governments. A hierarchical ranking order exists within the ministries as well (Ma and Ortolano 2000).

Ministries delegate authority and issue orders within their own lines of command. Lower ranking bureaus that operate on a local level act upon the orders of the superior office; however, local offices are not beholden to their superior office alone (table 3). Local offices are also responsible to their local governments, who regulate their annual budget (Ma and Ortolano 2000).

When responsibilities overlap between agencies or one agency's actions affect another's, there is no clear line of authority unless the State Council intervenes and provides an official ruling. Therefore, ministries and commissions have to develop a consensus for allocation of authority that is drafted into law before it can be passed by the State Council, who can then issue binding orders to the Ministries (Ma and Ortolano 2000; Lieberthal 1997.)

An understanding of this hierarchical authoritarian system and the roles of relevant agencies gives legitimacy to our recommendations for the development of a river protection. Identifying appropriate institutional stakeholders is critical to building

an effective consensus building coalition. The roles of the National People's Congress and the State Council are explained below. Descriptions of three relevant ministries that we have identified as likely candidates to play lead roles in the river protection system follow. We conclude with discussions of additional ministries, bureaus, and authorities that can also play supportive roles in the decision making process.

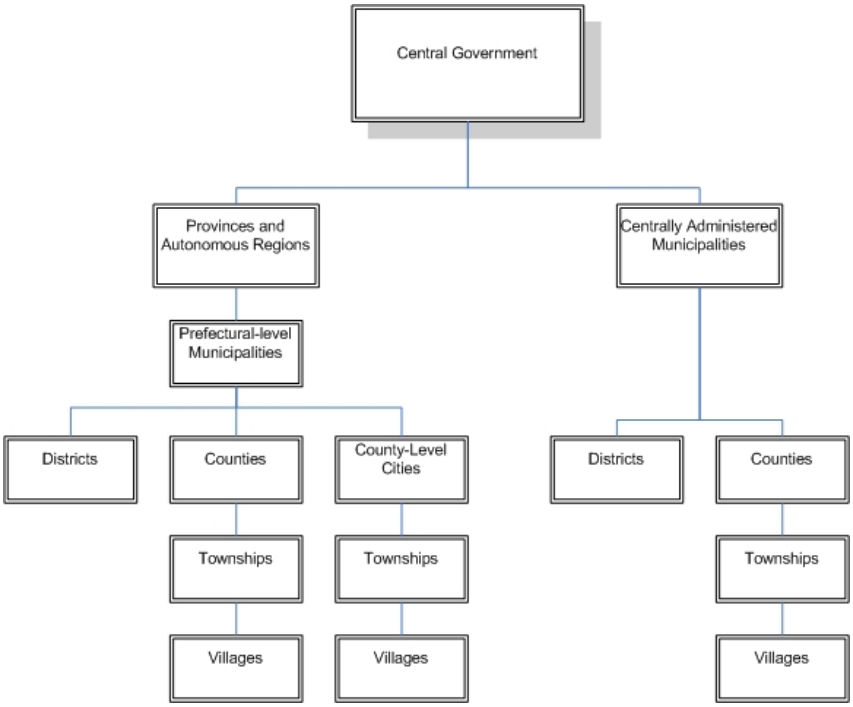


FIGURE 4.1.1.1: CHINESE GOVERNANCE HIERARCHY FROM THE CENTRAL GOVERNMENT TO THE LOCAL LEVEL GOVERNMENT OFFICES (MA AND ORTOLANO 2000).

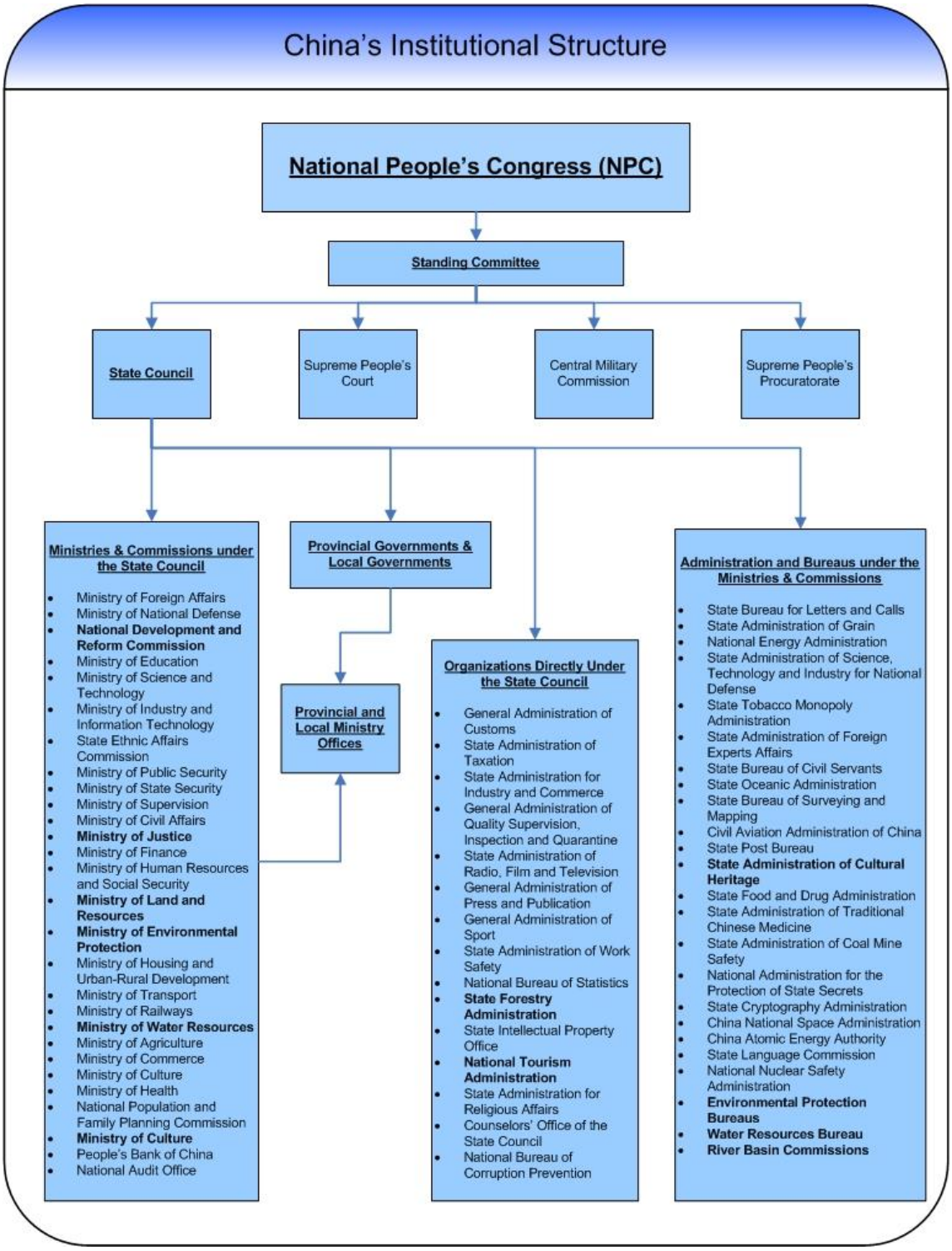


FIGURE 4.1.1.2: CHINESE INSTITUTIONAL STRUCTURE.
This figure indicates the delegation of authority from the National People's Congress to the State Council and the ministries, bureaus, offices, and local governments beneath them. Agencies that could play a role in river protection are marked in bold font.

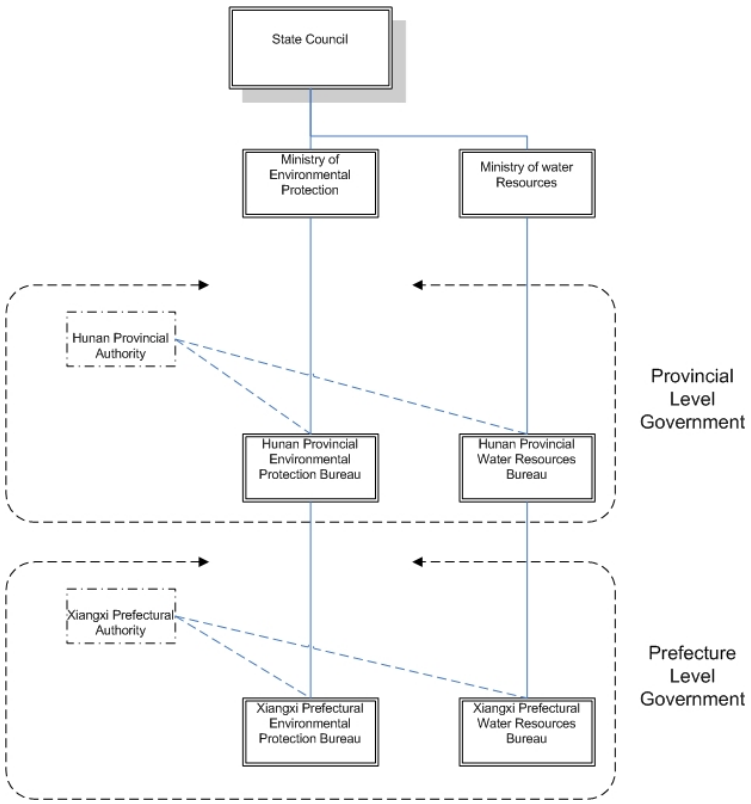


FIGURE 4.1.1.3: BASIC LINE OF AUTHORITY FROM THE CENTRAL GOVERNMENT TO LOWER RANKING MINISTERIAL BUREAUS.

Decisions made in the State Council are passed on to supporting ministries, who then delegate authority and responsibility to the lower level bureaus. Individual bureaus also receive orders from their local political offices.

4.1.1.1 NATIONAL PEOPLE'S CONGRESS

The National People's Congress is the highest-ranking administrative body in China's legal system (Ma and Ortalano 2000). The Congress has the power to write and revise legislation, augment the Constitution, examine and approve plans for national economic and social development, approve the state budget, decide on the establishment of special administrative regions as well as on which systems will be instituted within the regions, provide oversight to state agencies, and elect key officials such as the President, the Premier, and heads of state agencies (Gov.cn 2008 a). The Congress's plenary sessions are held annually and under special circumstances; however, other Congressional committees meet more frequently (Gov.cn 2008 a). The standing committee, which consists of the chairman, secretary-general, and additional members who do not hold other offices in the state administrative organs, meets bi-monthly (Gov.cn 2008a). Additional special

committees of the Congress may meet more frequently (Gov.cn 2008a). These committees study, review, and draft motions and bills. Special committees are composed of the chairman, vice chairman, and other nominated members (Gov.cn 2008a). Similar congressional structures also exist on smaller government scales down to the township; they provide similar functions to the national congress, but on a local scale (Gov.cn 2008a).

Congress's authority to the responsibilities and the function and leadership of key agencies indicates that its authority can have a significant impact on the success of a river protection program. With Congress support, a river protection program can be provided with legislative support, a national budget, and the authority to move quickly on setting up the river protection system. While Congress cannot provide an administrative role, it can provide a river protection system with the tools and resources that are necessary for effectiveness.

4.1.1.2 STATE COUNCIL OF THE PEOPLE'S REPUBLIC OF CHINA

The State Council of the People's Republic of China is the highest executive organ in the Chinese National Government (Ma and Ortalano 2000). The Council is comprised of the Premier, vice-premiers, State councilors, heads of ministries and commissions, the Auditor-General, and the Secretary General (Gov.cn 2008b). The Premier is nominated by the President and reviewed by the National People's Congress (Gov.cn 2008b). The State Council is responsible for carrying out the policies set by the Communist Party as well as the laws and regulations put forward by the National People's Congress (Gov.cn 2008b). The Council also has responsibilities within the realms of international politics, diplomacy, national defense, finance, economy, culture, and education. All of the states ministries, commissions, state institutions, and state administrations work under the State Council (Gov.cn 2008b).

For a river protection system to be successful, it will require the support of the State Council, who has authority over all ministries, and has the ability to approve legislation that the ministries have to promulgate (Gov.cn 2008). A river protection system that is written into law and approved by the State Council provides more authority than a system that exists only as a program assigned by a ministry. Programs within a ministry cannot limit the behavior of other ministries and can be overridden by orders from the State Council (Ma and Ortalano 2000). Protection systems that have authority provided by the State Council will be recognized in future development plans. Additionally, a protection system that is legally approved by the State Council can facilitate communication between ministries.

4.1.2 POTENTIAL MANAGEMENT AGENCIES FOR A RIVER PROTECTION SYSTEM

4.1.2.1 MINISTRY OF ENVIRONMENTAL PROTECTION

The Ministry of Environmental Protection (MEP) is the central agency under the State Council that is designated to protect the environment in China (Ma and Ortalano 2000). Their mission is "to prevent and control environmental pollution, protect nature and ecology, supervise nuclear safety, safeguard public health and environmental safety, and promote the harmony between man and nature (MEP 2009)". The MEP has legal, oversight, and public outreach responsibilities, all of which could support an effective river protection system.

The MEP has the legal authority to establish environmental protection plans and designate zones for environmental protection. It also has the legal authority to draft and revise environmental legislation (MEP 2009). A river protection system lead authority requires an ability to designate land as protected from development and have experience drafting environmental protection plans. Additionally the MEP's ability to draft and revise environmental law indicates that the agency could even improve the effectiveness of the river protection as new issues arise.

The MEP has oversight of protected areas and already conducts environmental monitoring in regions of interest and other protected areas. This experience could be applied to plans for river protection. The MEP could assure that protection rules are followed and that the values for which rivers are protected are maintained. The MEP is the agency responsible for reviewing environmental impact assessment reports for proposed development projects (MEP 2009). As a lead agency for a river protection system, the MEP can offer its insight about where these projects are proposed and ensure that development projects do not unduly harm the environment and also do not interfere with the goals and plans of protected rivers.

Finally, the MEP is responsible for public outreach, education, and dissemination of environmental information (MEP 2009). Analysis of other river protection frameworks reveals that public outreach and involvement are key elements of river protection system efficacy. Through increased public education and the creation of opportunities for public participation, the MEP can increase the visibility of the values of river protection, increase public support for the protection of rivers, and improve adherence to the restrictions applied to these protected rivers. The MEP's authority to draft law, designate zones of environmental protection, provide environmental monitoring, provide public outreach and education, and regulate project development uniquely positions it to provide a leadership role in a river protection system.

4.1.2.2 LOCAL ENVIRONMENTAL PROTECTION BUREAUS

Environmental Protection Bureaus (EPB) are the acting offices of the Ministry of Environmental Protection at the local level. They are responsible for enforcing national environmental laws and policies, setting local pollution standards, and assessing environmental accidents and disputes (Jahiel 1998). Since the EPBs are the local offices of the MEP, they could either manage rivers that are protected by the MEP under a river protection plan or serve as active monitors of the protected rivers.

4.1.2.3 MINISTRY OF WATER RESOURCES

The Ministry of Water Resources (MWR) is the Chinese governmental department responsible for water administration (MWR 2009). The MWR was founded in 1949 as the primary water administration in China. In 1982, the MWR and the Ministry of Electric Power were consolidated into the Ministry of Water Resources and Electric Power, and in 1988, the State Council renamed the Ministry the Ministry of Water Resources. The MWR would maintain responsibility for water resources and electric power (MWR 2009). Although the agency supports project that further energy development, it also has the capacity to aid a river protection system.

The MWR manages national water resources to meet a number of national interests from the protection of water quality for drinking water, to development of resources for energy production and flood control, to the conservation and protection of water resources (MWR 2009). The MWR is a well-funded ministry that could provide the resources needed to maintain the functions of a river protection system that other ministries such as the MEP may not be able to provide. Second, although it often supports development projects, the MWR has other mandates to manage and preserve water resources in a rational manner, that lend to the ministries ability to be a lead river protection administration (MWR 2009).

The MWR is the lead planning and supervising authority for river basin management planning. Plans are designed to ensure that water resources are developed and utilized - domestic, industrial, and environmental uses of water are all taken into account. The MWR has designed plans for national resource conservation. Plans that address urban conservation and water savings as well as national soil loss control programs have been put into action (MWR 2009). Other programs are focused on development. The MWR controls the development of major rivers, lakes, and other water bodies since it organizes and implements construction and management projects and is responsible for resettlement plans that must be drawn as a result of these projects.

4.1.2.4 RIVER BASIN AUTHORITIES AND WATER RESOURCE BUREAUS

River Basin Authorities (RBA) and Water Resource Bureaus (WRB) oversee the function of the MWR on regional scales (Ma and Ortalano 2000). WRBs are the local level offices of the MWR and work alongside local governments. Since rivers and watershed basins often cross political boundaries, difficulties can arise when regional bureaus and governments have contrasting interests. River Basin Authorities have been established to manage rivers and watersheds that cross these geopolitical boundaries (Ma and Ortalano 2000).

Water Resource Bureaus manage local issues (Mertha 2008). Bureau offices do not have strict rules for how their departments are set up (Mertha 2008). Their region of authority is usually established following physical and topographical lines, rather than political jurisdictions (Merhta 2008). They have some autonomy in their operational structure since they receive their budget and personnel allocations from the government at the corresponding level (Mertha 2008), and so they are able to be very focused on issues of local concern. This system allows for the bureau the flexibility to either provide high levels of protection or on the other end local pressure for rapid economic development could result in additional hydropower construction.

There are 7 national-level River Basin Authorities or Commissions (MEP 2009):

- Chagjian Water Resources Commission
- Yellow River Conservancy Commission
- Huai River Water Resources Commission
- Hai River Water Resources Commission
- Pearl River Water Resources Commission
- Songliao River Water Resources Commission
- Taihu Basin Authority.

These river basin authorities are responsible for managing the nation's major rivers that cross provincial boundaries (Mertha 2008). These commissions and authorities operate at the provincial level of government, except for the Changjian Water Resource Commission, which under special circumstances receives direct authority from the State Council, allowing it to bypass approval from the Ministry of Water Resources and the Provincial Government (Mertha 2008).

Since local economic, social, and environmental benefits may drive the need for river protection, RWBs and RBAs can have management roles in a river protection system. These local bodies can balance the needs and values of the local communities through the provision of local expertise and insight. Large development projects are decided at the national level and supersede local approval (Mertha 2008). Given this reality, river protection that operates on a national level

will be likely to ensure that local protection concerns are not trumped by national development demands.

4.1.2.5 NATIONAL DEVELOPMENT AND REFORM COMMISSION (NDRC)

The National Development and Reform Commission, formerly the State Planning Commission, is responsible for the development, implementation and monitoring of China's economic plans and coordinates existing social and development plans between government agencies and ministries (NDRC 2009). Additionally, the NDRC is responsible for the examination and approval of major construction projects, and promotes the Western Region Development Program, which aims to increase economic development of the poorer western communities (NDRC 2009). While the NDRC does not have direct administrative authority over China's water bodies, its role in regulation, planning and development and its lead role in managing the nation's economy indicate that it could be a useful agency in the management of a river protection system.

Many NDRC programs promote development, but the NDRC provides planning support that encourages protection as well. The State Council has required that the NDRC promote sustainable development and the conservation of natural resources (NDRC 2009). The NDRC has promoted environmentally friendly industries and has created plans to reduce emissions. Additionally, the NDRC's role in developing plans to restructure economic systems can be used to help design new economic plans that utilize river protection to boost regional economies through expansion of the tourism and recreational industries.

The NDRC encourages development, but is also mandated to find ways to preserve natural resources. The NDRC could provide national planning support and ensure that national economic and development plans do not conflict with the goals of river protection.

4.1.3 ADDITIONAL MINISTRIES, BUREAUS, AND OFFICES

The MEP, MWR, and NDRC may be best positioned to provide the lead support for a river protection system; however, decision makers responsible for drafting river protection plans should also consider the potential role of the following agencies as consulting bodies given their unique knowledge and expertise that may benefit the strength and efficacy of river protection.

4.1.3.1 MINISTRY OF CULTURE OF THE PEOPLE'S REPUBLIC OF CHINA

A river protection system for China does not only seek to protect rivers for their environmental values, but for their economic, social and cultural values as well. The Ministry of Culture (MOC) is involved in the protection of all forms of Chinese art,

literature, and immovable relics (China Embassy 2004; MOC 2006). Immovable relics include ancient cultural remains, ancient tombs, significant architecture, temples, carvings, murals, and other important remnants of Chinese history. There are nearly 400,000 immovable cultural relics registered with different levels of government (MOC 2006).

The Ministry of Culture is the chief authority responsible for overseeing the State Administration of Cultural Heritage (SACH) (MOC 2006). This Administration can play a significant role in promoting the protection of rivers for their social and cultural values. This SACH examines and reports on historical and cultural cities and legacy projects, examines the appropriateness of excavation, protection, and maintenance of key state relics, and oversees the allocation of funds utilized to protect such relics (China Embassy 2004; MOC 2006).

The MOC claims that local economic and social development has benefited due in part to the protection of these sites. World Heritage Sites such as the Forbidden City and the Emperor Qing's Terra-cotta Warriors and Horses sites, for example, have become world famous tourist destinations that also provide jobs and income for local communities (UNESCO 2010). This suggests that rivers protected for their cultural values may provide similar financial gains for local communities as protected rivers provide surrounding communities greater visibility to tourists. Current laws do not provide complete protection from development to many registered cultural heritage sites. Managers of infrastructure development projects are required to conduct surveys to determine if there are sites of cultural significance that would be harmed by development. The Chinese Cultural Heritage Law states that development projects should avoid developing these sites, but if this is not possible, it is the responsibility of the MOC to conduct excavations and decide if the site can be preserved with development (MOC 2006).

In 2005, the State Council issued a document calling for the People's Government at all levels to recognize the value of protecting cultural heritage and to increase efforts to protect the nation's cultural heritage. Shortly after, the MOC called for efforts to expand and strengthen the laws designed to protect cultural relics. Integration of cultural protection into a river protection program could be one such route, and this could be achieved by either granting the MOC some authority in a river protection system or by including the MOC and SACH as a major contributors to the decision making process.

4.1.3.2 UNITED NATIONS EDUCATION, SCIENCE, AND CULTURAL ORGANIZATION (UNESCO)

The United Nations Educational, Scientific and Cultural Organization (UNESCO) identifies and encourages the protection and preservation of cultural and natural heritage across the globe (UNESCO 2010). UNESCO has listed 38 world heritage

sites within China and 52 additional sites are being considered for listing (UNESCO 2010). The World Heritage Site labeling has increased the visibility of many of these sites to the world. Sites such as the Great Wall, tombs of emperors, Giant Panda sanctuaries, and karst landscapes have become world famous tourist destinations. While the UNESCO office does not have any political authority in China, it does have the ability to designate or rescind World Heritage Site status of locations (UNESCO 2010). By listing protected rivers and segments as World Heritage Sites, these rivers and segments may experience similar increases in tourism increasing the economic potential of the protected areas.

4.1.3.3 STATE FORESTRY ADMINISTRATION

The State Forestry Administration is responsible for managing forestry work conducted in China. Their major responsibilities include forest resource development, establishment of afforestation programs, management of forests for the conservation of national plant and animal species, and provision of support and guidance for scientific research of forests (Gov.cn 2009).

Forest management plays a large role in watershed dynamics and stream flow characteristics. Changes in land cover affect erosion, water runoff, and subsurface flow characteristics; dramatic changes in these watershed elements can jeopardize the quality of a river. Coordination between the State Forestry Administration and the River Protection Program's lead agencies could encourage protection of river values.

4.1.3.4 MINISTRY OF LAND AND RESOURCES

The Ministry of Land and Resources (MLR) is responsible for planning, administration, protection to ensure that there is rational utilization of China's land and marine natural resources (MLR 2010). The MLR develops and oversees land use planning for urban and mineral development prior to State Council approval (MLR 2010).

Land use planning and mineral extraction can have significant downstream impacts on water quality in rivers. To ensure that future resource development does not impair protected rivers, collaboration between River Protection Authorities and the Ministry of Land Resources is highly recommended.

4.1.3.5 CHINA'S NATIONAL TOURISM ADMINISTRATION

China's National Tourism Administration (CNTA) is the agency under the State Council that is responsible for developing the national tourism industry (CNTA 2010). The CNTA plans and coordinates development of the industry through market development strategies, oversight of the development of tourism resources,

consistency of the quality of customer and tourist services, and management of subordinate organizations (CNTA 2010). The CNTA could aid river protection authorities by increasing the economic viability of protected rivers through the promotion of tourism in selected areas.

4.2 ENVIRONMENTAL LAWS AND THEIR RELATION TO RIVER PROTECTION

This section highlights a number of Chinese environmental laws which are relevant to the protection of rivers. Each of the laws is summarized, and the institutions responsible for its implementation are identified. Most importantly, an explanation of how each of the laws is applicable to the development and management of a river protection system is provided.

4.2.1 ENVIRONMENTAL PROTECTION LAW OF THE PEOPLE'S REPUBLIC OF CHINA

China's Environmental Protection Law (EPL) was China's first environmental law and it established the foundation for all ensuing environmental laws in China (Gheleta 1998). Originally developed in 1979 and updated in December of 1989, the law was designed for "the purpose of *protecting and improving* people's environment and the ecological environment, preventing and controlling pollution and other public hazards, safeguarding human health and facilitating the development of socialist modernization (Environmental Protection Law 1989; Gheleta 1998)." To ensure that environmental protection is considered in all future development, environmental plans are required to be coordinated with and incorporated into national economic and social development plans. The EPL builds upon the state constitution and sets up a framework for more precise laws to be established (Gheleta 1998). This section provides an explanation of a few of the key elements of the Environmental Protection Law that can be applied to river protection.

The EPL establishes environmental protection responsibilities for a number of relevant government agencies; however, the majority of environmental oversight is assigned to the Ministry of Environmental Protection (Environmental Protection Law 1989). The MEP is responsible for establishing pollutant discharge standards and environmental monitoring systems and networks, drawing up environmental protection plans, and issuing regular environmental situation bulletins to the public (Environmental Protection Law 1989).

Article 17 of the EPL mandates that the MEP protect a diverse array of natural features and ecosystems, especially regions with rare and endangered plant and animal species. Features include major sources of water, regions of cultural and historical significance, fossil deposits, karat caves, traces of glaciers, volcanoes, hot springs, and precious trees. The EPL also contains a series of articles that are designed to ensure the maintenance of water quality by limiting the discharge of pollutants from construction, agriculture and urban development.

The most significant provision for protection of water resources in the EPL is Article 13, which requires the MEP's approval of a construction project's Environmental Impact Assessment before the Department of Planning can ratify the project's development plan. This article applies to all major construction, including the development of reservoirs and other river impoundments; hence, the EPL will be a key law and the MEP an important authority if a river protection system is developed.

The EPL was one of the first legal documents that demonstrated the Chinese government's commitment to creation of a balance between protecting natural terrestrial and aquatic environments and increasing development – this marked a departure from an old belief that economic growth undoubtedly results in the loss of cultural and biological diversity (Mc Donald 2007). The EPL has multiple provisions that require the protection of water resources from pollution and development that harms communities, wildlife, scenic locations and nature reserves that depend on the water. The EPL builds on that assertion by requiring efficient and reasonable use of resources along with provisions to oblige pollution-reducing technology as vehicles to ensure the protection of the natural environment (Environmental Protection Law 1989).

The Environmental Protection Law has proved to be a pivotal piece of legislation in ensuring that environmental preservation be prioritized. Though the law does not specifically reference river protection, many of the articles that provide mandates for protecting species, habitat, and cultural relics could be administered to provide such protection. Additionally, requirements for maintenance of water quality standards for both human and natural environments can be applied to situations in which dams will result in disturbance of sediment and nutrient flow, decline of dissolved oxygen in water, stimulate rapid algae growth, or provide any other threat to water quality. Lastly, Article 13, which requires the MEP to approve a project's EIS, could be expanded to consider the value of protecting a river before it is developed. Such considerations exist in other river protection systems such as the Wild and Scenic Rivers System in the United States.

4.2.2 WATER LAW

ADOPTED JANUARY 1988; REVISED AUGUST 2002

The Chinese water law presents a framework to achieve rational water resource development, planning, and use. The law aims to establish programs that balance the needs of development, meet urban, agricultural, and commercial demands, and the safeguard the environment. Some of the main goals are to ensure that water development is planned for multiple beneficial uses and to encourage conservation of water resources. Many of the Water Law's goals and mandates are consistent with policy that is also needed for river protection. This section discusses some of the most significant elements of the Chinese Water Law, and explains how the law can be applied to river protection in China.

PLANNING FOR WATER RESOURCES

Effective water resource planning is a crucial element for any successful river protection program. The Chinese Water Law calls for resource planning to be made on both river basin and regional scales and requires the drafting of comprehensive and special plans. Comprehensive plans address economic and social development needs as well as the extent of water resources development, utilization, conservation, and protection. Special plans address the utility of the water resource projects such as flood control, irrigation, navigation, water supply, hydropower, fisheries, logging, conservation of water, and sediment control. Newly drafted comprehensive and special plans should also consider other existing plans such as the general urban, land use and environmental protection plans, as well as the consumptive needs of regions and industry. Plans should take into account the results of scientific surveys, investigation and assessments of water resources made by the Ministry of Water Resources (MWR). County level governments are responsible for monitoring local hydrology and water resources and for providing that information to the public (Water Law 2002).

As outlined in the Water Law, all waterworks must be built within the guidelines established by the comprehensive river basin plans. All construction projects on key rivers and lakes must receive approval from the relevant River Basin Authority after they confirm that the construction is in compliance with the comprehensive plan. All other rivers must receive similar approval from MWR at or above the county level, in conjunction with other relevant departments at the same level (Water Law 2002).

WATER RESOURCES DEVELOPMENT AND UTILIZATION

The chapter dealing with water resource development and utilization presents a few opportunities for promoting river protection; however, it also presents the

strongest policy roadblocks to such a system as well. It establishes the requirement for multipurpose use of water resources as well as requirements for governments at all levels to identify opportunities for water conservation and utilization of alternative water supplies, such as rainwater harvesting, recycled water, and water desalination. It also emphasizes the necessity of scientific analysis of the geologic appropriateness of a project as well as analysis of the environmental impacts of these projects; however, these articles are in stark juxtaposition to other mandates that require the development of these resources. Article 21 places urban daily supply as the clear priority over the needs of agriculture, industry, the environment, and navigation. Article 26 encourages the development of hydroelectric dams and cascading developments, when possible. Article 27 encourages development and utilization of water resources for transportation, though it also requires such development projects to develop facilities to allow the passage of wildlife, ships, and log rafting or to provide some other remedial action if authorized by the appropriate department (Water Law 2002).

PROTECTION OF WATER RESOURCES, WATER AREAS AND WATERWORKS

The articles pertaining to the protection of water resources can provide additional support to a river protection system. The articles explain how all levels of the MWR, the River Basin Authorities, and all other relevant departments must ensure proper flow in water bodies so as not to inhibit the designated water purification capacity. Basin authorities are required to determine the pollution-receiving capacity of the water areas and prescribe appropriate total pollution discharge limit recommendations to the MWR. Additionally, these articles explain how a system in which the MWR, in conjunction other relevant provincial authorities can divide key water bodies into functional zones. Functional zones can be designated for multiple purposes, but the law emphasizes the use of protecting drinking water sources as a priority (Water Law 2002). A river protection system could use this pre-established system to develop functional zones for river protection.

The Chinese Water Law has excellent potential in aiding a national river protection system. The requirements for measuring the needs of regions alongside environmental needs, mandates for scientific feasibility, and maintenance of specific river flows provide strong legal foundation to support the protection of specific rivers and river segments. Additionally, the provisions that allow for the designation of functional zones indicate that an existing framework could be used to set aside key water bodies for protection. The Water Law provides a legal foundation from which decision makers can learn and apply to a river protection system.

4.2.3 LAW ON PREVENTION AND CONTROL OF WATER POLLUTION

Originally adopted in 1984 and revised in 2008, the Law of the People's Republic of China on Prevention and Control of Water Pollution, was created to prevent and control water pollution, protect and improve the environment, safeguard human health, ensure effective use of water resources, and promote sustained economic and social development (Water Pollution Law 1984). The Law details plans for the prevention and control of water pollution in river basins and entire regions.

Local governments at various levels and departments under the State Council incorporate the protection of the water bodies into their plans (Water Pollution Law 1984). When a plan involves two or more provinces, the environmental protection administration works in conjunction with the water conservancy administration to avoid controversy. Water disputes that involve different administrative levels are settled through negotiation between local governments, or through coordination facilitated by a common higher people's government (Water Pollution Law 1984).

The Law stipulates that water bodies that possess unique economic values (e.g. important fisheries) or cultural values (e.g. scenic or historic sites), may be designated as protected zones by the people's government at or above the country level (Water Pollution Law 1984). Activity within protected zones must not violate water quality standards for uses specified by the designation. Tourism and swimming activities may cause water pollution to domestic and drinking water supplies, and therefore are prohibited within the "first class" protected zone. A report in 2004 recommends the establishment of a comprehensive legal framework for a system of protected areas (CCICED 2004). This would be applicable to a river protection system since the protection of these areas would ensure that values are preserved, and that the integrity of the river would be preserved.

RELEVANCE TO RIVER PROTECTION

Different aspects of this law could be applicable to a river protection system. Article 10 states that collaboration can take place if plans for river basins involve two or more provinces (or counties). This would be important for a protection system because it is likely that a river, and even a river segment, will stretch between provinces.

Article 12 recognizes a number of different values that water bodies posses. In a river protection system, multiple environmental, economic, and social values would be recognized that are often overlooked. It is important that this law protects environmental areas by setting aside "zones" that limit environmentally destructive activities to ensure continued protection.

4.2.4 STATUTE FOR ADMINISTRATION OF RIVERWAYS OF THE PEOPLE'S REPUBLIC OF CHINA

The Riverways Statute, enacted in 1988, was established in order to improve riverway administration, ensure safety in flood prevention, and promote the effective utilization and development of river and lake resources (Gheleta 1998). After the law was enacted, plans were created for the development and utilization of rivers and lakes and these were integrated into national and economic social development endeavors. Activities that would hinder flood control efforts were to be prevented (Gheleta 1998). While this law strives to maintain the integrity of riverbanks (e.g. it is forbidden to harm trees along a riverbank or remove vegetation) and promote sustainable development, the protection of a river or segment would alone be beneficial in conserving riparian environments. This statute is important to resource protection, and could be used as a reference in the creation of different zones that could be established to specifically designate different areas for different uses, continuing to protect rivers and their surrounding environments.

4.2.5 ENVIRONMENTAL IMPACT ASSESSMENT LAW

INTRODUCTION

The People's Republic of China began using the Environmental Impact Assessment (EIA) process in 1979 (Tullos 2008). EIAs were formally adopted as part of the Environmental Protection Law in 1989. In the late 1990s, work began on a new, stand alone Environment Impact Assessment Law (EIA Law). This law was passed in 2002 and officially came into effect on September 1, 2003 (Wang et al. 2003). The goal of an EIA is to characterize and minimize environmental impacts associated with proposed projects (Tullos 2008). In China, the EIA Law's stated purpose is to further sustainable development goals and to "prevent the unfavorable impacts of programs and construction projects on the environment" (EIA Law 2003). Many of the ideas incorporated into this law are applicable to a river protection system. Experiences and lessons from the utilization of the law provide insight into the possible design and functioning of a river protection system.

PROCESS

The EIA process in China involves a series of steps shown below (Figure 4.2.5.1). When an EIA for a proposed construction project is necessary, a central step in the process is the preparation of a report which includes an appraisal of environmental impacts (also known as an environmental impact report or EIR). Each report should included three elements: (1) an analysis, predication, and appraisal of possible environmental impacts of the project, (2) mitigation measures for those impacts and (3) a conclusion of the impacts on the environment. The Ministry of Environmental Protection (MEP) is charged with examining and approving an EIR. According to the law, no developer can begin construction until the MEP has approved the EIR (EIA Law 2003).

Many countries employ some kind of EIA in the process of decision-making on construction projects. Although the EIA process has certainly improved the consideration of the environment in development decision-making, many problems with the execution of EIAs can be found in various countries around the world. Main problems with the use of EIAs are: (1) insufficient consideration of impacts, (2) inadequate consideration of alternatives, and (3) poor public participation (Li 2008). China has started to address some of the noted problems in their EIA process and real changes have been observed.

CONSIDERATION OF IMPACTS

The assessment of cumulative impacts is seen as an increasingly important element of an EIA. This is especially true with dam-building and, in particular, when several dams are planned or built on a single river. While the effect of a single dam may not

result in significant environmental or social impacts, the cumulative impact of multiple dams may be devastating (Li 2008). One of the ideas incorporated into the EIA Law to address cumulative impacts is the concept of a Strategic Environmental Assessments (SEA). A SEA seeks to go a step further than a traditional EIA by evaluating direct and indirect impacts of a project and then addresses the consequences of those impacts (Tullos 2008). Another dimension of impacts that needs to be included in an EIA is first, second, and sometimes third order impacts (Tullos 2008).

One component of the EIA process is the natural uncertainty related to impact projections; however, a few factors can compound the natural uncertainty and affect the overall validity of the EIA itself. If an EIA is informed by inadequate or incorrect baseline data or causality was not properly accounted for the negative impacts of a project can be underestimated. Lack of time and resources are common explanations as to why impacts are not properly assessed (Tullos 2008). Therefore, initiating an EIA early in the planning process and providing adequate funding can aid in the creation of a sound EIA. If an EIA is carried out with inefficient data, there is little chance of generating a thorough and accurate assessment of a potential project. An incomplete EIA wholly undermines the EIA process, and also increases the likelihood that a project will have adverse effects on the environment. In contrast, a well-developed EIA with high-quality baseline data can be the first step in the prevention of irreversible environmental damage.

Public Participation

The EIA Law includes requirements for public participation. The Law directs construction companies to seek the opinions of experts and the general public before a report of the project's environmental impacts is submitted for approval by the MEP (Article 21, EIA Law 2003). The MEP is tasked to seek public opinion on the draft report of environmental impacts (Article 11, EIA Law 2003). In both cases, the procedure for soliciting public opinion can be in the form of meetings, hearings, or other means. In addition, once opinion is taken, consideration and documentation of opinions accepted or rejected must be made. Although details of how public participation will be organized is not provided in the EIA Law, the government issued Provisional Measures on Public Participation in the Environmental Impact Assessment in 2006 to provide further guidance and clarity on public participation measures (Xiaohua 2006).

Public participation is being increasingly demanded in environmental decision-making in China. Not only can the public be a valuable resource for information gathering, especially of baseline data, the public can also serve a role in post-EIA monitoring efforts. Open and convenient public hearings, workshops and educational programs are key elements when conducting public outreach. Involving the public and affected communities also helps legitimize the project and can yield

smoother project development. Public participation is required in the EIA Law, but there are several reasons why participation is very limited. Inadequate funding, lack of legal infrastructure for civic participation, and unfamiliarity with the law are all causes of poor participation (Li 2008). To facilitate participation in the EIA process, the concept of the "People's" EIA has evolved. The "People's" EIA, detailed in a 2007 article by Dr. Kanokwan Manorom, aims to create opportunities for local people to articulate their needs, values, and priorities when a project that will impact them is proposed (Manorom 2007). The involvement of all stakeholder groups is central to this EIA process, as well as participation in multiple stages of decision-making (Manorom 2007).

ALTERNATIVES

Although the consideration of impacts and requirements for public participation has improved in the EIA process, the failure to consider alternatives to projects still remains an issue. The EIA Law does not include a legal provision or discussion of consideration of alternatives to the proposed project (EIA Law 2003). The consideration of alternatives is not only important when seeking to minimize environmental impacts, it is also important to the performance of the project. Careful site selection and design elements can make a significant difference in a project's long-term viability (WCD 2000). Most alternative analyses vary one or more factors including the location, scale, site layout, employed technology, operating criteria, and mitigation measures (Wang et al. 2003). In addition, a "no-action" option can be an alternative, which means that the project does not move forward (Wang et al. 2003).

RELEVANCE TO RIVER PROTECTION

Several articles in the EIA Law promote useful and applicable procedures for a river protection system. For example, Article 6 calls for the state to create a basic database to be used when appraising environmental impacts (EIA Law 2003). The purpose of the database is to encourage more scientific research and support the sharing of information. The MEP is tasked with organizing, establishing, and improving the database. For a river protection system, a similar or joint database could be set up by the MEP for evaluation of river values and provision of baseline data on river conditions. The collection of accurate and thorough baseline data is important to the effectiveness of a river protection system. If river status and values are not properly assessed, an underestimation (or overestimation) of the benefits of protection could occur. A flawed assessment would undermine the utility of the protection system.

Article 4 of the Law speaks to the importance of objective, open, and impartial appraisals of impacts and the necessity of scientific basis in decision-making (EIA Law 2003). The assessment of river values and the decision to designate a river as

protected must also be based on these qualities. The inclusion of a river into the system will likely confer benefits and costs to the local community and to the agency assigned to its protection. Therefore, the decision to protect or not protect should not be influenced by biased opinions and considerations. The study process carried out by an interdisciplinary team of experts should aid in producing an objective, scientific and impartial river assessment.

The EIA Law also provides support for the suggestions made for a river protection system on public participation and stakeholder consultation. Specifically, the system allows various stakeholders to nominate rivers and calls for the involvement and consultation of the public and stakeholders in the study process and drafting of management plans. Several articles require public participation and the involvement of various stakeholder groups in the various stages of the EIA process. For example, Article 5 of the EIA Law encourages relevant entitles, experts, and the general public to participate in the appraisal of impacts through meetings and hearings (EIA Law 2003).

REDRESS OF EIA ISSUES IN A RIVER PROTECTION SYSTEM

Several challenges with the administration and operation of the EIA in China have been cited and include: lack of funding and staff shortages at environmental protection agencies, local environmental protection bureaus' reliance on local governments for funding, the level of discretion afforded to local governments to interpret national legislation (Wang et al. 2003), the presence of unqualified, unlicensed EIA assessors, and a misconception that EIAs seek to hinder economic progress (Li 2008).

The recommendations made for a river protection system aim to correct some of the cited issues. Funding for river protection efforts will be provided by the central government, eliminating the funding shortages that local Environmental Protection Bureaus (EPBs) often face. In addition, responsibilities for the administration and management of the system will be divided among several agencies reducing the workload of a single agency and reducing the staff and funding requirements for a single agency. Assigned responsibilities will be clearly articulated to each agency as to reduce the confusion over lines of responsibility and accountability. To ensure proper management and administration of the system, a training program for personnel involved in river protection management and monitoring will be provided. Finally, the potential rewards and benefits of river protection to local jurisdiction and the nation as a whole will be clearly communicated. As discussed in the recommendations for a river protection system, incentives consist of special recognition of officials, cities, and agencies (including monetary and promotional rewards), receipt of revenue from ecotourism, and avoided expenditure on capital for environmental improvement.

INSTITUTIONAL CONSIDERATIONS

Even if procedural improvements to the EIA process are made, vital institutional changes must be made as well. The National Development and Reform Commission (NDRC) has stated that the initiation of hydropower projects, including activities like the construction of roads and induction tunnels, only requires the permission of local government officials (Xie 2009). Only when water interception and dam construction begins does the MEP need to sign off on the project (Xie 2009). Unfortunately, significant alterations of the environment and local communities have often already occurred during this initial stage. Local governments have an incentive to frequently abuse the existing decision-making structure. Local governments gain tax revenue from construction projects in their jurisdiction and are eager to capitalize on them (Economy 2004). Therefore, construction projects are frequently permitted by local governments before the EIA process is even initiated (Xie 2009). As a result, projects are started and then developers apply for environmental permission at a later date. Local governments take advantage of the fact that by the time the central government via the MEP starts to investigate a project and initiate an environmental impact statement, the project is well underway and significant investments have been made (Xie 2009). Since time and money have already been committed, the MEP is essentially forced to permit the project (Xie 2009). Hence, without changes to the institutional structure of project permitting and decision-making especially in dam construction, even the most sophisticated EIA process cannot serve its function.

Another fundamental legal change to the EIA process that should be made relates to the required timing of EIA completion. The law clearly requires an EIA to be completed prior to the construction of a proposed project; however, the penalty for failing to do so is simply a post-construction assessment (Tullos 2008). This weak penalty undermines the very purpose of the EIA itself, which is to account for and minimize environmental impacts *before* an action occurs. A post-construction assessment can only assess the damage which has already occurred and is in many cases irreversible. Therefore, enforcement of the law as written without exception must be made a priority by governmental official if the EIA is to have any efficacy.

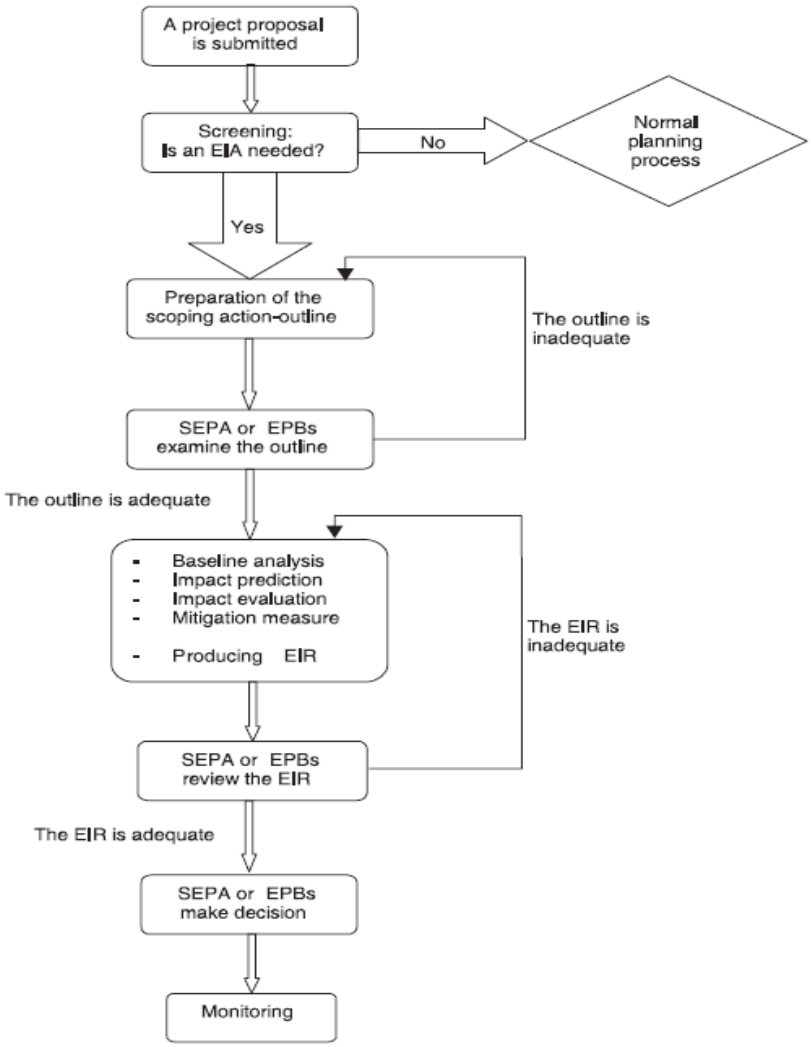
CONCLUSION

By making the suggested procedural, institutional and legal changes, not only will the EIA process be strengthened in its utility and effectiveness, but gains for other environmental legislation will also result. A river protection system in China will require the thorough scientific understanding of river systems and the ecological, economic, and social context in which these systems are located. Information gathered from past and future EIAs could serve as a valuable reference. The institutional and legal changes will make administration and enforcement of river

protection more effective by increasing the compliance with project construction and permitting requirements and decreasing illegal development of rivers.

Recently, the government has shown its commitment to the legal requirements in the EIA Law and its willingness to improve the enforcement of EIA requirements in development projects. On June 11, 2009, the MEP suspended construction and approval of two hydropower construction projects on the Jinsha River (Jingrong 2009). This action came as a result of the projects' failure to receive environmental approval and proceed with construction activities anyway. This move by the MEP set a precedent and sends a message to other construction companies that the government is serious about environmental protection.

FIGURE 4.2.5.1: EIA PROCESS IN CHINA.



Source: Wang et al. 2003.

4.2.6 PUBLIC PARTICIPATION

The efficacy of public participation in environmental decision-making in China may serve as an important indicator for gauging implementation of a permanent river protection system. River protection is more likely to be effective if the public has the opportunity to be well-informed about the process and how they can play a role; however, government transparency and accountability to the public is not always the norm. In cases where the public has been vocal in response to development projects in China, participation has begun after the government has already made, at least, a preliminary decision. The public is not always privy to important information as it is kept within what is often referred to as China's decision-making "black-box" (Zhang and Jennings 2008).

It was not long ago that laws were established around the world to address the public's role in decision-making for projects that impact the environment. Public participation in environmental policy-making was first formally addressed in China in the 1970s, but most progress has been more recent. In November of 2001, the State Environmental Protection Administration of China (SEPA), which is now the Ministry of Environmental Protection (MEP), drafted a groundbreaking regulation to strengthen public participation in the Environmental Impact Assessment (EIA) process. The regulation addresses participants' rights, procedures and methods for public involvement, such as debates, hearings and even opinion surveys (Liu 2005). Today this could be instrumental for better decision-making about river protection strategies.

In 2003, a controversy over the protection of the Nu River arose when proposals to dam the Three Parallel Rivers, a UNESCO Heritage site, were made. Scientific professionals and NGO officials immediately protested the projects, which would have had harmful impacts on thousands of species of plants and rare and endangered animals and fish. Their response caused government officials to halt the project and request a more thorough evaluation. The evaluation was completed, but the EIA report was never released as it was considered a state secret. The public continuously asked to know what had been determined, but never received an answer. The project was delayed and the decision about whether or not to start the project was deferred as well.

Public involvement in China's EIA process since the Nu River controversy continued to be minimal, but in 2006, SEPA brought forward the Provisional Measures on Public Participation in the Environmental Impact Assessment. These measures went beyond the 2003 Law by providing a description of who would conduct public participation during the EIA process, and how this would be carried out (Zhang and Jennings 2008). In February of 2007, SEPA put together a set of "Measures on Open Environmental Information (for Trial Implementation)," which would become effective in May 2008. The articles explained in the document detail the process of

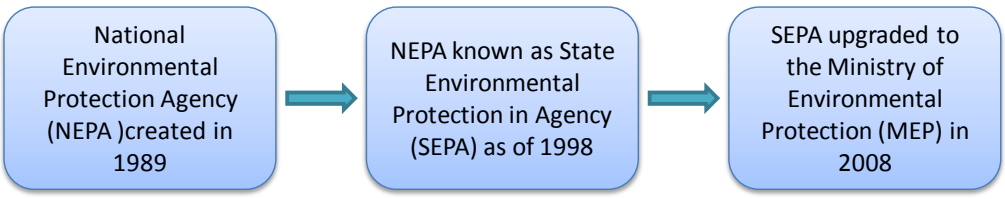
disclosure of environmental information to Chinese citizens by their government and by environmental organizations within the country (Measures on Open Information 2008). These measures would be imperative to the river protection nomination process in which the public is given the opportunity to learn about the consequences of protecting rivers upon which they depend.

One of the first basic articles in the Measures explains what "environmental information" is, and more specifically defines "government environmental information" as "information made or obtained by environmental protection departments in the course of exercising their environmental protection responsibilities and recorded and stored in a given form" (Measures on Open Information 2008). The Measures were written and brought into effect to "propel and regulate the disclosure of environmental information," so that Chinese citizens could more actively take part in the decision-making having to do with the natural environment.

Article 6 of the statute states that "environmental protection departments should establish and perfect open environmental information systems" (Measures on Open Information 2008). Transparency as stipulated by this article could be instrumental in decision-making about river protection that would have impacts on river communities. If community members understood the reasons to either develop or protect rivers, they could offer up their concerns and questions, and receive answers.

The organizational office of the environmental protection department responsible for conducting open government environmental information work formulates policies, rules and working guidelines for the release of open government environmental information and coordinates open government environmental information sharing among different business offices of the department (Measures on Open Information 2008). Additional opportunities to strengthen connections within, what is now, the MEP would arise if the choice to protect rivers was one that required the cooperation of a number of decision-makers.

FIGURE 4.2.6.1: EVOLUTION OF THE ENVIRONMENTAL PROTECTION BODY WITHIN THE CHINESE GOVERNMENT.



The Ministry of Environmental Protection (MEP) replaced SEPA in 2008; it plays a major role in furthering public participation in environmental policy making. The MEP is more transparent than was SEPA in dissemination of information (Zhang and Jennings 2008). In fact, MEP Vice Minster Pan Yue and the environmental administration have initiated the "Environmental Protection Storm." In 2005, the first wave of the storm rolled in as SEPA halted a number of industrial projects mid-construction as they had begun work before the proper paperwork had been filed (Jian 2005). As its title suggests, this national campaign promotes widespread environmental awareness and responsibility (He 2008). Transparency and open discussions about environmental issues are steps that will aid the furthering of public participation in environmental protection systems, such as a river protection system.

BOX 4.2.6.1: NEWS MEDIA IN CHINA

China's media has become increasingly diversified in content, and there has been an increase in investigative reporting by Chinese news agencies. According to a government report, there are more than two thousand newspapers, over eight thousand magazines, and some 374 television stations in the country. China also has hundreds of millions of Internet users. A 2001 public opinion poll revealed that nearly 80 percent of Chinese citizens had learned about environmental protection-related issues from either radio or television (Economy 2004).

In recent years, the government has placed environmental concerns higher on the national policy agenda than before, and the news media has had the opportunity to report more widely on environmental issues. Television and newspaper journalists and radio personalities have been able to be leaders in environmental education (Economy 2004). The television has played a role in investigation of environmental crimes and provision of information to government officials about these issues. The television show, *Focus*, has been a crucial force in its reporting about environmental crimes, drawing in hundreds of millions of viewers, and even inspiring numerous citizens to line outside the studio to request the reporting of other environmental wrongdoing (Economy 2004). Further, the State Environmental Protection Agency (SEPA) and the State Forestry Bureau have encouraged the publication of environmental newspapers for many years; however these papers are generally only circulated within government agencies (Hildebrandt and Turner 2002).

A river protection system could be supported with through media coverage. The media could play a role in the educating the public on river protection and alerting citizens to newly designated rivers.

Experts will continue to have an important role in encouragement of public participation. University professors, in particular have a prestigious standing in China, and therefore, their attitudes and opinions tend to have impacts on public participation and even encourage mobilization. NGOs and mass media also have imperative roles, especially when they cooperate with one another. NGOs often find creative ways to wager support in opposition to projects with negative environmental

impacts, by garnering celebrity signatures for petitions, informing the public, and writing letters to government agencies. Media professionals record and present the participation of NGOs and citizens in public hearings. The media, in fact, is not just a "mouthpiece" for the Party today, it is actually encouraged to inform the public (Zhang and Jennings 2008).

Currently, most Chinese citizens obtain information about development that will impact the natural environment through television, newspapers and the internet (Keio University student 2008). As communication technology advances, there are increased opportunities for the public to share information via cell phones, emails and websites. Sometimes demonstrations are held, many of which are facilitated by NGO support (Zhang and Jennings 2008). Although there is "widespread official concern that participatory processes will open the floodgates to public disorder and conflict among different social factions" (Moore and Warren 2006), decision-making about projects with major impacts on the environment and society should be made at least in part by an interdisciplinary and informed public. River protection, in particular, could be furthered with increased public participation because the protection of natural resources spurs advocacy from the diverse fronts of the environmental, sociocultural and economic sectors.

BOX 4.2.6.2: THE INTERNET AS A VEHICLE FOR ENVIRONMENTAL COMMUNICATION IN CHINA

Since the late 1990s, Chinese NGOs, governmental agencies and individuals have used the internet to share information about environmental crises, laws and regulations CNNIC 2003). This medium has provided a means of communication for those who are interested in mobilizing to impact policy and safeguard the environment.

Government agencies, green NGOs and research centers have created environmental websites, as well as environmental activists and volunteers, most of whom rely upon minimal resources and manpower. Some green site-builders do not own personal computers, or only own one that is utilized by an entire team of people eager to distribute current information.

Websites such as *Green-Web* and *Greener Beijing* give participating groups public visibility, which in turn creates a forum where citizens can go to become informed and organize. Although China's internet population was numbered at only one million in 1998, by 2008, the count was at 298 million (CIA 2009). Growth of the internet population indicates that the internet is a viable source to publicize information and reach a large amount of people. In particular, the internet could provide a medium through which citizens could access and share information about river protection measures and newly designated rivers.

4.2.7 REGULATIONS FOR SOCIAL ORGANIZATIONS AND NON-GOVERNMENTAL ORGANIZATIONS IN CHINA

The Chinese non-governmental organization (NGO) offers a political space for public participation in environmental protection. The variety of NGOs in China has been and continues to be an actor in a process that impacts state-societal relations. Chinese NGOs are influential and informed, and contribute to the shaping of environmental protection in China.

Civil law in the People's Republic of China allows for three forms of nongovernmental, not for profit organizations (NPOs), or "minjian zuzhi" (USIG 2008): (1) Social organizations, (2) Foundations and (3) Civil non-enterprise institutions. All three are tightly linked to the government through a number of oversight mechanisms, namely the registration process, which requires the sponsorship of the government (Brennen and Jones 2009). Following a government-placed moratorium on the registration of new NGOs, new regulations that made the process more difficult were released. Today, a national level NGO must "prove [that it has] a 'legitimate' source of funding, raise at least 100,000 yuan and [be] comprise[d] of more than 50 individual members" (Economy 2004).

Further, Chinese regulations from 1998 stipulate that no more than one organization for any specific niche of work should exist in the same region. Sometimes, this means that an emerging NGO's role is already served to some degree by a government-organized NGO (GONGO) or other entity (Yang 2005). GONGOs sometimes act as a bridge between government and NGOs (Economy 2004), but their existence also limits the number of new NGOs that can be registered. Hence, some groups opt to register as businesses, web groups or even carry on without formal registration in order to sidestep the requirement and continue their work (Yang 2005). Additionally, there are more than 415,000 officially-registered civil society organizations (CSOs) in China (which must go through the same registration process as that of NGOs) and a number of international NGOs (INGOs). The World Bank has actually made an effort to strengthen its engagement with civil society in China by offering support to the Ministry of Civil Affairs to help promote the development of CSOs (The World Bank 2009).

NGO membership is contingent upon one's political history and credentials. Any citizen who has ever been deprived of political rights, such as a political prisoner, cannot participate in an NGO. Further, NGOs classified as "second-tier" cannot directly accept new members. In the case of Action for Green, which promotes a "green lifestyle", new members must first join the Yunnan Environmental Science Society, whose access is limited by specific scientific credentials (Economy 2004). The result is that individuals interested in furthering the mission of the NGO must either wait to be credentialed or act as volunteers.

The strong connection that Chinese NPOs must maintain with the government has meant that the government and environmental NGOs have worked under the auspices of mutually re-enforcing goals (Economy 2004; see Box 4.2.7.1). It is important to note, however, that the decentralization of government in China has loosened state control to some degree and opened the door for expansion of civil society in creative ways. NGOs must operate under state policy, but environmental NGOs (ENGOs) in particular, encourage a discourse of citizen participation. ENGOs that operate in minority regions argue that the "sustainable development" pushed by the government must also incorporate into its actions protection of local cultures, communities and traditions. Finally, the NGO plays a role in enforcement of environmental standards through legal action (Yang 2005).

The Centre for Legal Assistance to Pollution Victims has taken more than 30 cases to court on behalf of pollution victims. Nearly half of the cases have been won, which points to the changing relationship between the state and citizens, or at least between the state and non-governmental organizations. Few organizations in China

BOX 4.2.7.1: ENVIRONMENTAL NGOS AND THEIR RELATIONSHIP WITH THE MEDIA

Media: The media tends to share a position with ENGOs; they both aim to emphasize the importance of environmental protection and even draw attention to efforts that have been made, but are politically safe since their aims are synonymous with the state policy of "sustainable development" (Yang 2005). Information about environmental issues and the positions embraced by NGO leaders have been shared with the public via radio shows, and in particular, Chinese television. Top environmental officials have even been informed and influenced by television programs that have revealed negative consequences of desertification and illegal logging (Economy 2004).

Internet: Internet communication is generally well-suited to NGOs or to NPOs in theory. Across the globe, civil society actors have adopted internet use because of an affinity between NGO culture and internet culture (Yang 2005). Chinese NPOs, however, have not always utilized the internet as a key advocacy tool, although many of these groups do have internet sites that explain their missions and work. For web-based NGOs on the other hand, the internet is the medium in which they are able to further causes they value without being subject to regulations on NGO registration (Yang 2005). NGO use of the Internet is continually evolving. Many Chinese citizens are active participants in environmental issues today as a result of internet communication (Yang 2008), although not all of this is related to NGO internet communication.

The role of the Chinese NGO is currently changing as the state re-evaluates its willingness to allot more of the responsibility of environmental information sharing to non-governmental entities. The status quo is a mutually re-enforcing relationship in which NGOs influence the public's desire to protect the environment for future generations alongside promotion of governmental goals for social harmony and sustainable development.

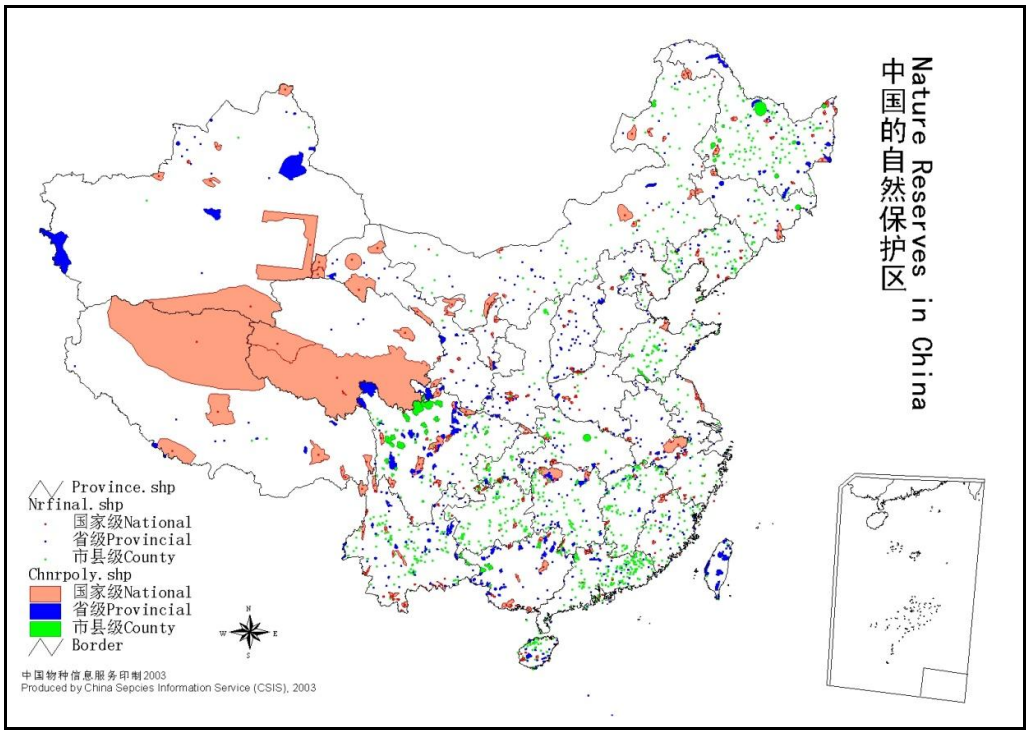
have had this kind of success, but the director of the Centre explains that citizens are decidedly beginning to "resort to legal weapons to protect their legitimate rights" (Yang 2005). And NGOs often play a role in forcing industry to comply with the law. Examples like this indicate that there is a space for action from NGOs on behalf of a river protection system, if implemented by the Chinese government. Not only are NGOs often crucial to conducting research about environmental concerns, they also encourage compliance with environmental regulations.

The Chinese environmental NGO community shares the idea that true environmental protection is facilitated by increased access to environmental data, as well as by collaboration between stakeholders. Information sharing by NGOs, in particular, might make the process of identification of rivers suitable for protection designation easier. And finally, if NGOs could play a role in the education component of river protection, there might be increased public awareness and participation during the designation process.

4.2.8 REGULATIONS ON NATURE RESERVES

The first nature reserve established in China was the Dinghushan Nature Reserve in Guangdong Province in 1956 (CCICED 2004). As of 2004, over 1,900 nature reserves were established across China covering 13% of the land area (CCICED 2004). There are also many other types of protected areas, such as forest parks, that cover an additional 2% of land area (CCICED 2004). Yunnan Province alone has 152 natural reserves, the most in any province (CIIC n.d.). The largest nature reserve by area is the Sanjiangyuan Nature Reserve established in 2000 in the Qinghai-Tibet Plateau; it protects the sources of the Yangtze, Yellow and Lancang rivers (CIIC n.d.).

FIGURE 4.2.8.1: NATURE RESERVES IN CHINA.



Source: China Species Information System 2003 as cited in CCICED 2004.

The legislative framework for nature reserves is found in the *Regulations of the People's Republic of China on Nature Reserves* effective as of December 1, 1994. These regulations were created to strengthen the development and management of natural reserves, and to protect the environment and natural resources (Article 1, Regulations on Nature Reserves 1994). Nature reserves aim to provide protection to locations with representative ecosystems, concentrations and areas of precious and endangered species, and natural relics (Article 2, Regulations on Nature Reserves 1994).

A reserve can be established at different levels of government – there are both National and Local reserves – and for a variety of purposes. A Local reserve can be

established by county, city or prefecture governments, or by environmental bureaus of provinces, municipalities, or autonomous regions (Article12, Regulations on Nature Reserves 1994). There are three types or categories of reserves, to which a reserve can be assigned one or more of these categories: wildlife reserves, natural ecosystem reserves, and natural monument reserves (CCICED 2004).

RELEVANCE TO RIVER PROTECTION

Several parallels can be drawn from the nature reserve system to the recommendations made for a river protection system. First, the management of nature reserves is assigned to several government agencies involved in land/resources protection, some of which include the Ministry of Water Resources, the State Forestry Administration, the Ministry of Construction, the Ministry of Land Resources, and the Ministry of Environmental Protection. The recommendations made for a river protection system propose that the administering authority of the system is shared between agencies that are involved in environmental/water protection and planning, namely the Ministry of Environmental Protection, Ministry of Water Resources, and National Development and Reform Commission. Second, the daily management of reserves is delegated to local governments, in the case of Local reserves. Management of a protected river can also be delegated to a local water bureau or to a local environmental protection bureau by the central government.

Third, there are restrictions on activities permitted within reserves. Natural Reserves are divided into three zones: a core zone, a buffer zone, and an experimental zone. Each zone allows a different level of use and interaction (Article 18, Regulations on Nature Reserves 1994). Within the core zone, no agency or individual is permitted to tread. Within the buffer zone (located outside of the core zone), scientific research activity is permitted, but tourism, construction, and manufacturing activities are forbidden. Within the experimental zone, scientific experiments, teaching practices, visits and surveys are allowed. In the remainder of the reserves, development activities are permitted as long as construction does not pollute or damage the environment. The tiered protection zones created for the nature reserve serve as a strong analogy for a river protection system with three classification levels for designated rivers or river segments.

Reserves have been criticized by some authors for their impact on local peoples (CCICED 2004); however, Article 14 states that after a reserve is established, the need for economic construction and the local people's livelihoods shall be taken into account (Article 14, Regulations on Nature Reserves 1994). The recommendations made for a river protection system include measures to insure the preservation of the livelihoods of local and indigenous peoples. The continued use of and interaction with rivers by local peoples is guaranteed under all levels of river protection.

4.2.9 RENEWABLE ENERGY LAW

The Renewable Energy Law (REL) came into effect on January 1, 2006 in order to "promote the development and utilization of renewable energy… protect the environment, and realize the sustainable development of the economy and society" (REL 2006). The renewable energy legislation provides a legal guarantee that renewable energy, such as wind and solar, will be developed (Yu'an 2009) and sends a signal to developers, investors, and resource management that the Chinese government is committed to clean, sustainable energy. In 2009, the National People's Congress Standing Committee adopted an amendment to the law that further supports the renewable energy sector by requiring electricity grid companies to purchase all power produced by renewable energy generators (Huizi 2009).

ELEMENTS OF THE LAW

The REL has two key elements. First, it establishes total volume targets (discussed below) for the development of renewable energy in China. Second, it provides financial incentives to investors to foster renewable energy development.

TARGETS

China's leading energy think-tank, the Energy Research Institute, which lies under the direction of the National Development and Reform Commission, has outlined a three-step strategic plan for the development of renewable energy resources through 2050(Yu'an 2009). Goals indicate that by 2020, renewable energy should account for15% of China's total energy consumption. By 2030, renewable energy production should account for 20% and finally by 2050, renewable energy should supply over one-third of energy in China (Yu'an 2009).

INCENTIVES

Financial incentives include preferential loan subsidies from financial institutions and government granted tax benefits to develop renewable energy projects. In addition, the government has established a fund for renewable energy development that supports a variety of activities including scientific research, pilot projects, rural projects, independent power systems in remote areas, resource surveys and assessments, information systems, and equipment production.

RELEVANCE TO A RIVER PROTECTION SYSTEM

The law details two concepts that are applicable to river protection efforts. First, the law calls for a national survey of renewable energy resources, called resource surveys. Secondly, the preparation of a national renewable energy development and

utilization plan is also mandated. The results of both the surveys and plans will be released to the public (REL 2006). These results could be useful to river protection efforts by delineating where hydropower projects are being considered for development and where protection efforts should or should not be focused.

Public participation and stakeholder consultation are requirements in the law as the preparation of the national renewable energy development and utilization plan must be informed by the opinions of relevant entities, experts, and the public. In addition, intergovernmental cooperation and coordination is also expected during the preparation of plans for administrative regions. Similar expectations of public participation, stakeholder consultation, and intergovernmental cooperation are imperative to a river protection system since these requirements facilitate the effective operation of a government-supported program.

PRECEDENT SETTING

The rapid development, passage, and implementation of this law illustrates the capacity of the government to move quickly on issues and enact legislation when supported by government officials (RenewableEnergyAccess 2005). While this law does not speak directly to river protection, it promotes the development of wind and solar power, which may decrease the need for some hydropower projects if electricity demands are met with these alternatives. Enormous advances have already been made in renewables in China in just a few years. Due in part to the REL, renewable energy in China increased by 51% between 2005 and 2008. This equates to the world fastest growth in the adoption of new energy and renewable energy and an annual growth rate of 14.7%. In addition, an equivalent of 250 million tons of standard coal was avoided by the use of renewable energy in 2008 (Tong 2009). Also, as of 2008, China was recorded as having half of the world's installed capacity of solar water heaters and the largest production capacity of solar photovoltaic battery modules (Yu'an 2009).

GRID IMPROVEMENT

To reach the goals set forth in the law, electricity grids require updating. The amendment of the law requires grid companies to "improve transmitting technologies and enhance grid capability to absorb more power produced by renewable energy" (Huizi 2009). Currently, it is estimated that one-third of potential wind energy cannot be efficiently transmitted to the grid (Huizi 2009). Therefore, improvements to the grid infrastructure can facilitate the expansion of wind (and solar) power into new areas which were not previously served by the electrical grid.

WIND AND SOLAR POTENTIAL

Both wind and solar power have enormous generation potential in China. These renewable energy technologies are rapidly growing in installed capacity. In 2008, China ranked first in the world in utilization of solar power and fourth in wind power (Huizi 2009). Han Wenke, director-general of the Energy Research Institute, has noted that continuous high economic growth, the opening-up policy, and improvements to the manufacturing industry have all positioned China to be a leader in the renewable energy sector (Yu'an 2009). In 2009, an article was published in *Science* which estimated that wind-generated electricity alone in China could displace 23% of electricity generated from coal and accommodate all of the demand for the electricity projected for 2030 (McElroy et al. 2009). With the continued use of wind and solar technologies, the electricity generated from these renewable energy sources may eventually decrease need for some amount of hydropower.

4.2.10 THE NATIONAL ELEVENTH FIVE-YEAR PLAN: FOR ENVIRONMENTAL PROTECTION (2006-2010)

China's 11th Five-Year Plan is the most recent document in a series of reports that are prepared by the Chinese government bi-decadally to map the nation's path to addressing some of the most pressing issues of the time. The current plan's central theme is "Constructing a Harmonious Socialist Society" (National Eleventh Five Year Plan 2007). The plan sets a number of goals to address social, economic, and environmental issues. Central features of the plan are the goals to develop a "new socialist countryside," slow economic expansion to encourage economic strength, close the gap between the rich and the poor, advance care for the elderly, and improve the environmental condition (AP 2006; China Daily 2006). To address the concerns about the environment, the plan includes a section entitled "The National Eleventh Five-Year Plan for Environmental Protection (2006-2010)" (National Eleventh Five Year Plan 2007).

The Plan opens with a sobering depiction of the national environmental condition. Sulfur dioxide emissions are increasing; 26% of rivers failed to meet Grade V (the lowest water standard) standards; 90% of urban rivers are classified as polluted; 90% of grasslands are degraded; rural communities are experiencing serious soil pollution; aquatic ecosystems have been compromised and lost biodiversity as well as economic value; and environmental pollution from hazardous waste, vehicle emissions and persistent organic pollutants is increasing. The plan goes on to discuss the nation's difficulty in meeting goals set to manage its environmental problems. The government recognizes that many of the state water bodies are failing to meet even modest environmental standards. Many of the standards set by the previous five-year plan to curb emissions of criteria pollutants were not met, and many categories observed backsliding in areas that were supposed to gain vital attention. The new plan states that "improvement of environmental quality is an important component for the implementation of the scientific outlook on development and development of socialist harmonious society."

Motivated by this new mantra, the state council claims that it is looking to make environmental protection a higher priority than before. The state recognizes that failure to enforce environmental laws has become common and the government has done little to punish lawbreakers, and proposes a number of changes that will create new opportunities for environmental protection. In this plan, the state has proposed a number of changes to the national philosophy of development and environmental protection, a number of changes to environmental laws, and augmentation of institutional functions.

PHILOSOPHY OF DEVELOPMENT AND ENVIRONMENTAL PROTECTION

The plan calls for a practical approach to addressing the most urgent environmental problems that threaten public health, social development, and a sustainable economy. Generally, the Chinese government is seeking to improve air quality by reducing sulfur dioxide emissions and controlling the release of greenhouse gasses, improve drinking water and aquatic environments by improving urban sewage treatment to treat at least 70% of urban effluent, and control solid waste disposal and recycling. More specific to river protection, the plan aims to protect ecological environments, prevent pollution of key river basins, strengthen marine environmental protection, modify and enhance environmental law enforcement, promote environmental information sharing, and create a financial source to fund these activities. To do this, a change has been proposed to the philosophy of development and its relationship with environmental protection: "*The key is to speed up the achievement of historical transformations"* (National Eleventh Five Year Plan 2007). To speed up these transformations, the state has proposed a 3-part approach. First, the government hopes to change the national focus from economic growth alone, ignoring environmental impacts, to focusing on balancing economic growth with the associated environmental impacts. Second, the government proposes attending to historic and new environmental problems at the same time. Lastly, the state is looking to move from administrative methods of environmental protection to an interdisciplinary approach using legal, economic, technical and administrative methods.

Throughout the five-year plan, the government expresses the need to reform regional development to be more sustainable and ensure the protection of key areas of the ecological environment. As part of its plan to "construct a harmonious socialist society," the government has made the development of a new socialist countryside a key strategy. Part of this system involves developing clustered communities that can share resources, reducing costly replication of services, and reducing the impacts on the environment (Jie 2006). In addition to reforming urban development, the state proposes development of natural zoning of ecological function areas. The zoned areas will be designed to create a nature reserve network to accommodate over 95% of the nation's ecosystem types, wildlife species, and important national relics (National Eleventh Five Year Plan 2007). This goal could be extended to the protection of different types of riparian habitat that are of unique environmental significance, as well as to the required river reaches that feed these regions.

Stemming out from the protection of ecological regions, the plan proposes to facilitate the prevention and control of water pollution in key river basins. The Songhua River, Three Gorges area, source areas for the South-North diversion, Three Rivers Three Lakes area, Xiaolandi Reservoir and its upper reaches of the Yellow River have been identified as critical areas to protect. As part of the

protection system, the government has recognized the necessity to protect the natural flow of the rivers as part of preserving the river's ecological and consumptive functionality (National Eleventh Five Year Plan 2007). This goes beyond the requirements of the water law and other environmental protection laws that were developed in the 1970s and 80s, and provides a clear statement that river flow protection is important to protection of the ecology.

The plan indicates a desire to strengthen marine preservation as well. Coastal wetlands, mangroves and coral reefs were specifically mentioned in the plan as regions of particular interest for protection. Current goals are centered on reducing land-based pollution from degrading these environments (National Eleventh Five Year Plan 2007); however, river protection may have a role in meeting this goal as well. Freshwater, sediment, and nutrient loads from rivers play a key role in sustaining many of these coastal habitats (Bergkamp 2000; Friedl and Wuest 2002). If China is serious about protecting its marine resources, it should to look at the value that rivers play in sustaining these environments.

LEGAL AND INSTITUTIONAL CHANGES

The five-year plan makes it clear that the state sees strengthening environmental law and its enforcement as one of the critical elements of attaining harmonious development of society, economy, and the environment. The plan calls for updating and enhancing a number of laws including the national EIA law and provincial environmental laws. The government expects that the provinces will develop and enforce their own environmental plans that are relevant to their specific contexts (National Eleventh Five Year Plan 2007). In addition, the government plans on establishing environmental law teams, to oversee environmental compliance, at provincial, county, and city levels.

To support the new legal enforcement, the Five-year Plan proposes the "Jinhuan Project," a national and local environmental protection information system, designed to support environmental management decision-making (Five-Year Plan). This system will be a huge step for Chinese environmental problem solving. Historically, even the most basic environmental information was held by national and provincial governments as state secrets, stymieing environmental protection. To improve the quality of the information that is being shared, the government is planning on developing national laboratories for environmental science and technology and plans to invest in the development of environmental protection professionals (National Eleventh Five Year Plan 2007).

The state is also looking to promote environmental protection through improved public participation. Public right to know laws will increase access to environmental information and improved social awareness (National Eleventh Five Year Plan 2007). At this time, most decisions for development and environmental

protection in China are made by government officials (Lieberthal 1997). Increased public support for environmental protection coupled with national calls for harmonious development of the economy with the environment should provide adequate pressure on local decision makers to promote development that will not seriously degrade the environment. Further public education about river protection from groups such as the China Rivers Project and the World Wildlife Fund could be used to encourage environmental protection aimed at rivers.

Lastly, the Five-Year Plan proposes environmental economic tools to pay for these new programs. While the central government is planning on providing some capital to jump-start a number of these projects, they also propose a new tax system to reflect the environmental impact in production price signals. This will include production taxes, emissions taxes and other taxes to reflect the full costs of pollution control (National Eleventh Five Year Plan 2007).

CONCLUSION

In the 11th Five-Year Plan for environmental protection, the Chinese government demonstrates that it has acknowledged the severity of environmental degradation within the country and identifies many of the institutional and legal shortcomings that have allowed for this condition to emerge. The plan indicates that the government is focused on approaching this problem more aggressively and has set a number of goals that if met will improve the current conditions and prevent future impairment. Most of the goals in the plan are aimed at prevention of pollution, remediation of legacy pollutants, and protection of a diverse selection of environments. Notably, the plan proposes the protection of terrestrial and marine environments as well as the protection of key water supply sources.

There are also a number of areas in which China indicates that it plans to make some dramatic institutional changes. The plan calls for strict enforcement of environmental laws that has historically been quite lax. The plan also promotes a transformation of public participation and environmental information sharing measures. Lastly the plan's proposal to fund new environmental programs through a series of taxes that reflect the environmental impact on the price point of development will encourage environmentally responsible actions and reduce negative impacts on the environment.

The 11th Five-Year Plan for environmental protection focuses in depth on treating water quality and protecting species. Increases in monitoring and sharing of information, as well as improving enforcement of environmental laws are suggested. These goals are a great step forward for Chinese environmental protection. Currently, many of the goals address terrestrial environmental protection and enforcement on riparian pollution, but by integrating a river protection system into this list of goals, China can ensure the survival of some of the

most critical habitats for plant and animal species. Preservation of prioritized rivers from development will improve flow preservation that is critical for maintaining diverse riparian habitats. Additionally, protecting rivers from development can also ensure higher water quality by preventing the accumulation of pollutants behind dam walls and their accidental releases as has been seen before on the Huai River (Economy 2004). The proposed changes in laws and institutions can be used as a platform to develop a river protection system to preserve rivers that provide unique biological, cultural, economic, and social significance.

The 11th Five-Year Plan presents a very ambitious path to improve environmental quality. The Plan for Environmental Protection goes beyond any previous piece of Chinese legislation and calls for historic changes in environmental management and legal infrastructure operation. The new, timely plans for the environment imply a sea change in environmental awareness at the top of the Chinese government that will have definite impacts on local governments and communities.

5. BENEFITS OF FREE-FLOWING RIVERS

5.1 ENVIRONMENTAL BENEFITS

Our recommendations suggest the protection of free-flowing rivers and river segments. A free-flowing river has been defined as an undeveloped river that flows unobstructed by anthropogenic structures from source to mouth (WWF 2006). Since few free-flowing rivers remain in China, we recommend the adaptation of that definition to include rivers where segments may be modified.

The health of rivers and riparian ecosystems are important for both humans and natural communities. Riparian environments support many plant and animal species; they serve as critical habitat for different life stages of many species, and can provide unique ecosystem services that are often costly for humans to reproduce after the river has been altered.

ECOSYSTEM SERVICES

Free-flowing rivers provide ecosystem services that humans and natural communities benefit from. Rivers naturally can breakdown many contaminants in water, provide essential nutrients to downstream communities, and provide water for crop irrigation and drinking supply.

Free-flowing rivers allow for mixing of natural, urban, industrial, and agricultural pollutants, which can dilute these chemicals below a toxic threshold. Additionally, the mixing process can also simulate hydrolysis, or degradation, of a number of these pollutants. The mixing that occurs in flowing rivers also allows for the cycling of oxygen in the water, a process crucial for the survival of fish, invertebrate, and aerobic microbial communities that maintain balance in the stream and surrounding environments.

Riparian habitats and wetlands can also play significant roles in flood control. Peak flow events fed by regional precipitation and snowmelt can be mitigated by large undeveloped floodplains (Mitsch and Gosselink 2000).These flood events also provide valuable nutrient and sediment transport to the downstream communities, as discussed below.

SEDIMENT

A key function of natural river flow is the ability to move sediment and nutrients through river channels. In China, sediment is moved from the land to the oceans by some of its major rivers such as the Huanghe (Yellow River) or Changjiang (Yangtze River; Saito et al. 2001). The rate of flow plays a direct role in the volume and the

size of sediment suspended and carried downstream (Frings et al. 2009). Sediment transport shapes the river channel, mobilizes nutrients, and the natural riparian habitat that local species have special adapted to.

Deltas, lagoons, floodplains, mangroves, and coastal wetland habitats provide examples of important ecosystems that depend upon seasonal flow variability and sediment and nutrient transport (WWF 2006). These habitats experience extreme droughts, floods, freezing, anoxia, and even toxic concentrations of nutrients, due to the natural variation in river flow. However, as peak flows flush these communities, new sediments can be delivered, allowing for the rejuvenation of the plant and animal populations.

BIODIVERSITY - AQUATIC AND RIPARIAN HABITAT QUALITY

Plant and animals species have become adapted to free-flowing rivers and their surrounding environments. Rivers have complex flow patterns that can vary annually, monthly, and seasonally; these variations serve as cues for life cycle stages of many riparian species (Suen and Herricks 2009; Fu et al. 2003; Poff et al. 1997). Additionally, intact ecosystems ensure that food webs remain connected (Allan and Flecker 1993). Disruption of the food web, such as the extinction of a keystone species, can result in cascading effects of local species loss (Mills et al. 1993). Protecting biodiversity in China is important because the country has one of the most diverse ranges of wild flora and fauna species in the world (Wenhua 2004).

Free-flowing rivers are especially important to fish species that can not disperse around a dam. In the United States, some of the last remaining strongholds of healthy fish populations are in the rivers that have been able to maintain their natural flow patterns (Poff et al. 1997). This condition is not unique to the United States. Many migratory fish species require large catchment basins with long uninterrupted stretches of river for different stages of their life cycles (WWF 2006). Prior to damming, the Chinese sturgeon of the Yangtze River once migrated over 3,000 km, from brackish water near the mouth of the river to upstream reaches to spawn (Ping 2009).

Studies have show native plant species to be more abundant in free-flowing rivers than in regulated rivers (Dynesius and Nilsson 1994; Nilsson et al. 1997; Jansson et al. 2000a; Jansson et al. 2000b). Aquatic biota have adapted to natural ecological processes that have been shaped by the natural flow regime of rivers (Naiman et al. 2002). The flow regime of rivers includes the: magnitude, frequency, duration, timing, and rate of change (Poff et al. 1997). Together these five components directly and indirectly impact water quality, energy sources, physical habitat and biotic interactions, ultimately determining ecological integrity. Intact and healthy free-flowing rivers balance these components and support plant and animal biodiversity.

CONCLUSION

The protection of rivers, particularly free-flowing rivers, has immense benefits for the natural and human populations that depend on those rivers. Our research of rivers systems has illustrated the role of free-flowing rivers in maintaining river channel characteristics, native biodiversity, and valuable ecosystems services. By developing a national river protection system, China can ensure the preservation of many of these natural processes.

TABLE 5.1.1: ENVIRONMENTAL BENEFITS OF FREE-FLOWING RIVERS.

River Function	Role in River Health	Dependence on Natural Stream Flow
Sediment Transport	• Prevents over siltation and erosion of rivers • Builds wetlands and spawning habitat for fish species	• The particle size and quantity of sediment transported depends on rate of stream flow
Nutrient Transport	• Delivers nutrients to downstream habitats. • Creates wetland habitats such as flood plains	• Nutrients are carried downstream in soil particles, vegetative debris, and other organic particles. • The rate of the stream flow directly determines how much material is carried downstream
Waste Processing	• Dilutes and breaks down pollutants. • Creates livable water for fresh water species • Provides safe water for drinking and irrigation	• Mixing rate is dependent upon flow rate of the stream • Larger stream flows can dilute chemicals more effectively
Water Temperature	• Maintains adequate temperature for fish homeostasis, especially in temperature sensitive species such as salmon	• Water temperature corresponds very closely to volume of water (larger volumes are less susceptible to temperature fluctuation) • Temperature gradients are dependent upon flow rate of water
Biochemistry (DO)	• Fish require oxygen in the water to breath. • Aerobic microbes use oxygen when they break down pollutants.	• Higher flow rates typically lend to greater mixing of oxygen • Low flow conditions can create anoxia at lower water depths.
Seasonal Flow Variation	• Supports reproduction, migration, and life cycle cues	• Requires uninhibited stream flow
Riparian Habitat	• Provides critical breeding and developmental habitat for a variety of species including wetlands, floodplains, deltas, mangroves, etc.	• Maintained by natural stream flow

5.2 ECONOMIC BENEFITS

Protecting rivers in their free-flowing state can yield economic benefits for China in the future. In other parts of the world, such as the United States, protected and free-flowing rivers have become economic assets. The Wild and Scenic Rivers Act was not passed because of the current economic value of preserved rivers. Nevertheless, the passage of the Act and subsequent protection of dozens of rivers has generated substantial economic benefits, in addition to the environmental and social benefits of protection. Tourism and river-based recreation on protected and free-flowing rivers create hundreds of jobs and millions of dollars in revenue for state and the federal governments. Similar economic rewards can be gained in China from the protection of rivers. By safeguarding some rivers from development and maintaining their free-flowing state, benefits from ecotourism, recreation, and fisheries can be attained in the near future.

ECOTOURISM

Each year, international and domestic tourists are attracted to China's historic sites, regions of cultural significance, and scenic landscape. China has one of the largest tourism markets in the world in terms of the number of visitors and its revenue production. In 2007, China received 131 million inbound tourists and 1.61 billion domestic tourists. The revenue produced by this tourism was US$41.9 billion and US$113 billion (¥777 billion) respectively (CNTA 2007).

Many tourists who travel to or within China are attracted to sites with scenic beauty, historical significance, and cultural significance (CNTA 2007); rivers often posses many the aforementioned characteristics. Rivers have the potential to serve as a major tourist destination as they can be enjoyed for recreation, sightseeing, photography, and general appreciation of the scenery and cultural heritage. The protection of free-flowing rivers would preserve the natural heritage of China that attracts visitors year after year. The National Tourism Administration of the People's Republic of China promotes tourists themes each year. Past themes have included "Tour of Relics and Cultural Sites" and "Folk Arts of China" (Gov.cn 2006). Themes revolving around free-flowing rivers could be selected in upcoming years to further encourage visitation to rivers.

Other resource protection systems in China have shown success in attracting tourists. Since the initiation of the nature reserve system in China in 1978, ecotourism has increased to these sites. Since the early 1990's, tourism has been developed in 80% of the reserves. Of the reserves with tourism, 15.9% have more than 100,000 visitors a year (Li and Han 2001). In 1995, it was estimated that the total number of visitors was 2.5 million, generating an annual income of US$63 million (Li and Han 2001).

RECREATION

Millions of dollars are generated each year from recreational use of rivers in the United States. Free-flowing rivers are used for activities such as rafting, boating, canoeing, kayaking, and fishing. The protection of rivers can safeguard the values for which local visitors and tourists are attracted to the river for recreational use. The following examples and case-studies illustrate the economic value of the recreational use of protected rivers in the United States.

SNAKE RIVER

The Snake River, in the Pacific Northwest of the United States, is currently dammed, however a 2002 study found that the restoration of the river could generate upwards of $310 million per year from non-fishing recreational benefits (American Rivers n.d.a). An additional $544 million per year could be generated from recreational fishing if the river was returned to a free-flowing state (American Rivers n.d.a).

COLORADO STATE

Colorado has a prosperous outdoor recreational industry, with more than $10 billion in annual revenue (Outdoor Industry Foundation 2009). Many of the recreational activities generating this wealth, such as fishing, rafting, and wildlife viewing, are dependent on the state's rivers. In 2002, fishing contributed $820 million to the state economy and supported almost 11,000 jobs (Pickton and Sikorowski 2004). In 2001, wildlife watching activities (including hiking and camping) yielded a total economic impact of $940 million and 13,000 jobs (Pickton and Sikorowski 2004). In 2009, almost 500,000 user days of commercial river rafting added $141 million to the state economy and amounted to over $55 million in direct expenditures (Colorado River Outfitters Association 2010).

Unfortunately, water in most of the major rivers in Colorado is overdrawn for utilization in agriculture, industry, and municipalities. Often, little or no water is left in rivers to support wildlife and recreational opportunities (Roberts and Grossman 2008). Sufficient river flows are critical to the maintenance of healthy ecosystems. Colorado's outdoor industry and many of the most popular outdoor activities are dependent on healthy ecosystems, riparian habitat and adequate instream flows (Roberts and Grossman 2008).

Furthermore, many authors have shown that higher instream flow levels enhance recreational experiences and increase recreational spending. Walsh et al. (1980) found that higher instream flow levels (compared to low flow levels) lead to increased participation in many recreational sports such as fishing, kayaking, and rafting. In addition, the work of Brown et al. (1991) and Johnson and Adams (1988)

found that increased fish populations, catch rates and improved quality of river rafting experiences can be obtained with higher instream flows. Research by Prof. John Loomis at Colorado State University has demonstrated the direct relationship between increased instream flow levels and higher recreational spending. His recent study evaluated how instream flow rates affect spending on rafting and fishing in Colorado (Loomis 2008). He found that slightly increasing water flow levels in rivers and streams would increase rafting expenditures by 6% and fishing expenditures by 2% (Roberts and Grossman 2008). From these additional rafting and fishing expenditures, $4.4 million in income and an additional 340 jobs in Colorado would be generated (Loomis 2008).

Colorado Wild and Scenic Rivers Study

Sanders et al. (1990) conducted a study to determine the total value of protecting 11 rivers in Colorado considered suitable for protection under the United States Wild and Scenic Rivers Act. The total values estimated were determined by measuring the willingness to pay of survey respondents. The results from the study indicated that the present value of total benefit from protection of the three most valuable rivers in the state (Cache la Poudre, Elk, and Colorado rivers) was $599 million, with $113 million from recreational use and $486 million from preservation value (Sanders et al. 1990). With all 11 study rivers under protection, benefits are estimated to be $1.43 billion (Sanders et al. 1990). This can be compared against the present value of total cost of protection, which was $27.2 million for the three most valuable rivers and $57.3 million for all 11 rivers (Sanders et al. 1990). Cost estimates include the opportunity cost of forgone water development projects. A quick comparison of the total benefits and costs reveals that the benefits of protection outweigh the cost by orders of magnitude.

Chattooga River Study

In 2003, a comprehensive study and survey of the use, economic impacts, and economic benefits of the 57-mile Wild and Scenic segment of the Chattooga River in Georgia, South Carolina, and North Carolina in the United States was conducted. The Chattooga is extremely popular for a variety of river-based recreation activities including canoeing, whitewater rafting, kayaking, and fishing. In addition, the lands that surround the river are popular for hiking, backpacking, horseback riding and other forms of nature-based outdoor recreation. Survey results indicated that a majority of recreational users of the river were aware of the river's protected status (82%) and thought the designation was very important (80.7%). When surveyed, the four most frequent activities users were engaging in were whitewater rafting (23.6%), kayaking (19.8%), swimming (11.8%), and wildlife observation (11.1%). Furthermore, users were motivated to use the river for nature-oriented reasons, such as "enjoy the view along the river", "experience the Chattooga River", and "be close with nature". In addition, when asked what users liked best about the river

and its corridor, the top responses were non-developed/untouched and beauty/natural beauty. Respondents were also asked the importance of particular benefits of the Chattooga River. The three benefits recreational users found to be extremely important were aesthetic beauty, preserving undeveloped space, and fish and wildlife habitat (America Rivers and National Park Service 2003).

Estimating the economic impact of river recreation through the estates of the demand and economic value of the river was one of the key elements of the study. Economic impact analyses try to determine what visitors spend to use a resource and the effect of these expenditures on the local economy. River users (i.e. visitors from outside the area) spent over $1.8 million in direct expenditures. The total economic impact by visitors to the Chattooga River was over $2.608 million with 60 jobs being supported by river recreation in 2002. The economic benefit analysis was also conducted, which estimates what a resources is worth to people by determining the total value to users of the resource (not what people spend as in the economic impact analysis). In this study, economic benefit was calculated using user demand for boating opportunities. The total economic benefit to recreational boaters was estimated to be $5,794,282. This is the amount of money that users would need to be compensated if the opportunity for boating was lost on the river. A similar study was also conducted on a National Wild and Scenic River stretch of the Farmington River, know and commonly used for its trout fishing. Economic results from that study found the total economic impact to be $3.63 million and total economic benefit to be $9.45 million (America Rivers and NPS 2003).

Overall the study results indicated that because of user's preference for a natural experience and high-quality environment when visiting the river, protecting and conserving the natural, scenic, and recreational resources of the river are the most important management priorities. These studies also show that protecting the values for which these rivers are designated under the Wild and Scenic Rivers System of the United States generate high levels of benefits to users, including economic benefits.

FRESHWATER FISHERIES

China has about 17.6 million hectares of inland water area and 18 rivers with a length exceeding 1000 km (FAO 2010). In 2004, the output of inland capture fishery in was 2.42 million tons (FAO 2010). Inland capture fishery catch composition consisted mainly of finfish (1.72 million tons), shellfish (340,000 tons) and crustaceans (310,000 tons), prawn (270,000 tons) and crab (40,000 tons) (FAO 2010). The five provinces with the highest inland capture catch are Hubei, Anhui, Jiangsu, Jiangxi, and Hunan (FAO 2010). The Yangtze River flows through these provinces. The catch from the Yantgze River is particularity significant as it constitutes river 70% of the total production of river fisheries (FAO 2008).

Thriving fisheries produce enormous economic benefits. In 2005, the gross domestic product of fisheries in China was US$45.9 billion (FAO 2010). China harvests almost 36% of the world's fisheries production (FAO 2006) and it is the most important inland capture fisheries producer, with 25% of the word total (FAO 2003). Regions close to China also gain large economic benefits from river fisheries. The Lower Mekong River Basin alone generates an estimated value of US$1.7 billion a year (Van Zalinge et al. 2004). Catch from river and other inland fisheries in the tropics have a gross market value of US$6 billion (The WorldFish Center 2008). Fisheries also support the livelihood and economy of many villages throughout China. In 2004, there were 4,036 fishery villages in inland fisheries and 710, 000 fishermen active in capture fisheries (FAO 2010).

Free-flowing rivers are a key player in the promotion of a healthy biological environment for fish. As noted in the *Environmental Benefits* section, free-flowing rivers are conducive for fish for several reasons. Migratory species have a much high spawning success rate in free-flowing rivers since there is no impoundment to impede their movement. In addition, water flows of free-flowing rivers are natural in their volume, timing, and temperature, as well as nutrient and oxygen levels. More than 700 species of freshwater fish and 60 species of marine freshwater migrating fish are found in inland waters (FAO 2010). The major commercial species include silver carp, bighead carp, grass carp, black carp, common carp, crucian carp, Chinese breams, catfish, snakehead, mud carp, eel, pond smelt, salmon, trout, mullet, bass, Japanese lamprey, Chinese mitten-handed crab and soft-shell turtle (FAO 2010).

CONCLUSION

Historically, the economic value of protecting free-flowing rivers has not been compared to the economic value of development of rivers in China. A holistic comparison of the economic benefits and costs of river protection can lead to more informed and economically sound decision-making on river protection and development. As discussed in the *Dam Removal* section of this paper, proper accounting of the costs associated with sediment removal and siltation and repair or decommissioning of a dam may alter a cost-benefit analysis and favor the protection of some rivers. While many of the economic benefits of river protection, such as river-based recreation and tourism, have not yet become a major market in China, the protection of rivers is likely to spur such industries.

5.3 SOCIAL BENEFITS

China's network of rivers has historic, scenic and recreational values that distinguish it from others the world over. Small fishing villages still exist amidst the expansion and economic development of the country. Communities continue to reside riverside, near the graves of their forefathers. Some of these rivers run through national protected areas and are famed for their beauty. International tourists, river enthusiasts, and Chinese families alike, are drawn to rivers to admire, photograph or raft. These rivers are also home to numerous fisheries, whose health and continued existence will impact the livelihoods of generations of fishermen.

The relationship that the Chinese people have with rivers is more than functional; it is also spiritual and cultural. Reverence for nature has been an integral part of Chinese culture for centuries. Daoism, a belief system with religious roots in China, was popularized by philosopher Laozi in the 5th century, at the same time that Confucianism and Buddhism existed. Laozi Daodejing wrote, "Humans model themselves on earth, earth on heaven, heaven on the way, and the way on that which is naturally so" (Berling 2005). Daoism advocates respect for nature through a philosophy which is centered on the unity of heaven and man (Chiu 2010). In fact, the word for heaven in Chinese is "tian", which refers not only to heaven but to the entire cosmos, including Earth. Different philosophies and ideas have taken precedence however, and with this change have come accompanying shifts in attitudes toward the environment. Today it seems that the central focus of the nation's agenda is economic growth (McDonald 2008). Nevertheless, there are many for whom the cultural relevance of rivers also continues to be important.

To many, the Yellow River is the cradle of Chinese civilization and the spiritual home of the Chinese people. According to Chinese author, Bao Xinghua, "it is the waters of the Yellow River and its spirit that nurture the whole Chinese nation." For thousands of years, the Yellow River has been admired by writers, artists, musicians and the common people. The yellow-ochre-colored river "bears special significance: the symbol of the Chinese nation, the spirit of the Chinese people and more importantly, civilization itself" (Bao 2009). Chinese journalist and environmentalist Ma Jun has written that "this is no ordinary river. It has long been revered by the Chinese, for whom the color yellow holds a special meaning: the yellow earth, the Yellow Emperor, and even the yellow-colored skin of the people. These are all cultural signs that have compelled people throughout history to assign an almost divine status to the murky waters of the river" (Ma 2004). Personal connections to the rivers in China are strong, since the lives, traditions, memories and stories of generations of Chinese people are tied to these waters.

In the Three Gorges area, however, few ancient civilian residences with cultural value have been left, and most of those that remain were built during the Ming (1368-1644) and Qing (1644-1911) dynasties. The three representative ancient

residential house groups can be found in the upper, middle and lower reaches of the Yangtze River. The house groups on this revered river are some of the existing evidence of the powerful dynasties that once ruled China. It was predicted that when the water level of the Three Gorges Reservoir reached 175 meters, these residences would be buried (Jinhui and Moller 2003), demolishing access to this cultural and historical archeological record forever. An old Chinese proverb says that "the quality of the tea depends on the water with which it is brewed," (Ma 2004) and in ancient times, the waters of the Yangtze's lower reaches were deemed by some Chinese tea connoisseurs to be the best of all. A river with a rich legacy of cultural benefits should be preserved so that future generations can also celebrate its magnificence and honor the past.

Elsewhere in the country, increased and continued development will have lasting impacts on continued cultural practices. River burial is widely practiced in a number of regions. In this ancient ritual, the remains of the deceased are cut into pieces, bound together with ropes, covered with stones, and then cast into the deepest part of the river. Rivers are believed to provide a direct portal to the underworld. It is even said that ancestral spirits on great golden yaks will sometimes appear in certain eddies (McDonald 2008).

While many rivers are revered, some people have even ventured to traverse the most treacherous of these passages in boats or kayaks. This adventurer's vista is different from that of the fisherman or even the riverside dweller; a kayaker can journey down cascades almost as does the yellow drum or silver croaker. He moves through the water at a speed that the river dictates, but also sees and feels where a river's meander is altered by the massive concrete wall of a dam. Recreation in the form of river runs allows river enthusiasts to see the grand canyons of China as well as the creatures and plant-life that create a richly biodiverse environment. River exploration, especially if supported with Chinese leadership, offers participants the opportunity to commune with nature, but also to recognize the importance of conservation (Last Descents 2007).

Conservation of fisheries, as another example, has implications for protection of biodiversity, but also for the continuation of livelihoods based on fishing. China is the world's top fishing nation, and it has been reported that China has 709 freshwater fish species and 58 subspecies, excluding 64 species migrating between sea and inland waters (NOAA 2007). Although fishing is a major commercial industry, a legacy of China's history is the persistence of traditional practices for the use of natural resources (Manzi and Coomes 2002). Traditional fishing practices remain important, but economic growth and structural change has influenced how rural people make their living and relate to their environment. Many riverside dwellers continue to fish relying upon their traditional practices; river protection that ensures the health of the fisheries will ultimately impact the longevity of their careers and practices.

Current national economic incentives suggest that numerous dams may be built along China's few wild or nearly wild rivers. The protection of the cultural and historical roots of rivers may become increasingly difficult as the rewards of development projects are made more attractive to a rapidly growing population. China's wild rivers have been compared to endangered species, and the rivers' unique ecosystems likened to breathing organisms that will die if they are not protected. The river landscapes are "an important part of China's national identity" (Yeung and Turner 2006) – but this will change too, if river protection is not prioritized.

It has been said that "the rivers are the elixir of life since they support the ecosystem of a vast region" (Ma 2004), and so rivers must be protected and celebrated. In 2008, the Suzhou River Culture Festival along the riverside of the Suzhou River was inaugurated as one of the highlights of cultural activities at the 10th China Shanghai Arts Festival. Shanghai's "mother river" was honored with moving poems shared by important officials, students, nurses, workers and riverside inhabitants. The opening ceremony presented the theme of a "more beautiful city, better life and deeper affection" to reflect the great changes that the Suzhou River has experienced through the years - in true Chinese tradition, the mighty river was celebrated with song, dance and music (China Shanghai International Arts Festival 2009).

Rivers are commemorated, but festivals are not sufficient in the battle to preserve the rivers that sustain livelihoods, economy and culture. In an interview in 2008, author and advisor to the International Forum on Globalization, Dale Wen, explained that an ecological and economic path for China should include an understanding of the strong spiritual connection that the Chinese people have with the land and environment, and in particular, with rivers. She continued, "for [us] Chinese, we should reexamine and relearn some positive aspects of our traditional culture including Confucianism, Daoism and Buddhism, as well as learn from the rest of the world" (Bello 2008). If some rivers are protected, then generations of Chinese people to come will have the opportunity to boat and fish down unpolluted, free-flowing rivers, and sing, dance and write praises to these consecrated waters.

6. CONSEQUENCES OF NOT PROTECTING FREE-FLOWING RIVERS

This section explains in depth the types of unintended impacts to developing a river. Environmental, social and economic consequences are detailed below. An understanding of the impacts of altering rivers allows the reader to understand some of the unintended consequences of development, but does not imply that development cannot also be beneficial. This section illuminates a number of impacts that should be considered prior to altering the natural environment.

6.1 CONSEQUENCES TO THE ENVIRONMENT DUE TO RIVER DEVELOPMENT

Rivers are invaluable natural resources; they provide the water supply for human populations and serve as irreplaceable habitat for many riparian plant and animal species. However, people have found additional utility in modifying natural river's flow to meet the demands of growing populations. Dams provide flood control, a regular water supply, and harness a river's energy to provide electricity to communities and local industry. Channelization, or the straightening of a rivers course, is a very common engineering practice that removes natural meander and alters the flow rates of rivers. Rivers are channelized to improve navigation and to provide rapid storm water conveyance. Along with the benefits of these river modification projects come some unforeseen environmental impacts that should also be considered before time and resources are committed to these endeavorsprprendeavors.

This section is focused on some of the environmental impacts associated with large-scale dam projects since they present the greatest risk to free flowing rivers in China. It should be noted that this is by no means a comprehensive list of impacts associated with dams, but this section should illustrate a number of common environmental impacts that are not always considered when a dam project is proposed for the purpose of maximizing energy production and profit.

Dam construction has immediate and often irreversible impacts on river systems (Dolan et al. 1974). By placing a large dam across a river channel, river ecosystems are instantly fragmented, flow dynamics are dramatically altered, and profound impacts on local habitat, species, and ecosystem services can develop. The impacts on the river are seen on both sides of the dam and have strikingly different repercussions (Bergkamp et al. 2000).

BOX 6.1.1: COLORADO RIVER

The Colorado River is located in the southwest United States and runs from its headwaters in the Rocky Mountains of northern Colorado to the Gulf of California, with its basin extending across parts of 7 states (Figure 6.1.1). Numerous dams have been developed along the length of the river to provide municipal and agricultural water as well as hydroelectric power to the surrounding areas. One area that has received extensive investigation for the impacts of this damming is the reach between Glen Canyon Dam and Lake Mead (Figure 6.1.2).

Prior to the development of Glen Canyon Dam, cold snow melt fed late spring peak flows, and summer flash floods carried large sediment loads down the river, scouring the channel.

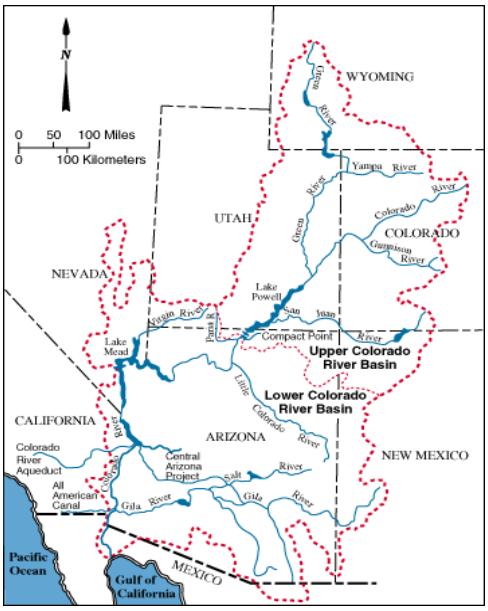


Figure 6.1.1: Map of the Colorado River Basin including major tributaries, reservoirs, and diversions (USBR 2009).

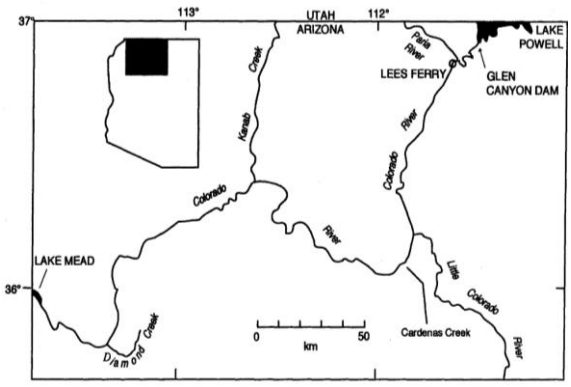


Figure 6.1.2: Map of the Colorado River between the Glen Canyon Dam and Lake Mead Reservoir (Schmidt et al. 1998).

As flows slowed in lower sloped or wider reaches, silty soils settled in the channel, building bars and terraces (Dolan et al. 1974; Schmidt et al. 1998). The river was home to 26 endemic fish species, many of which have been extirpated from the river, along with plant and invertebrate species that were uniquely adapted to the variable and turbulent flows that produced high levels of turbidity (Schmidt et al. 1998, Dolan et al 1974).

Following the construction of the Glen Canyon Dam, there has been a marked change in river flow dynamics. Seasonal variability has been significantly diminished, while daily variability has dramatically increased as demand for hydroelectric energy becomes the leading driver of the rivers hydrology (Turner and Karpisack 1980; Dolan 1974). "Changes in these factors have caused adjustments in channel geomorphology, alterations in riparian vegetation and fish assemblages, decreases in habitat availability for endangered fish, and changes in water temperature and quality" (Schmidt et al. 1998). Loss of habitat and change in algae growth has resulted in the extirpation of a number of endemic fish species and the continued invasion of a number of introduced fish species. While this region still maintains a strong draw for tourists, the damming of this river has resulted in irreversible losses in native biodiversity.

DOWNSTREAM IMPACTS

Development of a dam has profound impacts on the downstream environment. Migratory species habitats are diminished, natural river flow dynamics are modified, and transport of sediment, nutrients, organic matter and other debris decrease. Each of these impacts has significant consequences for the local habitat, species, as well as ecosystem services to humans.

One of the most significant and well researched impacts of dam development is the impact of dams on surrounding habitat and the subsequent loss of species (Ricciardi and Rasmussen 1999; Dynesius and Nilsson 1994; Allan and Flecker 1993; Dudgeon 1992; Benke 1990). Dams fragment habitat of migratory species and disconnect rivers from floodplains and wetlands. These changes in river habitat conditions decrease the survivability of species that have specially adapted to these habitats (WWF 2006; Nilson et al. 2005). Some dam projects result in the dewatering of downstream lakes and large portions of rivers, halting flow before it can reach its historic terminus. California's second largest river, the San Joaquin, no longer flows to the ocean due to a series of dams that have been established to produce hydroelectricity and provide water for agriculture (SJRRP 2009). The loss of this river habitat has decimated salmon populations, a key species in the local food web and a major fishery.

Development of dams changes the downstream volume and timing of river flows (Nilsson et al. 2005). Many rivers have dramatic seasonal variations as peak flows are driven by snowmelt and rainy season storm events. Dams that are built for water storage or hydropower change this dynamic. Flow patterns that were once driven by natural inputs are shifted to flows that correspond with the goals set by project managers. This can result in a more consistent average downstream flow rate throughout the year as seasonal high and low flow rates are captured by the reservoir. In the case of hydropower dams, daily flow patterns can experience dramatic shifts as flow releases are managed to meet demand for electricity which varies throughout the day (Dudgeon 2000). These changes can have a significant impact on wildlife that are adapted to use seasonal peak flows as migratory indicators as well as species that require certain flow rates to sustain different life stages within the river channel (Dudgeon 2000; Poff et al 1997).

Flow releases from dams can also have a significant impact on water temperature downstream based on where the water is released from the reservoir (WWF 2006). Dams that release from the top of the reservoir discharge warm water, where bottom releases introduce cold water to the stream (WWF 2006). Studies have shown that many riparian species that can be sensitive to changes in the water temperature (Dudgeon 2000; Poff et al 1997).

Construction of a dam across a river channel also reduces the transport of sediment, nutrients, organic material, and other debris that is carried in the flow. Decreasing the load generally results in a change in stream morphology, habitat, and species survival (Nilsson and Berggren 2000). Sediment is transported from regions of high erosion in a watershed to lower reaches of the river where slow moving waters allow the suspended particles to settle. This process is essential for the formation of many riparian habitats such as deltas, coastal mangroves, and other wetlands, as well as the formation of bars and terraces in and alongside river channels (Nilsson and Berggren 2000). The impact of a dam on sediment transport then is twofold. First, sediment is trapped behind the face of the dam reducing the delivery to downstream environments (WWF 2006). Second, water released from dams is typically low in sediment, and is often referred to as "hungry water" that has the capacity to take up new sediment, increasing rates of sediment erosion in the reaches directly beneath the dam (WWF 2006; Nilsson and Berggren 2000). The loss of this material downstream can impact the shape of a riverbed, habitat availability, and rates of vegetative growth (Johnson 1992). Loss of nutrients and organic matter can decrease productivity of in stream vegetative growth as well as the macro invertebrates that are needed to support many of the riparian wildlife species. Box 6.1.1 illustrates how some of these impacts have been observed on the Colorado River following the development of the Glen Canyon Dam.

Development of dams can have considerable impacts on water quality and ecosystem services that rivers provide to human populations. Reduction in flows downstream of a dam can lead to increased concentrations of urban, agricultural, and industrial runoff as diminished flows do not have the same ability to dilute these pollutants (Dudgeon 2000). Additionally, decreases of flow rates diminish the waste processing ability of river systems (WWF 2006) so pollutants can become very concentrated. Lastly, reducing flow cuts off ecosystems such as wetlands and floodplains that can provide natural flood attenuation (WWF 2006). River systems provide all of these services naturally, by developing a dam on a river, services can be lost, leaving municipalities to provide that function fore themselves.

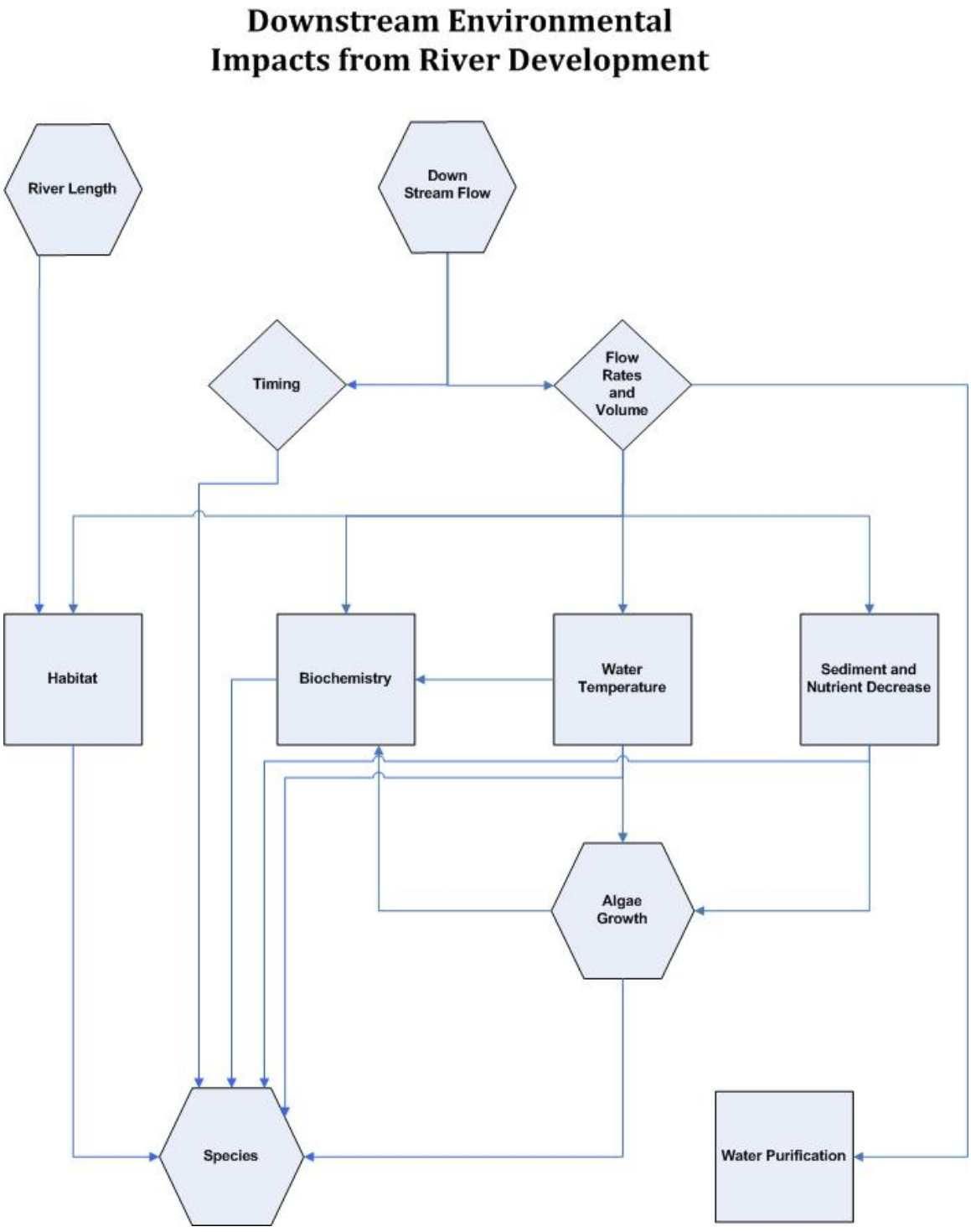


FIGURE 6.1.3: DOWNSTREAM ENVIRONMENTAL IMPACTS FROM RIVER DEVELOPMENT. This illustrates the connectivity of the downstream impacts of a dam on the local environment and subsequent impacts on species.

UPSTREAM IMPACTS

As with downstream impacts, the primary impacts upstream of a dam are associated with the change in flow dynamics and habitat fragmentation, followed by a series of second order impacts such as changes in sediment deposition, water temperature, nutrient accumulation, and biochemical changes within the reservoir. Upstream of a dam, species' historic ranges are cut off as the dam prevents species from moving further downstream. The dam also backs up river flow up the main channel and the tributaries as the reservoir fills in. The slowing and pooling of the water in the reservoir has immediate impacts on the surrounding environment as habitat is submerged. As the water rises, the soil surrounding the reservoir becomes saturated and can result in deep soil landslides that impact local wildlife and human populations, and even increase the rate that the dam fills with sediment (Luo and Che n.d.).

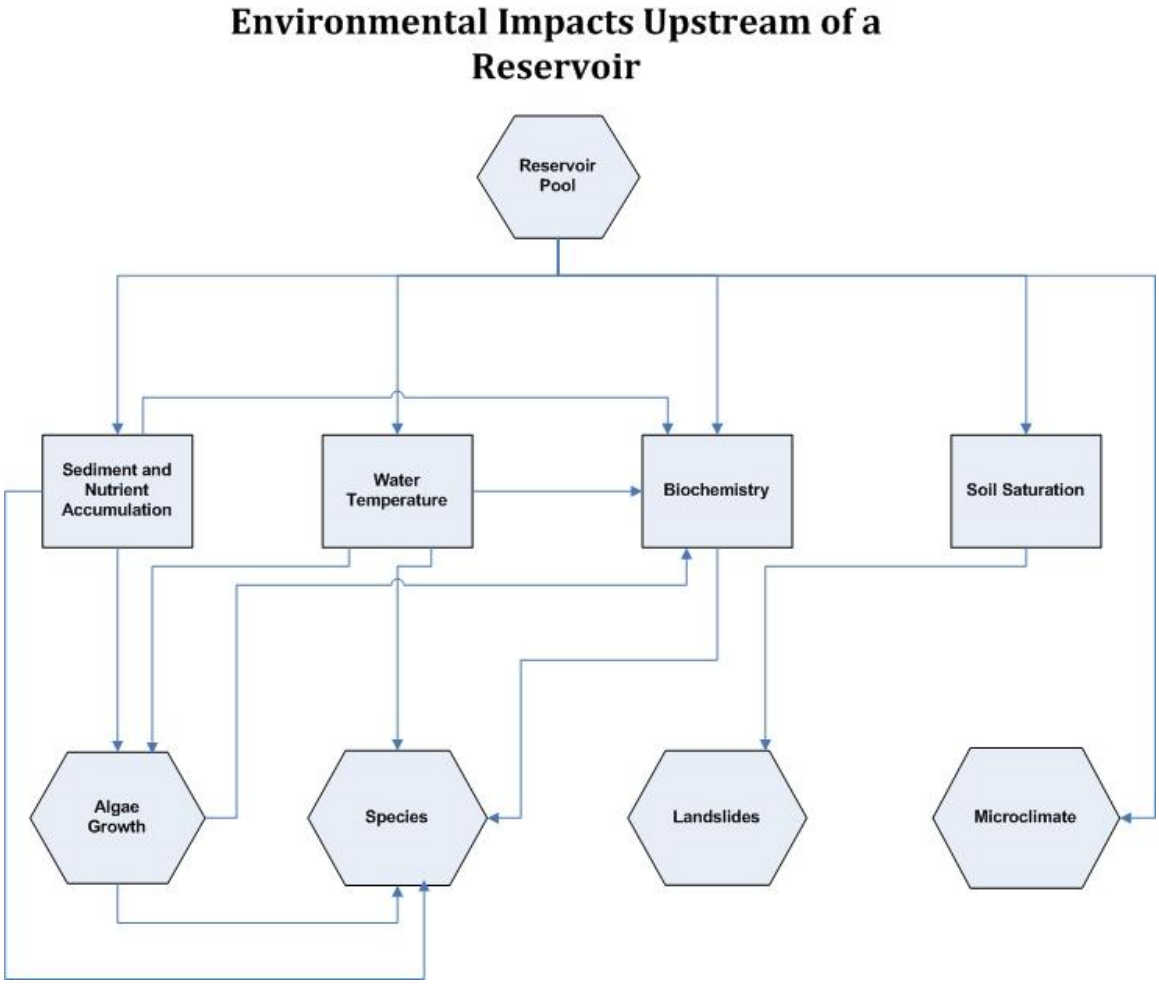


FIGURE 6.1.4: UPSTREAM ENVIRONMENT IMPACTS OF A RESERVOIR.
This illustrates a number of upstream impacts from the development of a dam.

Among the most significant impacts of a reservoir is the impact on water quality due to changes in river flow. Changes in water quality have impacts on species survival and downstream ecosystem health. Factors such as sediment and nutrient accumulation, water temperature stratification, and changes in vegetation growth all contribute to modifications of aquatic chemistry, such as the decrease in dissolved oxygen content, which can result in changes in species composition, and methane release from the dam (Bergkamp et al 2000). Decreased flow rates and rising water levels in a reservoir decrease the natural mixing of water temperature and oxygen that occurred in the more rapidly flowing river. Calm water in the reservoir becomes stratified as dense cool water sinks to the bottom and warmer water rises to the top (Bergkamp et al 2000). This has impacts on wildlife dispersion as fish seek temperatures that match those of the river prior to dam construction (Bergkamp et al 2000). Warmer surface temperatures provide excellent growing conditions for algae, plankton, and aquatic plants (Friedl and Wuest 2002), but this condition is amplified as sediment, nutrients, and organic content that were previously transported downstream by river flows become trapped behind the dam and the slower water allows the particles to settle into the riverbed. The accumulation of nutrients and biological material further encourage the growth of algae, plankton, and aquatic plants (Bergkamp et al. 2000), and if nutrient input is high enough, thick biological growth can inhibit the mixing of oxygen in the water. Biological growth can become dense enough that the plants and algae will crowd each other out, resulting in large mats of dead debris. As microbes break down this material, they consume the oxygen in the water, creating anoxic conditions that can kill off other life in the water and if conditions are appropriate, produce methane, a strong greenhouse gas to the environment (Friedl and Wuest 2002).

Development of reservoirs not only impacts the in stream environment, it can also impact the surrounding banks and shore communities (AEG 2010). Rising flood waters from the filling of a reservoir can raise the groundwater table significantly, filling soil pore spaces, and decreasing soil stability (AEG 2010). As a result, steep slopes around a reservoir can become increasingly prone to landslides (AEG 2010). These slides impact the immediate river bank communities, shorten the life of the dam by increasing the rate of sedimentary filling, and can potentially cause the over topping of dams (AEG 2010).

CONCLUSION

River development will continue to occur for a number of reasons. For China, international pressure to reduce the use of coal-fired power plants and goals to increase economic development point to the continued development of hydropower as a carbon-free source of energy. While many benefits are gained from these

projects, developers and decision makers should also consider the full environmental cost of these projects before implementation.

This section highlights a few of the potential impacts of dam development. Changing water flow regimes for hydroelectric energy or water storage does more than amass water behind a concrete structure. Changes in natural flow dynamics have lasting impacts on upstream, downstream, and surrounding environments. Water quality, water temperature, and adjacent habitat are all altered, which means that there are repercussions for wildlife that has adapted to the specific conditions of a free-flowing river. As Chinese decision-makers set goals for the responsible management of natural resources, they should consider how a river protection system can safeguard riverine environments for the future. The mark left on the environment if these waters are or are not protected will be the nation's lasting legacy well into the future.

6.2 ECONOMIC CONSEQUENCES

The development of rivers for flood control, navigation, and power generation has benefited China in many respects. Flood control operations save millions of lives that would otherwise be at risk. Navigation of rivers allows the transport of goods and services throughout China's vast territory. Power generation via hydropower has reduced the amount of fossil fuels burned at coal-fired power plants. However, river development also comes with economic costs, which are traditionally largely unaccounted for when the decision to alter a free-flowing river is made. At times, the benefits of development may be exaggerated while the costs are discounted due to the parameters included in a cost-benefit evaluation. Accounting for the full costs of a project over a life-time during the decision and planning process would result more economically and environmentally sustainable decision-making on river development. Costs of a development project should include budget and time overruns, repair and decommissioning, community resettlement and compensation, and fishery or other local industry losses. In addition to these specific costs, there are larger trends in the economy relating to environmental degradation and investment in hydropower that could have significant economic impacts if unaddressed.

BUDGET AND TIME OVERRUNS

The World Commission on Dams found that large dams have been, at best, only marginally economically viable. The average cost overrun of dams is 56% (WCD 2000). Patrick McCully, author of *Silenced Rivers: The Ecology and Politics of Large Dams*, analyzed the construction of 30 large dams worldwide. He found that cost overruns ranged from 17% to 2900%, with an average of 342%. He also determined that time overruns ranged from 14% to 280%. Since dams are not standardized products, some cost overrun is expected. Often unforeseen geological factors are a major contributor to a project exceeding its initial cost estimate. Reasons for time overruns include resettlement problems and legal challenges (McCully 1996).

In some cases, cost overruns are due to corruption and the filtering of money on the project. For example, the Itaipú Dam on the border of Brazil and Paraguay was protected to cost US$3.4 billion, but due to filtering by military rulers and political allies the final cost reached US$20 billion. This made the final cost almost six times as expensive! Likewise, the costs for the Yacyretá Dam in Argentina increased from US$2.7 billion to US$11.5 billion. The Argentinean President, Carlos Menem, called the project a "monument to corruption" (WWF 2003). In China, the National Audit Office found that the developers of the $10 billion Xiluodu Dam project on the Jinsha River have overspent, misused funds, and displayed a general lack of accountability (Tejada 2009). In addition, in an audit of public funds from January-November of 2009, the National Audit Office found that 234.7 billion yuan (US$34.37 billion) in

public funds was misused. Most of these funds were tied to the 4 trillion yuan stimulus package, to be used for development projects and increasing domestic consumption (Hornby 2009).

REPAIR AND DECOMMISSIONING

According to the American Society of Civil Engineers, the average life-span of dam in the United States is 51 years (ASCE 2009) after which, major repair must be undertaken to maintain the integrity and safety of the dam. In 2009, the Association of State Dam Safety Officials (ASDSO) estimated that the total cost to repair the nation's dams totaled $50 billion and the needed investment to repair high hazard potential dams totaled $16 billion (ASDO 2008). Decommissioning and removal of the dam altogether is also an option. In fact, removal of a dam is usually one-third of the cost of repairs. Nevertheless, dam decommissioning and removal is expensive. The plan to remove four dams along the Klamath River is estimated to cost around $200 million (Sullivan 2009). Other dam removal projects with high price tags in the United States are the Butte Creek removal of 2 dams at a cost of $9.5 million, the Naugatuck River with plans to remove 7 dams at a cost of $8 million, and the Santa Fe River Two-Mile Dam remove at a cost of $3.2 million (American Rivers n.d.b). Most economic analysis of dams do not account for decommissioning costs, therefore the decision to dam could be altered if a full cost estimate was made that included decommissioning (WWF 2003).

RESETTLEMENT COSTS AND COMPENSATION

Resettlement costs of World Bank hydropower projects are, on average, 54 % higher than original estimates. Resettlement costs usually account for around one tenth of total costs but can be over a third of the total construction cost of dams when the project displaces a large number of people or when it involves high compensation payments (McCully 2000). Additionally, river development projects that involve the resettlement of a large number of people often attract international attention and opposition. Investors often see controversial projects as a financial risk; therefore they are hesitant to involve themselves in such projects. In addition, the public image of an investor, bank, or supplier can be damaged once linked to a controversial project (Hildyard 1998). Planning and accounting for long-term and adequate resettlement at the start of a river development project will provide investors with more security the project will not be plagued with controversy.

FISHERY LOSS

Substantial losses in fisheries can occur from river modification such as dam construction. The FAO reports that the principle factor threatening inland fisheries is the loss of fish habitat and environmental degradation. Modifications of rivers by dams or channelization are two reasons for these effects (FAO 1999). Dams hold

back sediments and nutrients, prevent the passage of migratory fish to their spawning grounds, and change the natural flow regime of the river. These effects lead to a decline in fish populations and translate into reduced catch and revenue yield. As previously mentioned in *Economic Benefits* section, inland freshwater fisheries can generate billions of dollars in revenue.

Several of China's most well-known and revered rivers have seen dramatic decreases in fish catch. Fishing in the Yellow River has decreased by 40% from past annual averages of 700 tons (AsiaNews 2007). Fish species in river have correspondingly declined with the extinction of one-third of its 150 species (Asia News 2007). In 2007, the State Environmental Protection Administration (SEPA now the Ministry of Environmental Protection) found that the Yangtze River's annual harvest of fish has dropped 77 % from the 1950s to the 1990s (Hance 2009).

Zhong and Power (1996) conducted a review of the impacts of four hydropower facilities on fish resources in China. The dams they considered in their analysis were the Gezhouba Dam, Xinanjiang Dam, the Fuchunjiang Dam , and the Danjiangkou Dam. Impacts of these dams included blocked migrations of anadromous and semi-migratory fish, delayed spawning due to lower water temperature, decline in freshwater species from 96 to 85 in the Qiantang estuary (Zhong and Power 1996). The author's review also showed that annual catch from the dammed rivers has been affected. Li (1987) reported the annual catch in the Qiantang River decreased by approximately 86% from 1954 to 1985. The Chinese shad, a highly economically valuable migratory fish, was historically an important river fishery. However, the fish is thought be extinct as no fish have been caught since the early 1990s (Zhu 1992). Overall, economically important fish species have been drastically reduced and small-sized, coarse fish of lower market value now account for most catch in the lower Qiantang River (Chen et al. 1990). Other parts of the world have also experienced decreased catch from the construction of dams. When the Porto Primavera dam channel was partially closed in Brazil, upstream catch was diminished by 80% (WCD 2000). Similarly, the Senegal River system in Africa lost 11, 250 tons of fish per year after a dam was constructed (WCD 2000).

OTHER ECONOMIC TRENDS

LOSS OF GDP

China has achieved monumental success economically over the past decades, but environmental degradation has the potential to curb this success. The total cost of the economy due to environmental degradation and resource scarcity is estimated between 8% and 12% of GDP per year (Pan Yue 2005). Rivers play a large role in Chinese economies by serving as a means of transportation of goods and generators of electricity. As rivers become degraded their capacity to sustain their economic

potential becomes weakened. With the right laws and practices in place, a healthy environment can strengthen the Chinese economy and position globally.

UNCERTAIN INVESTMENT OPPORTUNITIES

Due to some of the anticipated effects of climate change and recent behavior of multinational funding institutions, investment in hydropower has an uncertain ROI (return on investment) and limited funding opportunities.

CLIMATE CHANGE

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) warned that China will be one of the world's most affected regions of climate change (He 2008). With changes in precipitation and melting of glacier ice-pack, river flows will also vary in volume and timing (Underwood 2009). These conditions should make investors in dams and other development wary. Climate change presents an uncertain investment opportunity in river development projects (WWF 2003). Severe precipitation events or changes in river regimes could destroy infrastructure and/or render the utilization of such infrastructure useless.

The future costs and benefits of development projects are linked to changes in hydrology. While an increase in precipitation could be an argument for addition dams and reservoirs in the short-term, the long-term consequences of such development projects may make a majority of projects an unwise undertaking. The uncertainty over the timing and intensity of river flows could generate major dam safety and public safety issues. In addition, once major glacier flows have ceased, the new infrastructure will be unnecessary since flows will be dramatically decreased. This does not mean there is not some utility in additional infrastructure, however, decision-making on development should be aware of the uncertainty in future climate and plan accordingly for long-term sustainability.

FUNDING

China is the World Bank's largest recipient of loans and grants for environmental projects (Turner & Otsuka 2006). In 2009, the World Bank's lending for large hydropower reached its lowest level in ten years with only $177 million. In contrast, their lending for efficiency improvements and renewable technologies topped over $3 billion (Bosshard 2009a). The disparity between to the two figures may indicate that funding for large dams has peaked and big lending agencies, such as the World Bank, are promoting different strategies of energy production. The World Bank's Operations Evaluation Department (OED) director-general, Roberto Picciotto, stated that: "as a result of a growing public awareness of social and environmental impacts of large [hydropower] projects" the risks have become "prohibitive" (Hildyard 1998). Private investment in dams is not very promising either. Hydropower

involves high financial risks due to cost overruns and unreliable output. Therefore, power projects that carry less risk are more attractive to investors (Hildyard 1998). The decrease in loans, grants, and private investment in large hydropower means the government will have to provide more funding for these types of infrastructure projects. Investment in energy projects that the World Bank and other agencies are supporting, such as renewable like wind and solar, may be a more economically prudent choice.

6.3 SOCIAL COSTS OF RIVER DEVELOPMENT

River development can benefit society with increased water supply, provision of energy for cities and industries, and flood control so that communities and businesses downstream are secure when river levels dangerously rise. The intentions behind river development projects are good, but the negative impacts on society that can also result must likewise be considered. In China, river development has allowed for progress; for example, increased dependence upon hydropower via the construction of dams allows the nation to reduce its reliance on coal and reduce emissions. Lasting impacts on communities' lives and livelihoods, as well as on cultural practices, however, are often incurred as a result of the same projects. A river protection system would not halt development that serves the public, but through the protection of some rivers and river segments would preserve numerous values that are often unaccounted for during the decision-making process.

One major consequence of river development is the displacement of communities. Large dams generally lead to an inundation of riverside dwellings that submerge homes, cemeteries, and lands that were once important for agriculture. Communities must flee, leaving behind their ancestral lands and homes. Then they resettle in often unsatisfactory areas. If new land is infertile, famers must pursue other professions to support their families. Government promises of compensation do not always ensue, and do not cover the costs of re-establishment (Sims 2001). Frequently, dispersal of compensation in cash does not encourage resettlement plans. Fishermen frequently leave behind their fisheries, too, and must find other ways to survive.

Examples of these scenarios can be found all over the world. Many Chinese citizens have been displaced due to river development; however, the nation does have laws on the displacement of people for dam projects (Chan 2003). The 2006 "Rules of land compensation and people resettlement in medium and large hydraulic and hydroelectricity projects" states : "Displaced people must be provided with a level of livelihood similar to or greater than that which they enjoyed prior to dam displacement; resettlement plans must include economic development plans, not just cash payments for land and resources lost; resettlement plans should create jobs for displaced people; if rural communities are to be displaced, resettlement plans must include a plan for reclaiming new farmland (to avoid over-crowding in resettlement areas)" (CSR Asia 2008). The rules do not, however, stipulate that companies should provide new and better jobs. Instead, the local governments shoulder the burden for implementation of the law (McDonald et al. 2008).

And so in practice, few communities displaced by dams in China have received new employment, although they do usually receive some payment for their land (CSR Asia 2008). Regulations should provide compensation for farmland with 3-4 times the average annual production in the past three years prior to acquisition (Chan

2003); however, these payments are not consistently enforced. With the construction of major dams, thousands, and sometimes even millions of people are forced to move. A river protection system might help to eliminate the cost of compensating residents displaced by dams if some rivers or river segments were set aside from development. The costs associated with displacement are not solely economic; people displaced by dam construction deal with another set of trials.

Displaced residents are reluctant to leave their homes, and a new challenge presents itself when they arrive in new provinces; often they are not welcomed. Sometimes they are stigmatized in their new locale, so they choose to migrate to urban areas or even return to their homes, full-knowing that they will no longer have access to their lands, factories or means of subsistence. Those who settle in the reconstructed cities can no longer rely on their former social networks (LeMentec 2006). Additionally, they are worried that their children's futures will be shortchanged, and that future generations will be robbed of a historic and cultural legacy with which to shape their identity.

When water level rises due to dam construction, many cultural relics are sunken, and the landscape is transformed. Ancient religious and historical sites have for thousands of years propagated culture and have even served as key assets for tourism. Today, the government has been provided a budget to promote new "local heritage" tourist sites (LeMentec 2006), but what seems to be missing in these measures is the preservation of the culture itself for those who have long been seeped in its traditions. In the Three Gorges region, the temple of Zhang Fei, a hero from the age of Three Kingdoms (220-280), as an example, has been restored and protected, but also removed from its original site following the Yichang dam construction. Since the relocation away from the hill of the Flying Phoenix, the temple has been transformed into an international tourist site that even boasts an English-speaking guide. Locals complain that the transfer involved the loss of the "fengshui" in which the water and surrounding trees were important symbols of life. The newly placed temple is accessible by roads today, which contrasts with what were very special voyages made via river by those who for years honored the "god of boatmen." Countryside residents tell stories about Zhang Fei's discontent and refusal to be moved, and have even constructed a small temple for him at the original site. Activities that are banned in the new temple can be enacted in this locally-constructed edifice (LeMentec 2006). A river protection system might preserve important sites such as this one so that their values can be preserved in their purest form.

The Yangtze River dolphin, a historically honored cultural treasure, has been driven to extinction, providing yet another example of where preservation of cultural and natural resources would benefit from a river protection system. The Yangtze River dolphin is the first large vertebrate forced to "functional" extinction by human activity in more than 50 years and this marks only the fourth time that an entire

evolutionary line of mammals has disappeared since 1500. Its extinction is attributed to unsustainable fishing and mass shipping, in addition to impacts brought on by river development (Sample 2007).

The river dolphin once achieved "nearly demi-god status" among fishermen who recounted tales of dolphins being reincarnations of drowned princesses (Sample 2007). Its status protected it, as it was a "harbinger of good fishing luck" when espied (China Expat 2009). During Mao's Great Leap Forward, however, the overthrowing of idols saw the protection of river dolphins lifted and they were hunted for food and their skin (Reeves et al. 2005).

The Great Leap Forward was an economic and social plan to use China's large population to rapidly transform the mainland from a primarily agrarian economy into a modern, industrialized communist society. Consequently, the "goddess of the river" became increasingly valuable for its skin that could be made into handbags and gloves (Reeves et al. 2005), and nearly half of all remaining river dolphins were killed as a result of frequent illegal fishing practices. Although a ban has existed for more than thirty years in China, some ships still drag long lines of unbaited hooks known as rolling hook trawls; these hooks slashed the dolphins and even entangled and suffocated them (China Expat 2009). These dangerous practices were prevalent during the 1980s and 1990s, in particular, when low employment led to a rise in unskilled fishing (Sample 2007). Although it was prohibited to use rolling hook trawls and fyke nets in the Yangtze River, enforcement proved to be very difficult (Reeves et al. 2005).

Additionally, development projects transformed the river dolphin's habitat with dredged riverbeds, concrete reinforcements and interruption of their movements upstream of dams. This development eliminated their access to tributaries and lakes, and reduced fish productivity. The building of the Three Gorges Dam further reduced the dolphin's habitat (Reeves et al. 2005). As a Chinese fisherman recalled in Simon Winchester's *The River at the Center of the World*, "we knew that we were wiping them out. We were killing them off, and by doing so we were helping to kill the river" (China Expat 2009).

During the 1960s, reliance upon food supply from the Yangtze, or "lifeblood of southern Chinese civilization" had caused fisherman to make choices that contrasted with their reverence for the river dolphin. The same fisherman explained, "It was very difficult. We had to eat. We thought we had no choice. It was the dolphins, or it was our children. Which would you choose?" (China Expat 2009). Consequently, the baiji was listed as Critically Endangered in 1996. In 2007, the dolphin was reassessed as Critically Endangered and tagged as Possibly Extinct. Since then, the dolphin has been marked as "extinct", which represents the disappearance of an entire branch of the evolutionary tree of life (Sample 2007). River protection might have preserved the baiji had the system existed when the

dolphin was first listed. If such a system is not considered soon, then other key species may no longer play a role in river ecosystems or in Chinese culture.

Another legacy of culture at stake, admired by locals and tourists alike, are the archeological sites of Yunyang, which house the traces of Ba culture (LeMentec 2006). The dam in the Chongqing region may completely inundate the hanging coffins there. The "hanging coffin", which first appeared during the spring and Autumn Period (722-481BC), is a unique funeral and sacrifice custom of the minority groups in southern China. People placed the bodies of their ancestors into wooden coffins that were later placed into caves of precipitous cliff sides (Ministry of Culture, P.R. China 2003). Usually coffins were made with one whole piece of wood and carved into various shapes. It was said that the hanging coffins could prevent bodies from being taken by beasts and also bless the soul eternally.

Ancient hanging coffins are found in many areas throughout China where minority groups exist and once existed. They represent the continuity of culture through the honoring of ancestors, and serve as popular sites for tourists to visit, especially as they travel down rivers. In 2003, a number of the hanging coffins were found in a rock cave on the bank of the Yangtze River in Zigui, Yichang of Central China's Hubei Province. The coffins were among the finds that local cultural heritage personnel made as they raced to research and rescue ancient ruins along the river before they were lost forever under the rising waters of the second phase of the Three Gorges Dam project (China Daily 2003). Hanging coffins valued both by Chinese people and by tourists, will be under water *forever* if river development continues without consideration for what projects leave in their wake.

Finally, it should be noted that river development also has impacts on river recreation. When a dam is constructed, a river's flow is never again the same. Certain segments are blocked as they form reservoir lakes. In many cases, this means that river segments can never be traversed again. Healthy rivers and streams inspire river enthusiasts and support local economies, but during certain months, so much water is diverted from rivers from major dams, that levels are insufficient for fish and wildlife survival, and certainly, for boating (Sims 2001). The aesthetic value of rivers is likewise transformed, and so the pristine and awe-inspiring views that may have once been enjoyed will never look the same after a major dam is constructed. A river protection system does not discourage all development, because it must be acknowledged that dams do provide important services. However, a river protection system can offer guidance to policy-makers and provide methods through which the many values that free-flowing rivers represent in the lives of Chinese people can be preserved.

7. AVAILABLE RIVER DEVELOPMENT ASSESSMENT TOOLS

Today, decision-makers consult a number of tools prior to going forward with most development projects in order to maximize benefits, but also to prevent unintended negative consequences. The tools below are used in evaluation of potential hydropower projects. Although dams cannot be constructed on protected rivers, some of the considerations for these projects are the same as those that must be factored into river protection efforts.

7.1 THE WORLD COMMISSION ON DAMS

Negotiations between the World Bank and the World Conservation Union led to the establishment of the World Commission on Dams (WCD) in May 1998 in particular response to escalating local and international controversies over large dams (UNEP 2009). The official World Commission on Dams (WCD) of 2000 established the most comprehensive guidelines for socially and environmentally sustainable dam building that had been written to date. The final report describes an innovative framework for planning water and energy projects that is unique in its intent to protect dam-affected people and the environment, and also to guarantee that the benefits that are gained from dams are more equitably distributed. The framework covers key areas for improved planning of dams. Some of these include the need to assess all available options for meeting water and energy needs, addressing outstanding social issues from existing dams before building new ones, gaining public acceptance for key decisions, and the importance of protecting healthy rivers (International Rivers 2009).

BENEFITS

The WCD is an excellent tool, and it also assesses the state of dams around the world and evaluates their effectiveness. Since the WCD was developed through a multi-stakeholder process and has been adopted by civil society, it is the most comprehensive and trusted river development assessment tool on this list. The guidelines and recommendations within the WCD report are useful to academics, activists, and government officials who want to promote a new model for addressing river management. In particular, the WCD offers suggestions for the inclusion of all affected people into decision-making, including indigenous groups.

DISADVANTAGES/CHALLENGES

Community groups can use the report to improve water and energy planning, but without leadership and/or government backing for the protection of rivers and riverside communities, the claims that communities make have no teeth.

Additionally, after publishing its final report in November 2000, the WCD dissolved. Thus, the Commission was limited in its influence by time constraints.

USEFUL RESOURCES

World Commission on Dams. 2000. *Dams and Development: A New Framework for Decision-Making*. London: Earthscan Publications.

International Rivers. 2008. *The World Commission on Dams Framework – a brief introduction*. <http://www.internationalrivers.org/en/way-forward/world-commission-dams/world-commission-dams-framework-brief-introduction>.

United Nations Environment Programme (UNEP). 2009. "The World Commission on Dams." UNEP Dams and Development Project. <http://www.unep.org/DAMS/WCD/>.

7.2 SUSTAINABILITY ASSESSMENT PROTOCOL

The Sustainability Assessment Protocol has been developed to guide and assist members of the International Hydropower Association (IHA) in assessing performance of hydropower projects against criteria described in the IHA *Sustainability Guidelines*. The three-part document is thorough and specific. Section A, "New Energy Projects," offers guidance on sustainability issues that should be considered in the assessment of new energy projects; twenty selected sustainability aspects are discussed. Part A is most useful as a preliminary review of newly proposed projects. Both sections B, "New Hydro Projects," and C, "Operating hydropower facilities," detail a sustainability scoring process against 20 selected sustainability aspects, which cover relevant environmental economic and social issues. A discussion of consideration and assessment requirements for each of the aspects in these three categories is included. Assessment is scored from five to zero, and looks at both process and performance against each aspect or criteria. An additional section "Obtaining objective evidence," is also included to assist in the process of obtaining scores against each of the 20 sustainability aspects (IHA 2006).

BENEFITS

An understanding of the economic, social and environmental issues related to hydropower projects is encouraged for better management.

DISADVANTAGES/CHALLENGES

The document discusses the integration of three components – economic development, social development, and environmental protection – in its analysis, but does not provide solutions when it is determined that the essential

requirements for sustainable development cannot be met. Further, there is no standard that determines whether a project truly does or does not meet criteria set by the tool. The IHA has undertaken efforts to revise and make operational their Hydropower Sustainability Assessment Protocol via their ongoing Hydropower Sustainability Assessment Forum.

USEFUL RESOURCES

International Hydropower Association. 2006. *Sustainability Assessment Protocol*. July 2006. <http://www.hydropower.org/downloads/IHA_SAP.pdf>.

Hydropower Sustainability Assessment Forum. 2009. *Hydropower Sustainability Assessment Protocol Key Components Document*. January 2009. <http://www. hydropower.org/sustainable_ hydropower/HSAF-Phase_1_Consultation/hydro power_sustainability_assessment_protocol-key_components_ document. pdf>.

7.3 INTEGRATIVE DAM ASSESSMENT MODELING (IDAM) TOOL

The World Commission on Dams (2000) calls for social, environmental, and technical monitoring and assessment for proposed dam projects, and the IDAM tool offers means to this end by employing a design which combines the three themes identified by the 1992 United Nations Conference on Environment and Development as primary areas of concern for environmental and social sustainability: biophysics, socio-economics, and geopolitics. To help policy makers better assess the costs and benefits of building dams, they explain the themes with two circle diagrams (Figure 7.3.1), one of which measures costs associated with proposed dam development, and another, which measures the benefits. Each of the two diagrams consists of 27 individual ''impacts,'' or effects of dam construction. Nine of these represent the biophysical impacts; nine represent the socio-economic impacts, and nine represent the geopolitical impacts. The same impacts appear on both the cost and benefit circles, and each impact comprises an equal portion of the circle diagram (Brown et al. 2007). Each of the 27 impacts includes an objective evaluation of the magnitude of the effect of dam construction (a ''metric'') and a subjective evaluation of its biophysical, socio-economic, or geopolitical effect (a ''valuation''). The circle diagrams show that each impact is broken into five sub-sections (each represents 2 and 2/3 of the circle) that classify the objective magnitude of the effect on a six-point scale ranging from zero for ''no impact'' to 5 for ''extreme impact'' (Figure 7.3.2; Brown et al. 2008). The published study features an illustration of the use of the tool by testing it on two hypothetical dams with different design characteristics. The tool was designed to be used anywhere on either small or large dams with some modifications, and the researchers who created it have already used the tool to study the impact of dams in China (Oregon State University 2009).

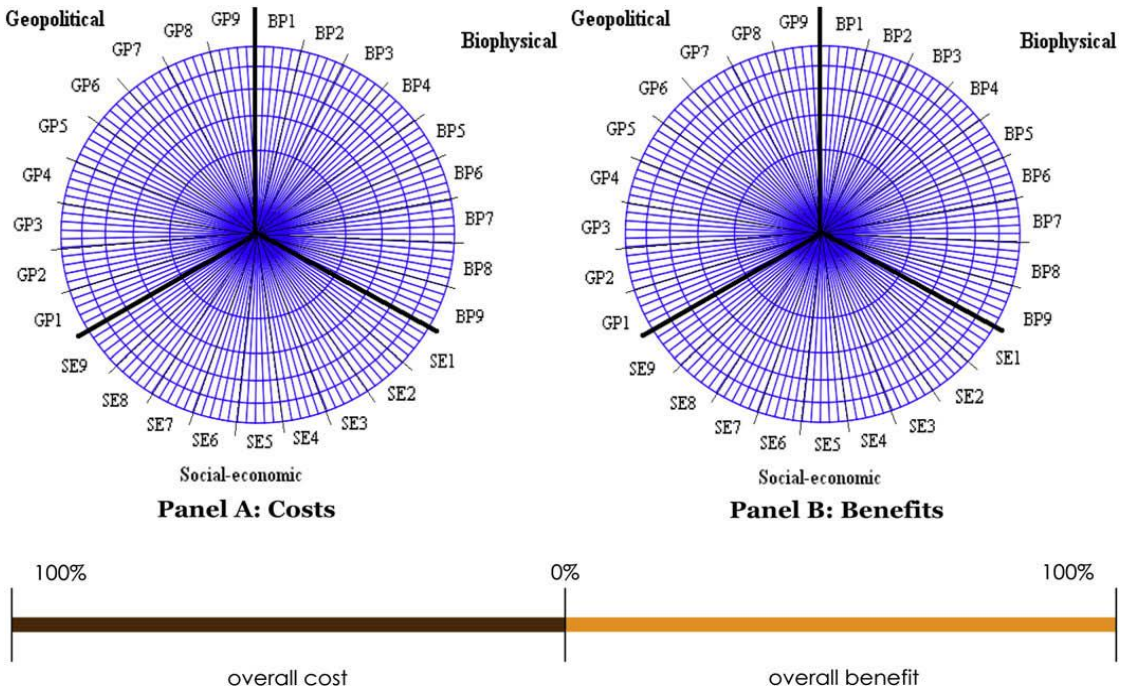


FIGURE 7.3.1: IDAM TOOL.
The sum of the shaded area for a completed IDAM characterizes the aggregated costs and benefits. The proportion of the costs and benefits is displayed on a scale that runs from o to 100 on costs and benefits (Brown et al. 2008).

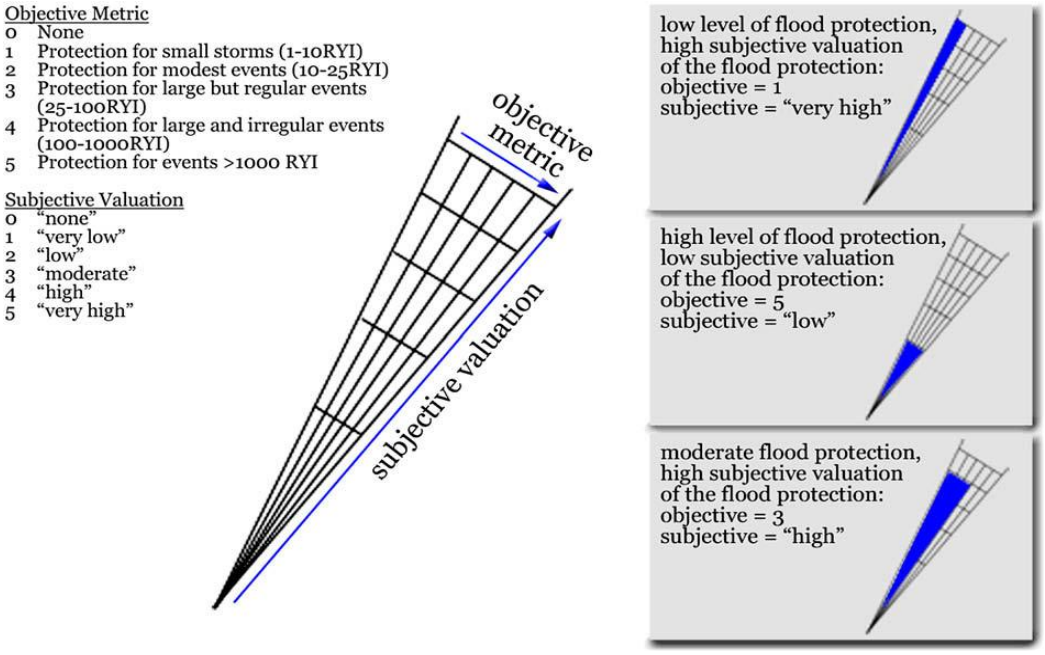


FIGURE 7.3.2: SAMPLE EVALUATION OF THE BENEFITS OF FLOOD PROTECTION (BROWN ET AL. 2008).

BENEFITS

An interdisciplinary team put together the tool, which is designed to be useful to dam evaluation conducted in any locale. The tool provides a visual representation of the various costs and benefits associated with dams. It allows decision-makers to evaluate alternatives and pinpoint priorities associated with a dam project. Hence, the decision process about dams is more informed and transparent.

DISADVANTAGES/CHALLENGES

The up-front data requirements for the objective assessments of dam impacts present a real challenge to anyone hoping to use the tool. Secondly, the 27 individual impacts may not be appropriate to every setting; decision-makers in China would need to adapt them to the local context. Third, the value of the IDAM tool depends on a balanced in analysis of each of the three types of impacts. Unbiased evaluations of the costs and benefits are imperative to the utility of this tool. Finally, the tool requires consensus building among diverse stakeholders and decision makers. However, with the necessary requirements for this tool met, the end result of this interdisciplinary and balanced analysis will be better than that derived from a less through model.

USEFUL RESOURCE

Brown, P., D. Tullos, B. Tilt, D. Magee, and A. Wolf. 2008. Modeling the costs and benefits of dam construction from a multidisciplinary perspective. *Journal of Environmental Management* DOI:10.1016/j.jenvman.2008.07.025.

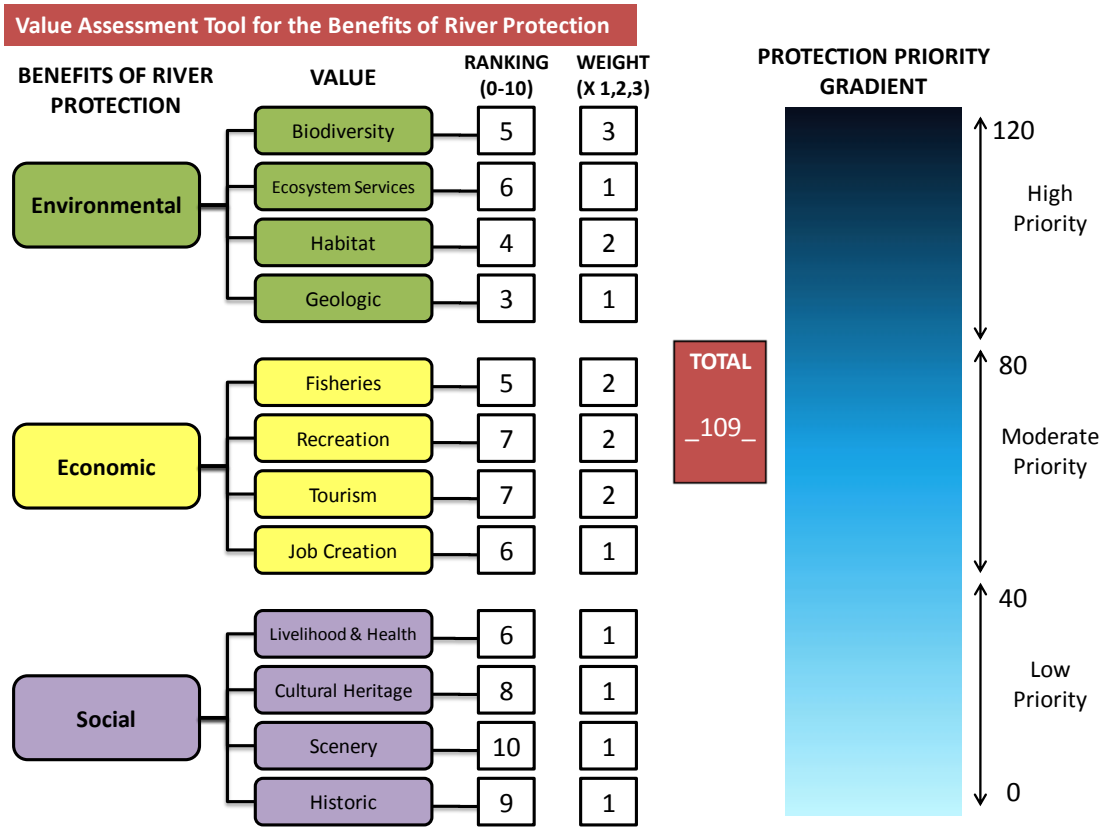
7.4 RIVER PROTECTION TOOL

Dam assessment tools are only one piece in the puzzle of protecting rivers from the negative impacts of dams. The three tools mentioned in this section, in combination with others, are useful in an analysis of proposed dam projects. What has not yet been designed is a tool or guide for decisions regarding protecting, rather than developing rivers. Our report should offer a look into what such a guide might look like. Certainly, even with such a guide, a river protection system can be aided by simultaneously requiring the use of thorough dam assessment tools.

The ***Value Assessment Tool for the Benefits of River Protection*** that we have developed aids the decision-maker during the study process of the river protection system. The purpose of this tool is to highlight the benefits of river protection and the values that rivers possess which are often overlooked. The results of this tool can be balanced against the costs of protecting a river, which may be quantified in

the form of recognized values such as hydropower, flood control, navigation, and water supply. This tool does not perform a cost-benefit analysis, since costs are not included; rather, it serves as a reminder of the benefits of river protection.

FIGURE 7.4.1: VALUE ASSESSMENT TOOL FOR THE BENEFITS OF RIVER PROTECTION.



Notes
Ecosystem Services – includes water quality, flood control, sediment transport
Job Creation – through fisheries, ecotourism, nature conservation
Livelihood – dependence on products derived from river ecosystems/habitats for income
Health (Human) – food, drinking water, bathing water

OPERATION OF THE VALUE ASSESSMENT TOOL

The operation of the tool works as follows. First, the interdisciplinary study team will evaluate the status of each of the listed values of the nominated river. After the status of each category is determined, a ranking from 0-10 is given. A ranking of 0 indicates that a value does not exist (i.e. uninhabited region or highly turbulent waters unfit for rafting). A ranking of 10 indicates that a value is prominent (i.e. ancestral burial ground, archeological relics, fish spawning habitat, UNSECO World Heritage Site). These rankings should be based on the scientific and impartial examination of the river and its surrounding habitat. After a ranking is assigned, a decision-maker can choose to weight the ranking based on the value that would be

most likely to merit protected status or based on the specific socio-political or socio-geographic setting of the river. The weights offer flexibility to the decision-maker because certain value rankings of the river can receive a higher point value in the overall assessment if the decision-maker is certain that the value warrants such a weight. For example, some rivers may be well-suited for recreation or tourism due to their close proximity to a city. In the case that the study team gives the river a low ranking, the decision-maker can chose to modify the value's ranking. After both the ranking and the weight are given, the point values from each box are added and a total value is recorded. The total value is then compared against the protection gradient to determine if the river is a high, moderate, or low priority for protection.

8. LESSONS FROM AROUND THE WORLD

This section allows us to reflect upon the decisions that have been made in regards to river development. Goals of growth and an improved economy inspired the construction of numerous dams, many of which later failed. Some of these are being removed today. Many lessons have been learned from the development and subsequent removal of dams worldwide, but especially in the United States. This knowledge from the experiences described below is guiding decision-making today on when, where, and how to build or remove a dam.

8.1 DAM REMOVAL

Dams have been built all over the world to provide a supply of water, irrigate crops, generate electricity, and control floods. Over time, however, dams age and deteriorate and can even become a safety concern. Dams can fail for a number of reasons (FEMA 2009):

- Floods cause water to overtop dams exceeding their storage capacity
- Structural failure occurs due to materials used in construction
- Dam foundations can move or fail to support the dam
- Concrete or embankment dams can crack
- Piping and internal erosion of soil decreases dam stability
- There is inadequate maintenance and upkeep
- There are instances of deliberate sabotage

In order to avoid or lessen the risk of dam failure, dam decommissioning may be an appropriate option for dams that are no longer functioning properly or that are structurally compromised. By 2020, it is estimated that more than 85% of existing dams in the U.S. will be near the end of their operational lives (FEMA 1999), and dams are deteriorating at a faster rate than they can be repaired (US 2009). Dam removal is being considered in many places, such as the United States, Brazil, Sweden, Spain, France, because of either the long-term environmental impacts of a dam, or the costs associated with the constant need for dam maintenance, renovation, and remodeling (Doyle et al. 2003). In many cases, removal of a dam is less expensive than continued maintenance and operation of the dam; therefore, sometimes removal is the economically preferable option. Hence, dam removal is becoming a practical solution to cost effectively eliminating some of the negative impacts associated with dams. Additionally, in some cases dam removal is a form of river restoration that can provide many ecological benefits in addition to the economic and public safety benefits (Massachusetts 2007).

8.1.1 BENEFITS OF DAM REMOVAL

When natural flows are restored to river ecosystems after dam decommissioning, population densities of native aquatic organisms may return over time, along with historic diversity and species composition. Rivers returning to their natural flow can restore old flood plains and the surrounding habitat, further supporting the return of native species.

Some migratory fish species rely on peak flow events to cue migration (prevented by dams). The removal of a dam may allow these fish to migrate to their spawning habitat. Habitats at the ocean/riparian interface are crucial for many species (American Rivers 2000). Fish populations are positively impacted because after a dam is removed, species' reproductive rates are enhanced (American Rivers 2002). The reconnection of upstream and downstream habitats essentially removes previous river fragmentation caused by a dam.

Dam removal restores a river's natural water temperature, and removes temperature stratification. Water temperature can become stratified with dam installation because the top layer of water is warm and highly oxygenated, while the cooler, denser water and poorly oxygenated water sinks to the bottom and the two layers are unable to mix. Dam's force rivers to slow down, and are essentially converted from fast-moving rivers into "slow-moving lake-like habitats with relatively large surface areas" (American Rivers 2002). This changes the entire structure of a river by decreasing the flow velocity and stratifying temperature. For most large dams, water is drawn from the bottom layer of the reservoir, and these layers do not have sufficient oxygen to support aquatic life. Many aquatic species have restrictive temperature requirements for survival, growth, and reproduction, and dam removal eliminates thermal pollution (Massachusetts 2007).

Sediment (sand, gravel, rocks) has to be redistributed after a dam is removed because it has been accumulating behind the dam. The increase in sediment can potentially increase the amount of colonization habitat for insects and spawning fish, and increase new and diverse habitats (American Rivers 2002). Fine sediment in particular is important for the storage, transfer, and fate of nutrients (Walling et al. 2003). The non-native plants and those that have established unnatural post-dam habitats with limited sediment are often growing at alarming rates and can be regulated when native plant species have a better chance to reestablish after dam removal (American Rivers 2002).

Not only do rivers benefit from the removal of dams, but wetlands adjacent to rivers also benefit because they can act as flood plains, that can attenuate much of the natural flood peaks, thus providing flood control and environmental services synchronously. Small ephemeral ponds are restored which act as nurseries for

aquatic species (American Rivers 2002). Increased habitat health function affects all levels of the food chain and restores balance to ecosystems.

8.1.2 IMPACTS OF DAM REMOVAL

It is important to keep in mind that there are short-term impacts associated with dam removal. For example, there is an initial geomorphic disturbance (Doyle et al. 2003), increased turbidity, increased exposure to contaminates, altered flow, and disturbances from heavy equipment (Massachusetts 2007). While these issues need to be taken into consideration, the short-term negative impacts of dam removal often outweigh the long-term impacts of keeping a dam in place. As the scientific understanding surrounding the issue of dam removal improves through studies and removal projects, dam removal strategies can be developed that balance long-term economic, social, and environmental goals (Doyle 2003).

"Beyond economic and safety issues, scientific and public awareness of the social and environmental costs of dams has increased substantially over the past two decades, promoting numerous calls for dam removal [World Commission on Dams 2000]" – Doyle et al. (2002).

8.1.3 CRITERIA FOR DAM REMOVAL

Many factors and questions must be addressed when considering dam removal (Pejchar and Warner 2001). The first is the ecological criteria: Is the dam currently degrading habitat quality, and quantity and will the removal of the dam restore habitat quality and quantity? Next, dam function and safety is considered: Is the dam still fulfilling its original intended function, and does the dam pose a current or potential safety hazard to human lives and property? Finally, the political process: Is there stakeholder support for dam removal, and would the Endangered Species Act play a role in dam removal (regarding the United States), and is funding available? In China, similar questions could be asked if dam removal is a consideration, or alternatively, when deciding whether or not to protect a river: What species would benefit from protection? Is there a unique habitat to conserve? Are there people who depend on a free-flowing or segment?

8.1.4 SHORT INTERNATIONAL CASE-STUDIES OF DAM REMOVAL

DAM REMOVAL IN SPAIN

During this past decade, dam removal in Spain has been increasing because of pressure on the government from water oversight committees, municipalities, anglers, and environmental groups. So far, most of the decommissioning has been of small dams in order to eliminate the risk of floods, and to protect their salmon stocks. About 50 dams have been removed in the past decade, and more dam

removals are planned around Spain including abandoned dams, hydropower dams, as well as dams in National Parks (International Rivers 2008).

In order to build a dam in Spain, a permit must abide by the European Union Water Framework Directive. Now that the water permit process is being reformed, about 6,000 water permits have been cancelled; almost 500 water permits have been cancelled in order to protect both salmon and brown trout. Scheduled demolitions are located in areas where migrating salmon need to their upstream habitat to spawn (International Rivers n.d.).

DAM REMOVAL IN FRANCE

Two dams on the Loire River in France were decommissioned, both relics of the 19th century, in order to restore Atlantic salmon spawning grounds (BC Institute of Technology 2009). A number of other dams were removed because they prevented passage of migratory fish: Kemansquillec on the Léguer River, Saint-Etienne du Vigan on the Allier River, and the Maisons-Rouges on the Vienne River (RiverNet 2009).

DAM REMOVAL IN SWEDEN

Dams in Sweden have been removed because they have either lost their function or require renovation (Lejon et al. 2009). Major obstacles involved when considering dam removal include: source of funding, threatened species, and cultural-historical values. The main drivers/ incentives for dam removal include: safety, law and policy, economics, and ecology. A number of dams have been removed in order to increase fish passage and increase general biodiversity. Some recommendations have been put forth to help dam removal decision-making. First, adequate information regarding the effects of dam removal need to be considered. Second, it is important to have stakeholder involvement. And lastly, more information needs to be provided to researchers in order to make appropriate and informed decisions (Lejon et al. 2009).

Worldwide, dams are important for power generation, and now it is important to consider treatment of dams when they fail or begin to deteriorate. Dam removal, as apposed to maintaining a failing dam or leaving it in place, is becoming a more popular because it is cost-effective (money is saved), and there is a possibility of restoring river habitat and the surrounding environment.

8.2 RIVER ALTERATION CASE-STUDIES

River development utilizes of a number of the values that rivers possess. However, this alteration changes the flow, scenic view or riverine environment that once existed. This section offers a few examples of cases in which river alteration has caused decision-makers to at least evaluate development impacts and even re-think prior choices.

8.2.1 KLAMATH RIVER

The Klamath River Basin has a long history as the center of water rights debates concerning water management and water scarcity, and debates concerning dam removal. This case-study provides an example where the benefits of restoration greatly outweigh the costs of keeping dams in place; as a result dams are to be removed in the near future, and fisheries, recreation, and culture restored.

BACKGROUND

The Klamath River originates in southern Oregon and stretches for 263 miles before it empties into the Pacific Ocean in northern California (Powers et al. 2005). River development has impacted a number of different stakeholders including Indian tribes, farmers, wildlife refuge managers, residents, sport fisherman, recreationalists, environmental groups, as well as state, local, and tribal governments.

Klamath River

Source: Rogue Klamath

COHO SALMON

Fish species are a main concern for this river; in particular, Coho salmon are affected because of their sensitivity to the drastic alterations in the watershed (National Research Council 2004). Coho salmon were once abundant, but are now listed under state and federal endangered species acts. From 1908 to 1962, six dams were constructed that severely impacted salmon and other anadromous species. Specifically, the Iron Gate Dam limits upstream migration for fish (Kruse and Scholz 2006).

In 2004, the Federal Energy Regulatory Committee (FERC) renewal application did not include salmon passage to rivers and streams above the Iron Gate Dam, therefore, "for a variety or reasons – including ecological, cultural, and economic factors – stakeholders, including tribes, conservationists, and commercial fishermen, contend that the removal of up to four dam would be a desirable outcome for the re-licensing process" (Kruse and Scholz 2006).

A study was conducted to provide a preliminary assessment of the removal of four dams on the Lower Klamath River, owned and operated by PacifiCorp: Iron Gate (built in 1962), Copco 2 (built in 1925), Copco 1 (built in 1918), and J.C. Boyle (built in 1958). The cost of removing a dam includes dam deconstruction (removal of the physical structure, sediment disposal and storage, and disposal of waste materials), lost services (alternative sources of energy), and external costs (changes in the environment, local economies, and/ or jobs). It would cost an estimated $100 million dollars to remove all four dams: $54 million to remove Iron Gate Dam, $20 million to remove Copco 2, $9 million to remove Copco 1, and $17 million to remove J.C. Boyle. The estimated economic benefit by removing all four dams would create 2,150 jobs (per $1m), and add $235,740,000 (per $1) to the economy. If three dams are removed, the estimated economic benefit would create 1,785 jobs (per $1m), and a total increase in economy is $195,664,200. Regarding fisheries, the estimated value of increased recreational and commercial Chinook salmon harvests is $4,495,939 (Kruse and Scholz 2006). More recent studies, however, indicate that the cost of removal could be higher, although the total cost of both dam removal and river restoration is not likely to exceed $200 million (Sullivan 2009).

In recent developments, in October of 2009, after months of negotiations PacifiCorp has agreed to remove the dams on the Lower Klamath. Until 2020 PacifiCorp will operate the dams, and then they will be destroyed (The Pioneer 2009). This case-study illustrates that at times decisions must be re-evaluated in order to take actions that will alleviate environmental degradation when the full impact of alternation of a river is realized.

8.2.2 HETCH HETCHY

BACKGROUND

The Hetch Hetchy Valley is a glacial valley in Yosemite National Park in California. Once called the "second Yosemite", this environment is currently flooded by the O'Shaughnessy Dam, which forms the Hetch Hetchy Reservoir; the Tuolumne River fills the reservoir, and the reservoir supplies the Hetch Hetchy Aqueduct. Just upstream from the valley is the Grand Canyon of the Tuolumne.

THE CONTROVERSY

At the turn of the 20th century, the City of San Francisco was frustrated with a privately-owned water company that provided sub-par service at very high prices. When the water company failed to provide adequate water to fight the fires that destroyed much of the city following the 1906 San Francisco earthquake, outcries ensued about the need for a reliable water supply. Some argued that poor management should take the blame for the meager response, and not a lack of water. The city was worried, however, about how it would maintain a sustainable and ample water supply for the burgeoning population. The city's mayor organized a municipally-owned water utility, and sought out new resources by applying to the United States Department of the Interior to gain rights to the Hetch Hetchy Valley (Fox 1986; Muir 1912).

In 1908 a city referendum had found favor for a dam in the Valley. Dam proponents thought its construction was not only necessary, but also that the valley would be even more beautiful with the lake that would be created. Environmentalist John Muir and the Sierra Club immediately responded with articles and pamphlets in protest of the dam project that would transform Hetch Hetchy forever. They had considerable influence on public opinion in favor of preserving the valley. Muir explained that among other negative consequences, the lake would deposit an "unsightly ring" around its perimeter, which would be visible when water levels were low. Letters poured into Congress by the thousands; most major newspapers published editorials condemning the dam (Chowder 1990).

Since the valley lay within Yosemite National Park, an act of Congress would be necessary to commence a dam project (Muir 1912). On December 6, 1913, after 12 years of fighting, the Hetch Hetchy question came to a final vote. The federal government ended the dispute with the passage of the Raker Bill, which permitted the flooding of the valley. The U.S. Senate passed the bill authorizing the dam, which would be built on federal land, with a 43-25 vote with 29 abstentions (History Matters 2009). The New York Times wrote, "the American people have been whipped in the Hetch Hetchy fight" (Chowder 1990).

When the act was signed by President Woodrow Wilson in 1913, Congress granted the city and county of San Francisco lands and rights-of-way in the public domain in both Yosemite National Park and in Stanislaus National Forest (BAWSCA 2007). Hetch Hetchy was to be used to construct and maintain a supply of water for the domestic purposes of the City, and to create an electric energy distribution system (Virtual Musuem of the City of San Francisco 2009). There has been some criticism that San Francisco has failed to provide municipalized power to its residents, as is required by the Raker Act, especially as violations of the act have been well-cited. The San Francisco District Court cited the City for violating the Raker Act when

water was used and managed by the Pacific Gas and Electric Company, a private utility (*United States v. San Francisco* 1940).

RESTORATION EFFORTS

The regional water system provides water to 2.4 million people in San Francisco, Santa Clara, Alameda and San Mateo counties. Hetch Hetchy water is important to many Bay Area residents. Still, the Sierra Club contends that the Valley should be restored to its natural state so that "one of nature's rarest and most precious mountain temples is available for public enjoyment". Currently, the valley is a poignant reminder of what could have been a spectacular preserved area, and many experts maintain that it could become just this if the dam were removed and restoration efforts initiated. Experts even explain that today both water and power supplies for San Francisco could be replaced by a combination of other measures, including different resources and efficient and conservation efforts. Removal of the reservoir would "result in an immediate ecological rebirth of Hetch Hetchy Valley (Restore Hetch Hetchy 2005), and restoration would allow the Valley to be reintegrated into its natural ecological and biological systems, and honor the act that created the nation's National Parks. A 1998 report from the Bureau of Reclamation for the National Park Service explains that "such restoration would renew the national commitment to maintaining the integrity of the national park system and keep in perpetual conservation an irreplaceable and unique natural area" (Sierra Club 2006).

8.2.3 SNAKE RIVER

BACKGROUND

The Snake River is 1,040 miles long and passes through three states: Idaho, Oregon, and Washington (USGS 1990). Two fish species, the wild Snake River salmon and steelhead, are on the brink of extinction in the lower Snake due to overfishing, development, and the construction of dams (American Rivers 2009). The addition of more dams on the Snake River would significantly impact these two species. Additionally, removal of four dams owned and operated by PacifiCorp on the lower Snake River may be crucial in order to protect these ecologically, culturally, and economically important species.

"Restoring a free-flowing lower Snake River would restore abundant salmon and steelhead and offer new economic and recreational opportunities"

-American Rivers

SPECIES PROTECTION

There are five main reasons why the Snake River should be restored to protect these species:

1. The river salmon and steelhead are protected under the Endangered Species Act, and the federal government is obligated to protect and restore their habitat.
2. Over 130 species (including bears and otters) depend on salmon for survival.
3. If these species are recovered, over $500 million per year in recreational fishing-related income would be generated, and thousands of jobs could be created.
4. Dam removal (of the outdated dams) could provide the opportunity to upgrade and diversify the region's grain transportation systems and energy supply.
5. The Snake River basin ecosystem could act as a future refuge* in the face of climate change.

*If future changes in climate do occur, the Snake River basin ecosystem may be a critical salmon refuge. The ecosystem has salmon spawning habitats with some of the highest elevations in the world, and therefore may be resilient to changes in climate (American Rivers 2009).

DAM REMOVAL

There are a few steps that would need to be taken prior to removal of the dams. The first step would be to replace the dams' energy so it is affordable and carbon neutral. By doing this, 15,000 new jobs could be created, and 13,000 megawatts of cost-effective energy can be developed through energy efficient investments. Next, the railroads, highways, and Columbia River barge system would need to be updated in order to maintain and enhance the region's freight transportation system. Finally, the irrigation pump system would need to be retrofitted in to draw water from a free-flowing river. After removal of the dam, pressure on irrigators would actually be decreased because irrigation is currently only provided from one of the reservoirs of the four lower Snake Dams (American Rivers 2009).

Removal of the dams would save both taxpayers and ratepayers money. It is proposed that in the long run, a one-time expenditure on dam removal will likely save money. The $6 billion the federal government plans to spend on a salmon plan would be better spent on removing the dams on the lower Snake River. This, in turn, would provide funds (left over after dam decommissioning) for habitat restoration, hatchery reform projects, and recovering the health of salmon and steelhead (American Rivers 2009).

The benefits of replacing the outdated dams include an increase in the following: energy output, grain transportation, irrigation, sport fishing, commercial fishing,

recreation and tourism. The Army Corps of Engineers estimates that non-fishing recreational benefits total about $310 million/year (American Rivers 2009). A one-time dam removal cost could provide significant environmental, social and economic benefits. All of these factors need to be considered to determine if dam removal is the appropriate action.

8.2.4 ITAIPÚ DAM IN BRAZIL

VULNERABILITY

Just weeks after announcements that Rio de Janeiro would host the 2016 Summer Olympics, the country experienced a massive blackout as the power output of the entire Itaipú Dam - the world's largest operational electricity generator on the border of Brazil and Paraguay - was down. The national electricity grid operator reported that 17,000 megawatts of energy had been lost (Reuters 2009) and tens of millions of people were affected. In Sao Paulo, Brazil's financial capital, thousands of subway passengers were forced to exit stalled trains and walk along the tracks to return to stations and climb to safety. Paulistas and citizens in populous Rio de Janeiro and Minas Gerais states were completely in the dark, as were Brazilians in many other parts of the country extending to the south (Latin American Herald Tribune 2009). In Paraguay, where the Itaipú power plant is responsible for more than 90% of the electricity supply, the power was out for 15 minutes (Reuters 2009). It is often the case with major dams that even well-planned development can wane in efficiency at some point. With responsibility for major energy production also comes the risk that failure will have widespread impacts.

DAMMING GOALS

Before the dam was built, engineers shifted the course of the seventh largest river in the world – the Paraná - around the construction site. Workers carved a 1.3-mile-long, 300-foot-deep, 490-foot-wide diversion channel for the river. After nearly three years, the dam was complete, and more than fifty million tons of earth and rock had been removed in the process. The American Society of Civil Engineers named the Itaipú Dam one of the "Seven Wonders of the Modern World" (PBS Online 2001), but it was built to do more than draw in tourists via newly constructed roads to see both the dam and regional wildlife.

After years of drought in Brazil and Paraguay, government leaders in both countries were eager to use the river more effectively. They wanted citizens to have sufficient drinking water, and farmers' water for crops. Finally, industry could also be served by an increased, reliable water supply (Kent ICT 2009). Water from the reservoir is used to supply homes and factories for the south, south-eastern and mid-eastern regions of Brazil, as well as for many homes and factories in Paraguay. Farmers are supplied with irrigation water, and most importantly, the dam is a critical

hydroelectric power station for both countries. The dam gets blocked with mud and silt, however, and consumption of untreated water from the reservoir has resulted in the spread of disease for human populations. Additionally, the construction of the dam required that land behind the dam and reservoir had to be flooded. This meant that a great deal of rainforest had to be demolished, taking with it, habitats and biodiversity (Kent ICT 2009).

CURRENT EVALUATION

Today, Brazil and Paraguay are able to provide a great deal of power without relying on coal, but this makes it the entire imperative that the dam and power plant be reliable. While the dam has offered a number of benefits to these two populous Latin American nations, its recent exhibition of vulnerability – and the panic that ensued – point to the need to re-evaluate alternative options for power supplies. Further, experts in both countries have initiated research that evaluates the sustainability of the dam, and the impacts on the river environment.

9. CONCLUSION

As China increases efforts to protect its natural environment, there is an opportunity to safeguard some of its remaining free-flowing rivers and river segments in perpetuity. Currently, rivers are being developed at a rapid rate; China has more than 22,000 large dams (Bosshard 2009b). The desire to increase economic development and carbon-free power generation has led to plans for even more river development in the near future (Bosshard 2009b). The impacts that these dams have on both human and ecological communities have often been discounted or not included in the decision-making process; however, in the last few decades, the movement to improve environmental protection has grown considerably (National Eleventh Five Year Plan 2007). By 1998, China's Nature Reserve System increased the number of protected sites from 100 in the 1950s to nearly 1,000 (Harkness 1998). Additionally, the Chinese government has made efforts to improve air and water quality throughout the country (National Eleventh Five Year Plan 2007).

The Central government has the ability to work quickly to meet goals when a particular issue motivates the nation. The Chinese government has begun to increase environmental protection as part of its progress toward a "harmonious society." All sectors of government and society have been encouraged to further this goal, and China has taken great strides to decrease its environmental footprint. The Chinese government is working to develop the largest photo-voltaic solar power project in the world and is conducting their first national survey of all rivers (Woody 2009). Additionally, the Premier has halted a contested dam development project on the Nu River (Yan 2009). Although the current focus on rivers as part of these efforts has centered on improving water quality for both human consumption and irrigation, the growing attention on environmental preservation and remediation provides an opportune window in which the Chinese could implement a river protection system.

Through our research and analysis of the environmental, social, and economic benefits of river protection, existing international river protection frameworks, and the Chinese legal and institutional structure, we have developed a set of specific recommendations to aid decision-makers within the Chinese government to create a national river protection system for China. We identified the key components of successful river protection systems by researching the U.S. Wild and Scenic Rivers System, The Canadian Heritage Rivers System, The European Union Water Framework Directive, and Norway's river protection system, as well as a number of emerging river protection systems. We developed a matrix to compare these systems and found that all four originated from a strong public demand for increased protection of free flowing rivers and improved water quality. Public demand for improved water quality and environmental protection in China

indicates that that there may be a social environment analogous to that of the systems we studied.

The most significant features that led to the effectiveness of these systems were the development of a management plan, designation of rivers and river segments, provision of a range of protection levels, protection of rivers in various stages of development, use of public participation and stakeholder outreach, and effective interagency coordination. We also identified a number of weaknesses possessed by these programs.

Our framework provides recommendations for implementation of the system, assignment of authority, designation and selection of rivers, and suggestions for monitoring and management to maintain an effective system. Research of the Chinese legal and institutional structure provided us with an understanding of the context into which our recommendations for river protection could fit.

We also created a Value Assessment Tool that could be used during the study process to prioritize river protection based on the environmental, social, and economic values possessed by individual rivers. The output of this tool can be balanced against the costs of protecting a river, which may be quantified in the form of recognized values such as hydropower, flood control, navigation, and water supply.

For this framework to be effective in China, we had to consider the existing legal and institutional system in China. We gained a basic understanding of how authority is delegated through the Chinese legal and political system, the role and functions of the major authorities, and how policy is developed and implemented. For a river protection system to be most effective in China, it should have national legislative support and national authority approved by the National People's Congress.

We recommend that a river protection system be managed by the Ministry of Water Resources, the Ministry of Environmental Protection and the National Development and Reform Commission. General oversight, management, and implementation of protected river areas will be allocated to local water bureaus and river basin authorities who can also be tasked with the development of management plans. Monitoring can be conducted by local environmental bureaus.

As China increases efforts to protect its natural environment, an opportunity exists to safeguard some of its remaining free-flowing rivers and river segments in perpetuity. A national river protection system can help China find a balance between continued development and conservation of its environmental resources. Through the establishment of such a system, China can ensure the longevity of one of its most precious and vulnerable natural resources – its rivers.

10. OPPORTUNITIES FOR FUTURE RESEARCH

Identification of Rivers for Protection

We have devised strategies for the implementation of a river protection system; however, given the time constraints and the focus of this project, we have not provided a complete list of rivers that should be considered for protection. Future research could include the identification of rivers that possess some of the outstanding values discussed in our report. This could be aided by the creation of GIS overlays that map areas of cultural significance, unique environmental features, existing protected areas, and riverside communities, as examples, along with China's expansive river network. The comprehensive river survey that is being undertaken in China can also provide some of the baseline data for this work. Once a priority list of rivers has been created, researchers can use the Value Assessment Tool to rank rivers and create a national priority list of rivers for protection.

Further Development of the Value Assessment Tool

The Value Assessment Tool aids the study process laid out in our framework plan. This is a valuable tool that can be used to guide decisions because it ensures the consideration of often discounted or overlooked river values. It can, however, be improved. The output from the Value Assessment Tool could be weighed against or compared to a tool or analysis that considers the costs of river protection. Some of these are opportunity costs in the form of lost hydropower potential, flood control, and navigational capacity. Thus, decision-makers could complete a comprehensive cost-benefit analysis that includes both costs and benefits that are not generally quantified.

Trial Run of Tool

Following the survey of rivers in China, an interdisciplinary team can assess the values associated with a river or river segment and document these values in a similar fashion to that of Table 2.1 in this report. A future research team could apply the Value Assessment Tool and cost tool (suggested above) to a river that is prioritized for protection to explore how the tool is utilized in practice and to see what adjustments may need to be made for future use of the tool in a protection system.

Adjustments to Recommendations

Once Chinese decision-makers have been able to review the recommendations that we have formulated, the recommendations can be revised either by those decision-makers or by a research team to meet gaps and or controversies. In particular, it can be assumed that Chinese decision-makers will be better equipped to determine the administering authority to which river protection designation and management should be delegated.

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